

Rwanda Handbook of Economic and Social Policy

Editor: Almas Heshmati

January 2018

Volume I

**Jönköping International Business School
and University of Rwanda**

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Editor: Almas Heshmati

**Jönköping International Business School,
Jönköping University, Jönköping, Sweden**

E-mail: almas.heshmati@ju.se

and

**Department of Economics,
Sogang University, Seoul, Korea**

E-mail: heshmati@sogang.ac.kr

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Volume I

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This first Rwanda Handbook of Economic and Social Policy is dedicated to Rwanda's children. May they grow up well-educated, protected, healthy and happy in their loving families, and in a democratic, sustainably developed, prosper, equal and caring welfare society.

Almas Heshmati

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List of Abbreviations

AD-AS	Aggregated Demand and Aggregated Supply
ADF	Augmented Dickey-Fuller test
AfDB	African Development Bank
AIC	Akaike Information Criterion
AIDS	Acquired Immune Deficiency Syndrome
AME	Small and Medium Enterprise
ANOVA	Analysis of Variance
ARCH	Auto-Regressive Conditional Heteroscedasticity
ARIMA	Auto-Regressive Integrated Moving Average
ATI	African Trade Insurance Agency
BDA	Proximity Business Advisory
BI	Baysian Information Criterion
BNR	Central Bank of Rwanda
BoP	Balance of Payment
CAFOD	Catholic Development Agency
CAPM	Capital Asset Pricing Model
CAVA	Cassava Adding Value for Africa
CBE	College of Business and Economics
CEE	Central and Eastern Europe
CEPGL	Countries of the Great Lakes
CES	Constant Elasticity of Substitution
CF	Capital formation
CIP	Crop Intensification Program (
CMA	Capital Market Authority
CMAC	Capital Market Advisory Council
COMESA	Common Market for Eastern and Southern Africa
CPI	Consumer Price Index
CPI	Transparency International's Corruption Perceptions Index
CRM	Customer Relationship Management
CV	Coefficient of Variation
DDDM	Data driven decision making
DOLS	Dynamic Ordinary Least Squares
DRC	Democratic Republic of Congo
EAC	East African Community
ECM	Error Correction Model
ECOSOC	Economic and Social Council
ECOWAS	Economic Community of West African States
EGARCH	Exponential Generalized Autoregressive Conditionally Heteroscedastic
EDPRS	Economic Development and Poverty Reduction Strategy
EFA	Exploratory Factor Analysis
EICV	Integrated Household Living Condition Survey
ELG	Export Led Growth
EMH	Efficient Market Hypothesis
EU	European Union

EWNA	Exponential Weighted Moving Average
FDI	Foreign Direct Investment
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistics
FATPS	Framework Agreement on Trade Preferential System
FMOC	Financial Market Operations Committee
FTA	Free Trade Agreement
GARCH	Generalized Auto-Regressive Integrated Moving Average
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GLS	Generalized Least Squares
GLM	Generalized Linear Model
GMM	Generalized Methods of Moment
GNI	Gross National Income
GNP	Gross National Product
GoR	Government of Rwanda
HCID	Human Capital and Institutional Development Department
HDI	Human Development Index
HDR	Human Development Report
HI	Herfindahl Index
HIPC	Highly Indebted Poor Countries'
HIVS	Human Immunodeficiency Virus Infection
HQ	Hannan-Quinn Information Criterion
IAEG	Inter-Agency and Expert Group
ICPC	Integrated Craft Production Centers
ICT	Information and Communication Technology
IFC	International Finance Corporation
IIAG	Ibrahim Index on Africa Governance
ILO	International Labor Organization
IMF	International Monetary Fund
IOSCO	International Organization of Securities Commission
IPO	Initial Public Offerings
IRF	Impulse Response Function
ISIC	International Standard Industrial Classification
IT	Information Technology
ITP	Indicative Trade Potential
IV	Instrument Variable
JoGG	Job Generation and Growth Decomposition
KTMM	KIPPRA-Treasury Macro Model
LAN	Local Access Network
LM	Lagrange Multiplier Test
LOESS	Locally Weighted Polynomial Regressions
M1	Monetary Base
M3	Measure of Money Supply
MA	Moving Average
MCR	Market Capitalization Ratio
MDG	Millennium Development goals
MENA	Middle Eastern and North African

MGARCH	Multivariate Generalized Autoregressive Conditionally Heteroscedastic
MINAGRI	Ministry of Agriculture and Animal Resources
MINEDU	Ministry of Education
MINECOFIN	Ministry of Finance and Economic Planning
MLE	Maximum Likelihood Estimation
MLR	Maximum Likelihood Ration Test
MNC	Multinational Corporation
MS	Money Supply
MTEF	Medium-Term Expenditure Framework
NAFTA	North American Free Trade Agreement
NBR	National Bank of Rwanda
NEP	National Employment Program
NGO	Non-Governmental Organization
NISR	National Institute of Statistics of Rwanda
NSE	Nairobi Stock Exchange
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
OMO	Open Market Operations
OPEC	Organization of Petroleum Exporting Countries
ORTPN	Office Rwandais du Tourisme et Parc Nationaux
PCA	Principal Component Analysis
PPP	Purchasing Power Parity
PSTA III	Strategic Plan for Transformation of Agriculture in Rwanda
RDB	Rwanda Development Board
REER	Real Effective Exchange Rate
REPO	Repurchase Agreements
RGB	Rwanda Governance Board
RGS	Rwanda Governance Scorecard
RIEPA	Rwanda Investment and Export Promotion Agency
RM	Reserve Money
RRA	Rwanda Revenue Authority
RSE	Rwanda Stock Exchange
RTA	Regional Trade Agreement
RTDA	Rwanda Transport Development Agency
Rwf	Rwandan Franc
SADC	Southern African Development Community
SC	Schwarz Information Criterion
SCI	Supply Chain Integration
SDG	Sustainable Development Goals
SEM	Structural Equation Modeling
SIDA	Swedish International Development Cooperation Agency
SITC	Standard International Trade Classification
SOE	State Owned Enterprises
SSA	sub-Saharan Africa
T-Bills	Treasury Bills
TFP	Total Factor Productivity Growth
TVET	Technical and Vocational Education and Training
UN	United Nations

UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nation Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children Fund
US	United States
USD	United State Dollar
VA	Value Added
VAR	Vector AutoRegressive
VAT	Value Added Tax
VEC	Vector Error Correction
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor
WB	World Bank
WDI	World Bank's Development Indicators
WEF	World Economic Forum
WGI	Worldwide Governance Indicators
WHO	World Health Organization
WTO	World Trade Organization

List of Contributors

Editor

1. Almas HESHMATI, Jönköping International Business School, Jönköping University, Jönköping, Sweden, E-mail: almas.heshmati@ju.se

Contributors

1. Leonidas BABAMWANA, Department of Applied Statistics, University of Rwanda, Kigali, Rwanda, E-mail: leontosbanamwana@gmail.com
2. Jonas BARAYANDEMA, Department of Management, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: jbarayandema@ur.ac.rw
3. Ewa CIESLIK, Faculty of International Business and Economics, Poznan University of Economics and Business, Poznan, Poland, E-mail: ewa.cieslik@ue.poznan.pl
4. Gisele U. CYUZUZO, University of Rwanda, College of Business and Economics, E-mail: ugisele29@gmail.com
5. Bertrand DUSHIMAYEZU, University of Nairobi, Nairobi, Kenya, E-mail: bertrand.dushimayezu@gmail.com
6. Alemayehu GEDA, Department of Economics, Addis Ababa University, Addis Ababa, Ethiopia, E-mail: ag112526@gmail.com
7. Ananias GICHONDO, Economic Research and Financial Stability Analysis Division, BN, Kigali, Rwanda, E-mail: agichondo@bnr.rw
8. Jean-Baptiste HABYARIMANA, Department of Economics, University of Rwanda, Kigali, Rwanda, E-mail: kradrimn@gmail.com
9. Almas HESHMATI, Jönköping International Business School, Jönköping University, Jönköping, Sweden, E-mail: almas.heshmati@ju.se
10. Callixte KAMANZI, National Bank of Rwanda, Kigali, Rwanda, E-mail: callixtekamanzi46@gmail.com
11. Nathan KARUHANGA, School of Business, University of Rwanda College of Business and Economics, Kigali, Rwanda, E-mail: karuhanga1900@gmail.com
12. Charles R. KAYITANA, University of Rwanda, College of Business and Economics, Kigali, Rwanda, E-mail:
13. Thomas R. KIGABO, National bank of Rwanda, and College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: thkigabo@yahoo.fr
14. Mary KIPSAT, Maseno University, Kisumu, Kenya, E-mail: mjkipsat@yahoo.com
15. Aristide MANIRIHO, School of Economics, University of Rwanda, Kigali, Rwanda, E-mail: manirihoaristide1@gmail.com
16. C. MUGEMANGANGO, Department of Mathematics, University of Rwanda, Kigali, Rwanda, E-mail: mucypro2@yahoo.fr

17. Martin MUGENZI, School of Economics, University of Rwanda, Kigali, Rwanda, E-mail: mmugenzi@ur.ac.rw
18. Barham MUHIRE, University of Rwanda, Collage of Business and Economics, Department of Economics, Kigali, Rwanda, E-mail: mubarham@gmail.com
19. Florence MUKAMANZI, Department of BIT, University of Rwanda / College of Business and Economics, Kigali, Rwanda, E-mail: fkamanzi15@yahoo.fr
20. Dative MUKARUTESI, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: datismuk@gmail.com
21. Aline MUTABAZI, School of Economics, University of Rwanda, Kigali, Rwanda, E-mail: amutabazi@ur.ac.rw
22. Josephine MUTESI, Department of management, University of Rwanda, Kigali, Rwanda, E-mail: mutejose5@gmail.com
23. Christine NAMAGANDA, Department of Entrepreneurship, Makerere University, Kampala, Uganda, E-mail: namagandac60@gmail.com
24. Joseph NDAGIJIMANA, School of Economics, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: jndagijimana16@gmail.com
25. Philippe NDIKUBWIMANA, Department of Insurance and Banking, University of Rwanda / College of Business and Economics, Kigali, Rwanda, E-mail: ndiphil2000@gmail.com
26. Idrissa NDIZEYE, Department of Management, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: indizeye@ur.ac.rw
27. Pia NILSSON, Jönköping International Business School, Jönköping University, Jönköping, Sweden, E-mail: Pia.Nilsson@ju.se
28. Pereez NIMUSIMA, School of Business, University of Rwanda College of Business and Economics, Kigali, Rwanda, E-mail: pereeznimusima@gmail.com
29. Ferdinand NKIKABAHIZI, Department of Economics, University of Rwanda, Kigali, Rwanda, E-mail: fnkikabahizi@gmail.com
30. S. NSABIMANA, Department of Rural Development and Agricultural Economics, University of Rwanda, Kigali, Rwanda, E-mail: uwipla@gmail.com
31. Tharcisse NZASINGIZIMANA, School of Economics, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail:
32. Masoomah RASHIDGHALAM, Department of Agricultural Economics, University of Tabriz, Tabriz, Iran, E-mail: maso.azar@gmail.com
33. Theogene RIZINDE, Department of Applied Statistics, University of Rwanda, Kigali, Rwanda, E-mail: rizindeth@gmail.com
34. Charles M. RUHARA, University of Rwanda, College of Business and Economics, Kigali, Rwanda, E-mail: ruharamch@yahoo.fr
35. Charles RURANGA, School of Economics, University of Rwanda, Kigali, Rwanda, E-mail: cruranga@ur.ac.rw

36. Desire SEKANABO, College of Business and Economics, University of Rwanda, Kigali, Rwanda, E-mail: sekanabod1@gmail.com
37. Timothy SULO, Moi University, Eldoret, Kenya, E-mail:
38. Josephine UMUTESI, Department of Management, University of Rwanda, Kigali, Rwanda, E-mail: j.mutesi@ur.ac.rw
39. Marie C. UMUTESI, University of Rwanda, College of Business and Economics, School of Economics, E-mail: m7chantal@gmail.com
40. Sandrine UNEZEZA, Department of Applied Statistics, School of Economics, University of Rwanda, Kigali, Rwanda, E-mail: sunezeza@gmail.com
41. Alexis UWAMAHORO, School of Business, University of Rwanda, Kigali, Rwanda, E-mail: uwamahoro231@yahoo.fr
42. P. UWIMANA, Department of Rural Development and Agricultural Economics, University of Rwanda, Kigali, Rwanda, E-mail: uwipla@gmail.com
43. Addis YIMER, Department of Economics, Addis Ababa University, Po Box 1176, Addis Ababa, Ethiopia, E-mail: addisyimer@gmail.com

Part One. Introduction

Chapter 1. Almas Heshmati, “Introduction to and Summary of the Handbook”.

Chapter 2. Almas Heshmati and Gisele Sekanabo, “Introduction to the Economy of Rwanda”.

Chapter One

Introduction to and Summary of the Handbook

Editor: Almas Heshmati

Jönköping International Business School,
Jönköping University, Jönköping, Sweden
and

Department of Economics,
Sogang University, Seoul, Korea
E-mail: almas.heshmati@ju.se

1.1 Background

China's rapid economic growth and development encouraged developing countries to target higher rates of their economic growth and development (Acemoglu, 2009; Barro, 1997; Barro and Sala-i-Martin, 2004). Sustained and inclusive economic growth has gained much attention in recent years (Heshmati et al., 2015; Tausch and Heshmati, 2012) with several studies focusing on growth and development in Africa (Belshaw and Livingstone, 2002; Binns et al., 2012; Chitonge, 2014; Robson and Lury, 2011). These studies focus on diverse aspects of growth such as the political economy of growth (Ndudu et al., 2008), characterizing the economies of Africa (AfDB, 2016, 2017), structural transformation (AfDB, 2016), entrepreneurship and industrialization (AfDB, 2017), determinants of growth, renewal of development, sustainable development and economic diversification (Johnson, 2016) and new perspectives on theory and policy (Kim and Heshmati, 2014).

Since several decades the Swedish International Development Cooperation Agency (SIDA) has financed collaborative higher educational programs and capacity building in research in a number of African countries. This development aid effort has resulted in the publication of a number of academic books which deal with poverty and well-being in Africa (Heshmati, 2016a), entrepreneurship and SME management across Africa (Achtenhagen and Brundin, 2016), economic integration, currency union and sustainable and inclusive growth in East Africa (Heshmati, 2016b), economic growth and development (Heshmati, 2017a), economic transformation and poverty reduction (Heshmati, 2017b), management challenges in different types of African firms (Achtenhagen and Brundin, 2017) and contextualizing entrepreneurship in emerging economies and developing countries (Ramirez-Pacillias et al., 2017). These studies have improved our understanding of the process of economic development and growth and the challenges facing African countries in general and East African countries in particular.

A major policy challenge facing many African countries, in particular countries like Rwanda, is how to achieve sustained and higher rates of economic growth. In addition, this economic growth should help reduce the high poverty rates and be both socially and regionally inclusive and environmentally sustainable. Among the many challenges facing Rwanda are an increasing population, rapid urbanization, increasing need for urban infrastructure, and provision of publicly provided services, low capacity and efficiency of institutions and governance and the urgency in responding to climate change.

Against this background, the Jönköping International Business School in cooperation with the University of Rwanda organizes a series of conferences on economic development in the East Africa region every year. This volume is a collection of selected empirical studies on determinants of economic growth and development in Rwanda. Several of the contributed chapters were selected from a set of papers presented at a conference on *Recent Trends in Economic Development, Finance and Management Research in Eastern Africa*, held at Kigali, Rwanda on 14-16 June 2017. These papers are complemented by other relevant studies. Following the review process and revisions, 25 chapters were accepted for publication in this first *Rwanda Handbook of Economics and Social Policy*.

The main reason for editing this policy handbook is to provide an up-to-date picture of the state and patterns of economic growth and development in Rwanda. Rwanda has benefited from donor countries' generous development aid in the aftermath of the genocide. This aid has been crucial for its recovery and development. A main contribution of this handbook is that it identifies important determinants of growth and development and estimates their effects using up-to-date primary and secondary data, modeling and estimation methods. The studies provide a comprehensive picture of the state of economic growth, its measurements, causal relationships between the key determinants and efficient policies and practices in achieving progress in the country. The handbook sheds light on growth, its development and spatial variations thus helping the national government and NGOs in their efforts at achieving higher growth and alleviating deep rooted chronic poverty in the country.

This volume of empirical studies on the determinants of economic growth and development in Rwanda has contributions from 44 authors. The studies are grouped into ten domains covering a descriptive presentation of the Rwandan economy; economic growth; development goals; poverty and well-being; international trade; agriculture and food prices; capital market and investments; labor market and employment; small and medium enterprises; and entrepreneurship and manufacturing. These cover major components of the economy though not fully. Part of this gap is filled by the introduction chapter 2 which discusses the Rwandan economy as a whole.

The studies in this volume provide a comprehensive picture of the growth, its measurement and causal factors in Rwanda. They investigate heterogeneity and efficient policies and practices in growth generation and poverty reduction in Rwanda. Differences in development across regions and sectors pose major challenges for the government and international organizations whose aim is equal opportunities, economic growth and alleviating poverty in the country. Though all the studies do not have the full characteristics of policy studies and have limited coverage, but their collection as a first policy handbook and the results presented in this volume can have strong implications for economic and social policy, in particular for economic growth and poverty reduction

policies in Rwanda. It is desired that an improved local research capacity will gradually lead to a higher quality of future policy handbook volumes and they ideally should be prepared by local researchers. In addition, the future volumes should include contributions from majority of University of Rwanda professors in Economics, Business and Management. Their contributions will increase the quality and coverage of the handbook. The university can play an important role in linking governance and business, and in design of development policies and in evaluation of their effects. It is recommended that College of Business and Economics (CBE) helps the government to publish quarterly social and economic policy briefs.

1.2 Summary of individual studies on the Rwandan economy

This volume is a collection of selected empirical studies on social and economic policy and practice to achieve economic growth and development in Rwanda. The volume has 26 chapters (the introduction/summary and 25 chapters) contributed by 44 researchers specializing in different fields of Rwandan economic development and policy. The studies are grouped into ten domains which are now described briefly.

Part I. Introduction

The first study (Chapter 2) by Almas Heshmati and Desire Sekanabo, *‘Introduction to the Rwandan Economy’*, is a descriptive presentation of the Rwandan economy and its development from 1960 onwards. The study follows a number of steps the first of which reviews the aggregate economy by decomposing it into agriculture, industry, manufacturing and services sectors. The focus of this step is on the performance of the economy and its different sectors and their development over time. It then decomposes the main sectors into their underlying sub-sectors and discusses their development. Third, since the Rwandan agricultural society is transitioning to industry and service societies, it pays special attention to the path of development by presenting the main components of the services sector components in detail. This step focuses on demography, the labor market, trade openness, balance of trade, state finances, the financial market, education, health, tourism and housing.

Part II. Economic Growth and Good Governance

This part has 2 chapters on a macroeconomic model for Rwanda and the relationships between good governance, economic growth and development.

The first study in this part (Chapter 3) by Alemayehu Geda and Addis Yimer, *‘An applied macro-econometric model for Rwanda’*, develops a macro-econometric model for a typical supply constrained African economy. It builds a macro-econometric model and a supplementary ARIMA based model for Rwanda to make the model useful for forecasting. It disaggregates the fiscal, balance of payments and money supply blocks of the model to offer an adequate picture of the macroeconomy. In addition, it conducts an econometric estimation of the core behavioral equations of the model using the error correction modeling approach. The model is developed such that it can be easily extended further to support budgeting, forecasting and macroeconomic policy analyses in the relevant ministries and central banks in Africa. The model successfully solves and

reproduces historical values from and forecasts the major macro-variables. It also uses the model to conduct a policy and external shock related simulation exercise that is important for policymakers.

The next study in this part (Chapter 4) by Jean-Baptiste Habyarimana and Bertrand Dushimayezu, '*Good governance, economic growth and development: Insights from a 22 years' econometric analysis*', uses two techniques of scatter and line plots and OLS to investigate how governance is related to economic growth and development. It simulates an alternative model for growth and calibrates it with the estimated shock in human capital development to investigate the spill over effects of good governance on economic growth. This study demonstrates the existence of a pro-cyclic relationship between governance and economic growth and development. It uncovers the existence of a counter-cyclic relationship between a shock in human capital development and growth. It suggest that, *ceteris paribus*, the level of economic development and growth not only depends on fixed capital formation and the labor force, but also on good governance. It argues that the most important pre-requisites for sustainable growth and development are strong politico-socio-economic policies and strategies to develop appropriate 'home grown solutions' and channelizing them.

Part III. Development Goals

This part has 3 studies which assess Rwanda's economic potential from an international perspective, the country's achievements of sustainable economic development goals and does an evaluation of Rwanda Vision 2020's achievements.

The first study (Chapter 5) by Ewa Cieslik, '*Assessing Rwanda's economic potential from an international perspective*', focuses on the multidimensional characteristics of Rwanda's business climate and potential in terms of its foreign economic relations. Rwanda has created macroeconomic stability and increasingly attractive investment conditions for foreign investors, trading partners, business start-ups and entrepreneurs. The study assesses Rwanda's economic potential in the background of the East African states using taxonomic methods including classical standardization by average and by range and evaluating the country's export potential. It gives policy recommendations for developing international economic relations. This study also classifies the conditions for doing business. Its evaluation of Rwandan export potential is based on the index of indicative trade potential with the country's most important export partners.

In the second study (Chapter 6), '*Achieving the sustainable development goals in Rwanda: The role of administrative data inclusion*', Theogene Rizinde, Ferdinand Nkikabahizi, Leonidas Babamwana and Josephine Umutesi investigate the extent to which decision makers in Rwandan institutions appreciate and use administrative data in their everyday decision making to achieve sustainable development. The study is based on semi-structured interviews with Rwandan establishments selected randomly from the Remera sector in Gasabo district in Kigali city. The research reveals that a majority of the decision makers did not understand the need of using statistics in their decision making while others felt overwhelmed by the volume and complexity of the data. It also finds that there is a strong lack of dissemination or sharing of data by institutions, especially in the private sector. The study further finds that the non-use of administrative

data for decision making is highly linked to the size of the institution and the level of education of the decision makers.

The last study in this part (Chapter 7) by Pereez Nimusima, Nathan Karuhanga and Dative Mukarutesi, '*An evaluation of Rwanda Vision 2020's achievements*', evaluates the extent to which Rwanda has achieved the targets of its Vision 2020 policy. It reviews the six-pillar composite indicators of good governance and a capable state; human resource development and a knowledge-based economy; a private sector-led economy; infrastructure development; productive and market oriented agriculture; and regional and international economic integration. It uses descriptive and analytical approaches for analyzing the data. It also reviews different theories that explain the development discourse and contrasts these with Rwanda's growth path. Further, it also reviews the country's short-term development strategies, annual performance targets and the seven-year government program.

Part IV. Poverty and Well-being

This part contains 2 studies which present the results of analyses of poverty and multidimensional well-being in Rwanda.

The first study (Chapter 8) by Almas Heshmati and Masoomah Rashidghalam, '*Measurement and Analysis of Poverty in Rwanda*', examines the extent of poverty in different provinces and districts in the country. It also looks at four categories of determinants of household poverty. The study is based on information from three household surveys and using both income and consumption per capita. Large variations in incidence of poverty, its gap and severity across districts and provinces is noticed. This study shows that older household heads and female-headed households were more likely to be poor. Living in rural and semi-urban areas increased the probability of households being poor while asset ownership decreased the probability of a household being poor. Hence, it suggests that the government should increase investments in physical infrastructure, create jobs for female-headed households and improve educational levels of household heads as part of its long-term strategy to alleviate poverty in Rwanda.

The second study (Chapter 9) by Almas Heshmati, Masoomah Rashidghalam and Pia Nilsson, '*Measurement and analysis of multidimensional well-being in Rwanda*', focuses on the high priority given to well-being of families and their children in Rwanda's development goals. It estimates multidimensional well-being of children and their families in Rwanda to compute an overall well-being index decomposed into its underlying main components. It ranks households by their level of well-being and by various household and community characteristics. The results shed light on the state and changes in the well-being of children and their families in Rwanda indicating which provinces and districts offer relatively better conditions for them. This can serve as a model for public policies aimed at improving general well-being in the country.

Part V. International Trade

The 2 studies in Part 5 focus on international trade through analyses of the causative factors of trade flows between Rwanda and its main trade partners and the causality between tea export and its determinants.

The first study (Chapter 10) by Marie C. Umutesi, '*Analysis of the causative factors of trade flows between Rwanda and its main trading partners*', focuses on trade which plays an important role in Rwanda's economy, especially in influencing the level of its economic growth, balance of payments and employment. Rwanda has initiated several policy reforms aimed at promoting trade. This research examines the factors affecting trade using a gravity model. It finds that Rwanda's GDP, its trading partners' GDP, population growth and real exchange rate had positive and significant effects on Rwanda's trade. The study also shows that Rwanda's population growth is not significant, while distance has a negative effect on its trade. It does not find having common borders, an official common language and the formation of EAC as statistically significant for Rwanda's trade.

In the second study in this part (Chapter 11), '*An analysis of causality between tea export and its determinants in Rwanda*', Placide Uwimana, C. Mugemangango, Mary Kipsat, Timothy Sulo and S. Nsabimana assess the causality between tea exports and their determinants in Rwanda using time series data. It uses Granger causality to test for predictability between exports and their factors. It concludes that non-causality in the long-term was possible because before the late 1980s Rwanda had an economy that was based on a pre-structural adjustment program when exports were under total control. Short-run causality was possible because after the 1980s, a decline in world tea prices may have led to an increase in Rwanda's exports. The study concludes that the country needs more investments in tea factories, diversification of commodities that are exported, prioritizing forward selling or contracting and widening niche markets for tea products.

Part VI. Agriculture and Food Prices

This part does an analysis of agriculture and food prices. It covers the determinants of livelihood diversification, special price transmission and food price volatility following external economic shocks.

The first study (Chapter 12) by Aristide Maniriho and Pia Nilsson, '*Determinants of livelihood diversification among households in Rwanda: The role of education, ICT and urbanization*', identifies the determinants of income diversification among Rwandan households using the Household Living Conditions Surveys. It applies a binary logit panel model to a representative sample of households controlling for latent household specific factors. The results show that education, access to ICT and urban areas were among the most important factors that influenced livelihood diversification. It also finds that household-specific factors such as age and gender of the household head and asset endowment were also important. Based on these results, the study recommends that professional training, internet access and urbanization should be enhanced to enable households to diversify their sources of income and thus improve their families' food security.

The second study (Chapter 13) by Charles Ruranga, Martin Mugenzi and Aline Mutabazi, '*Spatial price transmission analysis in beans and rice markets of Rwanda*', uses spatial price transmission to examine the impact of a change in prices in one market on another market. Specifically, it analyzes the spatial price transmission of retail prices of beans and rice in Huye, Nyabugogo, Musanze, Gisenyi and Nyagatare markets. The series are stationary in their first differences and co-integration tests reveal that the variables are

co-integrated implying that there is a long-run relationship. It uses impulse-response functions to show a shock on the retail prices of different commodities in different markets. Variance decompositions reveal that the effect of a shock in the price of beans in the Musanze market is unidirectional Granger causality between prices in different markets; however, for retail prices of rice there is bi-directional Granger causality.

The last study (Chapter 14), by Sandrine Unezeza and Jean-Baptiste Habyarimana, '*External economic shock and food price volatility in Rwanda: Evidence from ARCH and GARCH*', investigates how variations in the prices of crude oil in Rwanda and in the world market as an external economic shock affect cereal prices in Rwanda's domestic market. The empirical results show that cereal price series are linearly related to crude oil price series and that they suffer from a high relative variability. An analysis of price returns gives evidence of volatility in cereal price returns clustering from variations in the price of crude oil in both the domestic Rwandan market and the world market. To reduce inefficiencies in the domestic cereal distribution system, the paper suggests that trade policy in Rwanda should take into consideration the relationship that exists between the prices of crude oil and cereals.

Part VII. Capital Market and Investments

This part looks at the capital market and investments in Rwanda. The 4 studies in this part discuss factors influencing the development and determinants of investment decisions in Rwanda's stock exchange; the monetary transmission mechanism and excess liquidity; and Rwanda's monetary policy.

In the first study (Chapter 15), '*Factors influencing the development of the capital markets in a developing economy: The Rwanda stock exchange*', Gisele C. Umuhuza investigates the factors influencing the development of capital markets in Rwanda with the aim of studying how macroeconomic variables affect the growth and development of the Rwanda Stock Exchange (RSE). It also analyses the stock exchange's contribution to the increasing economic growth in Rwanda. It uses the key repo rate, inflation rate and money supply as the macroeconomic variables and consumption as a conditioning variable. The results show that among the four macroeconomic variables only money supply had a statistically significant relationship with market capitalization. The results also show that there was a positive relationship between market capitalization and GDP.

The second study (Chapter 16) by Jonas Barayandema and Idrissa Ndizeye, '*The determinants of investment decisions on the Rwanda stock exchange*', explores which economic, psychological, social and demographic factors determine investment decisions in RSE. It adopts an explanatory design combined with a survey design and analyzes the data using a factor analysis. The findings show that economic factors were the most influential, followed by psychological factors and then social factors, whereas demographic factors were ranked last. The study identifies the five most and least influential factors and recommends that RSE's authorities should focus on the identified influential determinants of investment decisions in proportion to their importance.

The third study (Chapter 17) by Thomas R. Kigabo, '*Monetary transmission mechanism in Rwanda*', assesses monetary transmission mechanisms in Rwanda. By analyzing their key determinants the study highlights the progress made in increasing the National Bank of Rwanda's (BNR) independence, flexibility in the current monetary policy framework

and financial sector development. However, the banking sector continues to show persistent short-term liquidity problems, the size of the formal financial sector remains small and banks are more competitive in the deposit rather than in the loan markets. It presents clear evidence that the monetary aggregates channel is active in Rwanda. A shock to M3 as well as changes in the available amount of credit have a very rapid, significant and persistent effect on output. This may be a reflection of the increasing monetization of the Rwandan economy. The study suggests that more efforts are needed to support further development of financial markets and extending the formal financial sector to all sectors of the economy.

The last study (Chapter 18) by Thomas R. Kigabo and Ananias Gichondo, '*Excess liquidity and monetary policy in Rwanda*', examines the potential determinants of precautionary excess liquidity in the Rwandan banking system and its optimal level above or below which excess liquidity becomes a constraint in monetary policy transmission. The study estimates the determinants of precautionary excess reserves. For the optimal excess liquidity level it estimates the probability density of the estimated precautionary excess liquidity and obtains a confidence interval of the values computed. The results suggest that reserve requirement, change in demand for cash proxied by the output gap and the lagged value of excess liquidity are important determinants of precautionary excess liquidity in the Rwandan banking system. The study finds the optimal levels of excess liquidity and excess reserves. These findings can be used as a base for the central bank to improve its liquidity management for an effective monetary policy.

Part VIII. Labor Market and Employment

Three studies analyze the labor market and employment conditions in this part. These cover growth in job creation, employment in manufacturing and service firms and determinants of youth unemployment.

The first study (Chapter 19) by Thomas R. Kigabo and Callixte Kamanzi, '*Job creating growth and governance: The case of Rwanda*', analyzes whether Rwandan economic growth is creating jobs. The results provide some interesting insights into the relationship between economic growth and job creation in Rwanda. Rwanda's growth profile is highly linked to an increase in its employment rate. In addition, the study also analyzes the role of governance, particularly policies targeted at creating jobs. Various government policies including those on employment promotion, investment facilities and access to finance which are in favor of employment have been initiated and implemented. These have created a business climate that attracts investments and fosters new enterprise creation that further boosts employment opportunities. As a result, there has been a remarkable increase in the number of establishments accompanied by new jobs. This research attributes job creating growth in Rwanda to good governance.

The second study (Chapter 20) by Barham Muhire, '*Employment in manufacturing and service firms in Rwanda*', analyzes employment and its determinants in the manufacturing and services sectors in Rwanda. Using the World Bank's Enterprise Survey database, the study finds that firm size, the number of establishments that form a firm, wages and social payments and research and development are significant determinants of employment in manufacturing and service firms. These factors can be

used in forming public policy using manufacturing and service firms as an engine for speeding up Rwanda's shift from a low-income to a middle-income country. The location of a firm, age, manager and women's workers experience, national sales and research and development have a positive but insignificant impact on employment in both manufacturing and services sectors. Based on its findings the study makes a number of policy recommendations for promoting the quality of employment.

The last study (Chapter 21) by Joseph Ndagijimana, Tharcisse Nzasingizimana and Almas Heshmati, '*An analysis of the determinants of youth employment in Rwanda*', analyzes the determinants of youth employment in Rwanda. The study uses a multinomial logit model to shed light on the determinants of youth employment in the country using household survey data. The results shows that a skill gap is most critical for employment creation and a transition from school-to-work seems problematic. It also asks questions about the factors which influence youth employment in Rwanda and how youth employment is related to poverty reduction and distribution of income. The research finds that youth employment in Rwanda is influenced by gender, age, education and geographical location.

Part IX. Small and Medium Enterprises

The main focus of the 3 studies in this part is on small and medium enterprises. The studies elaborate on the contribution of an institutional environment and support to the growth of SMEs and the relationship between entrepreneurial orientation, government policy, ICT adoption and SMEs' performance.

The first study (Chapter 22) by Josephine Mutesi, Christine Namaganda and Theogene Risinde, '*The contribution of institutional environment and institutional support to the growth of SMEs in Rwanda*', ascertains the contribution of an institutional environment and support to the growth of SMEs in Rwanda. The results show that the factors that make up an institutional environment for SMEs' growth in Rwanda include accessibility to finance, market and training in entrepreneurship skills and knowledge and SMEs' abilities to interpret the environment. The findings indicate that there is a need for improving the factors that affect the institutional environment for SMEs in Rwanda.

The second study (Chapter 23) by Dative Mukarutesi, '*The relationship between entrepreneurial orientation, government policy and SME performance: The case of SMEs in Rwanda*', examines this relationship. The study uses the correlation coefficient and does an analysis of the regression model to test the research hypothesis. The results show that entrepreneurial orientation is positively related to both SME performance and government policy. At the same time, government policy is also positively related to SME performance. These results are confirmed by the hierarchical regression model which shows that entrepreneurial orientation and government policy are both significant predictors of SMEs' performance.

The last study (Chapter 24) by Florence Mukamanzi and Philippe Ndikubwimana, '*The effect of ICT adoption on SMEs in Rwanda: Case study of Kigali City*', examines the factors that influence the adoption and the management of adoption and use of ICT. It assesses the level of awareness and skills of SMEs' employees and other variables which can be helpful in gaining valid outcomes. In the empirical part it statistically compares the mean difference between the level of awareness and adoption patterns of ICT

facilities among SMEs. A regression analysis helps evaluate factors influencing ICT adoption choices in the SME sector and assess the perceptions of SMEs' employees towards ICT adoption. It also explores the relationship between ICT adoption and its five influencing factors. The results show that perceived costs and external factors are insignificant in ICT adoption whereas perceived benefits, perceived costs and ICT knowledge are significant in its adoption.

Part X. Entrepreneurship and Manufacturing

This section discusses entrepreneurship development in manufacturing. It contains 2 chapters analyzing firms' mindsets and entrepreneurship activities in Rwanda and the effects of supply chain integration on manufacturing performance.

The first study (Chapter 25) by Charles M. Ruhara and Charles R. Kayitana, '*Mindset and entrepreneurial activities in Rwanda: A firm level investigation*', examines the effects that an entrepreneur's mindset has on entrepreneurial activities. It seeks to establish whether the lack of an entrepreneurial mindset contributes to the high rates of SME failure in the country. The estimation results show that the factors affecting a firm's sustainability include an entrepreneurial mindset, the manager's experience and gender and the competition in the market. This study also shows that an entrepreneurial mindset is an important factor in the performance and sustainability without which a business will fail. It recommends entrepreneurial education to nurture and support a firm's success.

The last study (Chapter 26) by Alexis Uwamahoro, '*Effects of supply chain integration (SCI) on the supply chain performance: An analysis of manufacturing*', attributes inconsistency in previous research for incomplete definitions of SCI, in particular the tendency to only focus on customer and supplier integration excluding the important central link of internal integration. It uses three dimensions of SCI -- internal integration, supplier integration and customer integration -- to determine the effects of individual SCI dimensions and their interactions in a firm's performance. The findings indicate that SCI is related to both operational and firm performance. The results also indicate that internal and customer integration are more strongly related to improving performance than supplier integration.

1.3 Final words and policy recommendations

This edited handbook of social and economic policy adds value to the growing literature on economic growth and development and the determinants of economic and social policy and practice in Rwanda. Its primary market is wide and includes undergraduate and graduate students, lecturers, researchers, public and private institutions, NGOs, international aid agencies and national and regional decision makers in Rwanda and the member countries of the East Africa economic integration. The handbook can serve as complementary reading to texts on economic growth, development, investment, welfare and poverty and policies in Rwanda and East Africa. The organizers of the annual conference on economic development in East Africa and the University of Jönköping and the University of Rwanda will market the book at their annual East Africa conferences.

There are several books on development and growth in Africa which were mostly published in earlier years and are written by non-African writers. The novelty of this handbook is that it is an up-to-date study about the Rwandan economy which has been written exclusively by or in cooperation with Rwandan researchers. The objective is to publish a new policy handbook on a biennial basis.

This edited handbook is authored by Rwandan researchers in the field who employ up-to-date data and diverse methods to provide robust empirical results based on representative firm and household surveys and secondary aggregate national level data covering households, firms, districts and provinces in the country. It contains a wealth of empirical evidence, deep analyses and sound recommendations for policymakers and researchers to design and implement effective national social and economic policies and strategies to alleviate and reduce poverty and its negative effects on poor households and regions. The handbook is a useful resource for policymakers and researchers involved in promoting sustained and inclusive economic growth and also for those fighting poverty. It will also appeal to a broader audience interested in economic development, resource economics, political economy, economic welfare and inclusive growth in Africa and elsewhere.

Based on the studies in this edited handbook and the knowledge gained from existing literature the Editor suggests a number of policy measures to promote sustained and inclusive growth and development in Rwanda. In general policy recommendation provided in each chapter are those of the authors and not necessarily reflecting the view of the editor.

The first part, an introduction to the Rwandan economy, provides a description of the Rwandan economy and its development from 1960 onwards. The chapter provides reviews of the aggregate economy by decomposing it into agriculture, industry, manufacturing and services sectors. Its focus is on the development and performance of these sectors over time. This chapter serves as a complement to the other contributions in the handbook and fills the gaps by addressing areas that are not covered in great detail in the rest of the volume. However, for future volumes of the handbook one should standardize the analyses by improving data coverage, quality and performance measurement methods and doing an evaluation of the social and economic policies to make the handbook useful tool for decision makers.

The second part focuses on economic growth and the quality of governance. The first study in this part develops a macroeconomic model for a typical supply constrained African economy like Rwanda. It disaggregates the fiscal, balance of payments and money supply blocks of the model to offer an adequate picture of the economy. The model is used for an analysis of policy changes and reforms as well as for forecasting. The model can easily be extended further to support budgeting, forecasting and macroeconomic policy analyses in the relevant ministries and central banks in Africa. This study also uses the model to conduct a policy and external shock related simulation exercise that is important for policymakers and for policy evaluations. Thus, the handbook is an important tool for the Ministry of Finance and the National Bank of Rwanda for an evaluation of their policy design, implementation and effect. The second study discusses good governance, economic growth and development by providing an alternative model for growth and calibrates it with the estimated shock in human capital development to investigate the spillover effects of good governance on economic growth.

It suggests that the level of economic development and growth not only depend on fixed capital formation and the labor force, but also on good governance. It argues that the most important pre-requisites for sustainable growth and development are strong policies and strategies for developing appropriate home grown solutions and channelizing them effectively to achieve desired outcomes.

The studies in the third part on development goals assess Rwanda's economic potential from an international perspective, discuss the achievements of the sustainable economic development goals and present an evaluation of Rwanda Vision 2020's achievements. The findings from the multidimensional characterization of Rwanda's business climate and potential in terms of foreign economic relations show that Rwanda has created macroeconomic stability and increasingly attractive investment conditions for foreign investors, trading partners, business start-ups and entrepreneurs. The evaluation of Rwandan export potential can be improved further by constructing and estimating various competitiveness indices. This part also presents research on the inclusion of administrative data and the extent to which decision makers in Rwandan institutions appreciate and use administrative data in their everyday decision making to achieve the sustainable development goals. The research reveals that a majority of the decision makers did not understand the need for using statistics in their decision making while others felt overwhelmed by the volume and complexity of the data. Various policy measures and reforms are required to improve their ability to use data in decision making. Introduction of higher civil service examinations practiced effectively in Japan and Korea will guarantee high quality and capability of governance. An evaluation of the Rwanda Vision 2020's achievements of targets reviews the six-pillar composite indicators -- good governance and a capable state; human resource development and a knowledge-based economy; a private sector-led economy; infrastructure development; productive and market oriented agriculture; and regional and international economic integration. An assessment of the quality of the composite index and its underlying components and their development patterns improves the formulation of the development targets and their achievements.

The fourth part analyzes the welfare conditions in Rwanda with studies on poverty and multidimensional well-being. These studies measure poverty using different absolute and relative approaches. An analysis using recent household surveys measures the extent of poverty in different provinces and districts in Rwanda. It also looks at four categories of determinants of household poverty in the country. It identifies a number of factors leading to poverty which can be used in public policy as part of a long-term state strategy to alleviate poverty in Rwanda. The same household surveys are also used to measure and analyze multidimensional well-being in Rwanda. This analysis sheds light on the policy direction and the effects of high priority given to well-being of families and their children as part of the government's national development goals. Studies in this part also decompose the overall well-being index into its underlying main components. Households ranked by the level of well-being and by various household and community characteristics show large variations in well-being. This can serve as a model for public policies aimed at improving general well-being in the country and reducing the welfare gap among the districts and provinces.

The fifth part emphasizes on international trade and has studies that analyze the causative factors of trade flows between Rwanda and its main trade partners and causality between the country's flagship tea export sector and the determinants of its flows. The tea industry

plays an important role in Rwanda's economy, especially in influencing its economic growth, balance of payments and employment. Rwanda has initiated several policy reforms aimed at promoting trade. Research examining the factors affecting trade finds that Rwanda's GDP, its trading partners' GDP, population growth and the real exchange rate had positive and significant effects on Rwanda's trade. The study also shows that distance had a negative effect on Rwanda's trade. A study of the causality between tea exports and their determinants, uses the Granger causality to test the predictability between exports and their determinants. The research concludes that non-causality in the long-term was possible earlier because of the conditions prevailing in the late 1980s. Short-run causality was possible because after the 1980s, a decline in world tea prices may have led to an increase in Rwanda's exports. In the authors' view, what is needed now are more investments in tea factories, diversification of commodities that are exported, prioritizing forward selling or contracting and widening niche markets for tea products.

The sixth part offers analyses of agriculture and food prices by focusing on the determinants of livelihood diversification, special price transmission and food price volatility following external economic shocks. The determinants of income diversification among Rwandan households using household surveys show that education, access to ICT and urban areas were among the most important factors that influenced livelihood diversification. Other specific factors such as age and gender of household head and asset endowment were also important. From these results, this study recommends that professional training, internet access and urbanization should be enhanced to enable households to diversify their sources of income to improve their families' food security. An analysis of spatial price transmission in this part shows the impact of a change in prices in one market on another market. Spatial price transmission of retail prices of beans and rice in different provinces shows a long-run relationship between the variables and a shock in the retail prices of different commodities in different markets. The last study in this part shows how variations in the prices of crude oil in Rwanda and in the world market as an external economic shock affected the price volatility of cereals in Rwanda's domestic market. The empirical results show that cereal price series are linearly related to crude oil price series and that they suffer from a high relative variability. To reduce inefficiencies in the domestic cereal distribution system, the study suggests that Rwanda's trade policy should take the stated relationships and their spatial price transmissions into consideration.

The seventh part looks at issues of the capital market and investments in Rwanda. The studies include factors influencing development and investment decisions in Rwanda's stock exchange, monetary transmission, excess liquidity and monetary policy. An analysis of how macroeconomic variables affect RSE's growth and development shows that this is conducive to economic growth. It identifies important macroeconomic variables where money supply had a statistically significant relationship with market capitalization, which in turn had a positive relationship with GDP. The determinants of investment decisions in the stock exchange involved economic, psychological, social and demographic factors. The research findings show that economic factors were the most influential, followed by psychological, social and demographic factors. The study recommends that RSE's authorities should focus on the identified influential determinants of investment decisions in proportion to their importance. An assessment of the monetary transmission mechanisms in Rwanda highlights the progress made in

increasing the National Bank of Rwanda's independence, flexibility in the monetary policy framework and financial sector development. The banking sector continues to show persistent short-term liquidity problems, the size of the formal financial sector remains small and banks are more competitive in the deposit than in the loan markets. More efforts are needed to support further development of the financial markets. An examination of the potential determinants of precautionary excess liquidity in the Rwandan banking system and its optimal is a constraint in monetary policy transmission. The study estimates the determinants of precautionary excess reserves and suggests that reserve requirements, change in demand for cash and the lagged value of excess liquidity are important determinants of precautionary excess liquidity in the banking system.

Analyzing the labor market and employment conditions part eight of the handbook focuses on growth in job creation, employment in manufacturing and service firms and determinants of youth unemployment. In investigating whether Rwandan economic growth is creating jobs, it analyzes the role of governance, particularly policies targeted at creating jobs. The government has initiated and implemented various government policies including promotion of employment, investment facilities and access to finance in favor of employment which have created a business climate that attracts investments and fosters new enterprise creation that further boosts employment opportunities. An analysis shows that firm size, the number of establishments, wages and social payments and research and development are significant determinants of employment in manufacturing and service firms. These factors can be used in forming public policy with the aim of using the targeted firms as an engine for speeding up Rwanda's shift from a low-income to a middle-income country. An analysis of the determinants of youth employment finds that youth employment was influenced by gender, age, education, skill gaps and the development of infrastructure at the geographical locations.

The ninth part investigates the contributions of institutional environment and support to the growth of SMEs and the relationship between entrepreneurial orientation, government policy, ICT adoption and SMEs' performance. An analysis of the contribution of institutional environment and support on the growth of SMEs shows that the factors that make up an institutional environment for SMEs' growth include accessibility to finance, market and training in entrepreneurship skills and knowledge and SMEs' abilities to interpret the environment. There is a need to improve the factors that affect the institutional environment for SMEs in Rwanda. A study of the relationship between entrepreneurial orientation, government policy and SMEs' performance shows that entrepreneurial orientation is positively related to both SME performance and government policy. Government policy is also positively related to SME performance. A study of the factors that influence the adoption and managements of ICT and an assessment of the perceptions of SMEs' employees towards ICT adoption shows that perceived costs and external factors are insignificant in ICT adoption whereas perceived benefits, perceived costs and ICT knowledge affect ICT adoption positively.

The last part discusses entrepreneurship development in manufacturing by analyzing the effects of firms' mindsets, entrepreneurial activities and supply chain integration in the performance of the manufacturing sector. Its aim is to establish whether the lack of an entrepreneurial mindset contributes to the high rates of SME failure in Rwanda. Estimation results show that the factors affecting a firm's sustainability include an entrepreneurial mindset, the manager's experience and gender and competition in the market. It recommends entrepreneurial education to nurture and support a firm's success.

The last study in this part measures the effects of supply chain integration on the supply chain's performance in manufacturing. It analyzes three dimensions of supplier integration, customer integration and internal integration and how their direct interactions effect a firm's operations and performance.

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Chapter Two

Introduction to the Rwandan Economy

Almas Heshmati¹ and Desire Sekanabo²

¹ Corresponding Author,
Department of Economics,
Sogang University, Seoul, Korea,
E-mail: heshmati@sogang.ac.kr

² College of Business and Economics,
University of Rwanda,
Kigali, Rwanda
E-mail: sekanabod1@gmail.com

Abstract

This chapter gives a descriptive presentation of the Rwandan economy and its development from 1960 till 2016 in a series of steps. The data used in this chapter is the most recent data available. A review in the first step covers the aggregate economy decomposing it into agriculture, industry, manufacturing and service sectors. The focus of this step is on the performance of the sectors and their development over time. The different sectors are further decomposed in the second step into their underlying sub-sector components and their development over the period of the study. Since the Rwandan agricultural society is transiting to industry and services societies, the third step pays attention to this path of development by presenting the main service sector components in more detail. The focus is specifically on demography, the labor market, trade openness, balance of trade, state finances, the financial market, education, health, tourism, and housing. The main objective of this chapter is to serve as a complement to the chapter contributions and to address the gaps in the areas not covered in the rest of the handbook.

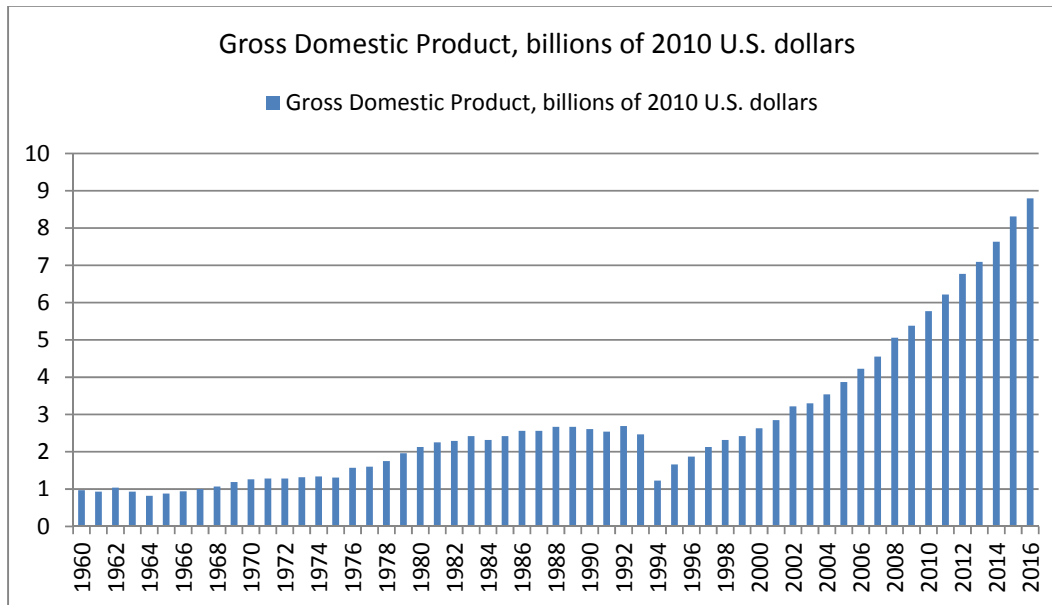
Keywords: Rwandan economy, agriculture, industry, manufacturing, services, growth and development.

1. Introduction to the Rwandan economy

Rwanda is a small land-lacked country (see Map 1 and Table 1) which maintained steady growth in the first three quarters of 2015. At 6.9 per cent the growth rate was almost the same as its average growth rate over the last five years. When it comes to medium-term progress, between 2010 and 2014, the Rwandan economy grew by 7.1 per cent on average. The five-year average annual growth rate was lower than the preceding two five-year periods (8.7 per cent in 2004-09 and 7.9 percent in 1999-2004). However, the 2014 growth rate was below the potential growth rate (the maximum amount of growth without triggering additional inflation) of approximately 8 per cent (BNR/Rwanda Economic Update 8, 2015:4; Rwanda Economic Update 9, 2015:2).

The growth rate declined significantly from 8.9 to 5.9 per cent in 2015 and 2016. Developments in the production account show that the service sector was the dominant source of growth in the last five years, followed by agriculture, industry (without manufacturing) and manufacturing. Table 2 and Figure 1 show GDP growth rates in 1960-2016.

Figure 1. Rwanda's Gross Domestic Product (1960-2016, billions of 2010 US dollars)



Source: Authors' computations.

On average, the service sector contributed 4.0 percentage points to the average growth in the annual gross domestic product (GDP) at 7.1 per cent followed by agriculture (1.6 per cent), industry (1.1 per cent) and manufacturing (0.3 per cent). Two important features of this period were high and stable contributions by services and a declining contribution by manufacturing (BNR/Rwanda Economic Update 8, 2015:5).

1.1 Development of GDP over time

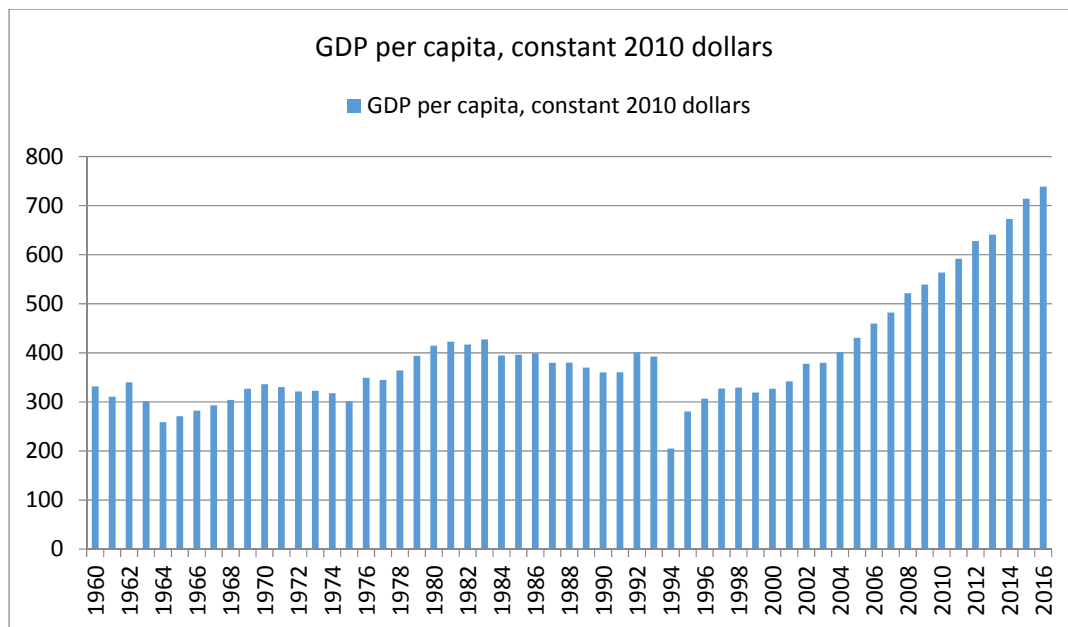
GDP is a measure of the size of the economy. It is the total market value of all goods and services produced in a country's territory during a period of time, for example, during

one year. To remove the effects of inflation GDP is measured in fixed prices. In this chapter it is measured in 2010 US dollar prices.

The World Bank provides data for Rwanda from 1960 to 2016 which shows that the average GDP values during this period were US\$ 2.81 billion with a minimum of US\$ 0.82 billion in 1964 and a maximum of US\$ 8.8 billion in 2016 (the World Bank 2016; National Institute of Statistics of Rwanda, 2017).

The World Bank data is an important indicator of development in the country from 1960 to 2016. The average value for Rwanda during the period as shown in Figure 1 was US\$ 394.62 with a minimum of US\$ 204.77 in 1994 because of the genocide and a maximum of US\$ 738.64 in 2016. The GDP per capita for 1960-2016 expressed biannually in 2010 US dollars is shown in Figure 2. The figure shows that after 1994 Rwanda's GDP per capita increased significantly.

Figure 2. Rwanda's GDP per capita (constant 2010 dollars, 1960-2016)



Source: Authors' computations.

GDP at purchasers' prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Dollar figures for GDP are converted from domestic currencies using 2010 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, the World Bank uses an alternative conversion factor.

1.2 Aggregate GDP

Though having an annually positive decreasing rate, the contribution of manufacturing remained small in 2015. In services, the growth rates of information and communication

and financial services were high. Although the shares of these sub-sectors remained small (2 and 1 per cent of GDP for 2015 and 2016 respectively), the high growth rates of these sub-sectors are nonetheless positive signs due to their high labor productivity. The share of these sectors to GDP over time is given in Tables 2- 6.

In industry, the construction growth rate has been accelerating in recent years. Given the high share of public investments (more than half the total investments), significant growth in construction indicates an increase in public investments. On the other hand, the growth rate of mining sharply decelerated and became negative for 2015 at -5 per cent. This sharp deceleration may reflect the decline in global commodity prices that resulted in negative growth rates in the mining sector (both in terms of volume and price). This deceleration was accompanied with a decreasing rate in education in 2015 and in economic growth, food crops and export crops in 2016.

General government final consumption expenditure (formerly general government consumption) includes the government's current expenditure on the purchase of goods and services (including compensation to employees). It also includes most expenditure on national defense and security but excludes government military expenditure that is a part of government capital formation. Between 1999 and 2016, the government consumption rate fluctuated between 19 and 13 per cent. Over the past 18 years, the household and non-governmental organizations (NGOs) indicator shows that there was no big change.

1.3 GDP by type of activity

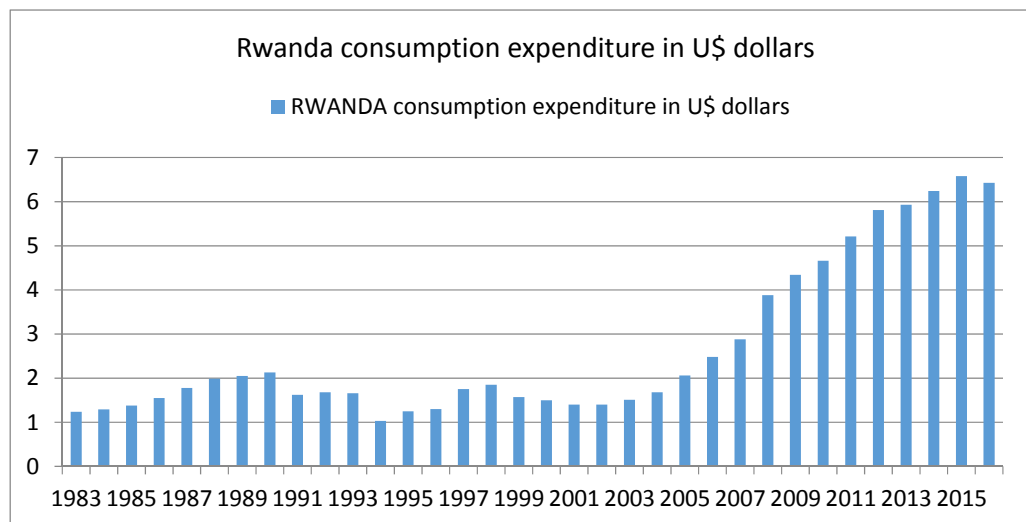
Fueled by strong growth (over 10 percent per annum between 2001 and 2011), the service sector increased its share in GDP from 45 percent in 1999 to 48 percent in 2016. The industry sector also grew at a constant rate per annum from 2011 to 2016, although from a low base and had increased its share in the economy by 3 percentage points to 17 percent by 2016. Agriculture, which grew at an average rate of 5 percent per annum, decreased its share in GDP from 37 percent to 30 percent (Table 1). By and large, by 2011 the structure of the economy was not very different from that in 2001. Between 2010 and 2014, the economy grew by 7.1 percent on average. While the growth rate was more than twice the average growth rates of all countries globally (2.9 percent), it was lower than the two preceding five-year periods (8.7 percent in 2004-2009 and 7.9 percent in 1999-2004) on average (Rwanda Poverty Assessment, 2015:32).

Recent economic indicators offer mixed signals about Rwanda's future economic direction. Its GDP growth rate accelerated from 4.7 percent in 2013 to 7.6 percent in 2014 (Table 2), with private consumption and government consumption leading this recovery; this is reflected in the accelerated growth of the service sector. However, the 2014 growth rate was below the potential growth rate (defined as the maximum amount of growth without triggering additional inflation) by approximately 8 percent. The growth rate declined significantly from 8.9 to 5.9 for 2015 and 2016 on average (Rwanda Economic Update 9, 2016:65/NISR, BNR and MINECOFIN).

The World Bank data for Rwanda from 1960 to 2016 shows that the average value of consumption expenditure for Rwanda during that period was US\$ 1.75 billion with a minimum of US\$ 0.1 billion in 1960 and a maximum of US \$ 6.43 billion in 2016 (also see Tables 4 and 5).

Household final consumption expenditure (formerly private consumption) is the market value of all goods and services including durable products (such as cars, washing machines and home computers) purchased by households. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. It also includes payments and fees to the government for permits and licenses. Here, household consumption expenditure includes the expenditure of non-profits institutions serving households even when reported separately. Figure 3 shows the development of consumption expenditure in 1983-2016 (Rwanda Economic Update 8, 1015:6).

Figure 3. Rwanda's consumption expenditure (in U\$ dollars, 1983-2016)



Source: Authors' computations.

Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the economy's fixed assets plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains and so on); purchase of plant, machinery and equipment; and the construction of roads, railways and the like including schools, offices, hospitals, private residential dwellings and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales and 'work in progress.' According to SNA (1993), net acquisitions of valuables are also considered capital formation. From 2014, Rwanda's consumption expenditure has been increasing at a high speed.

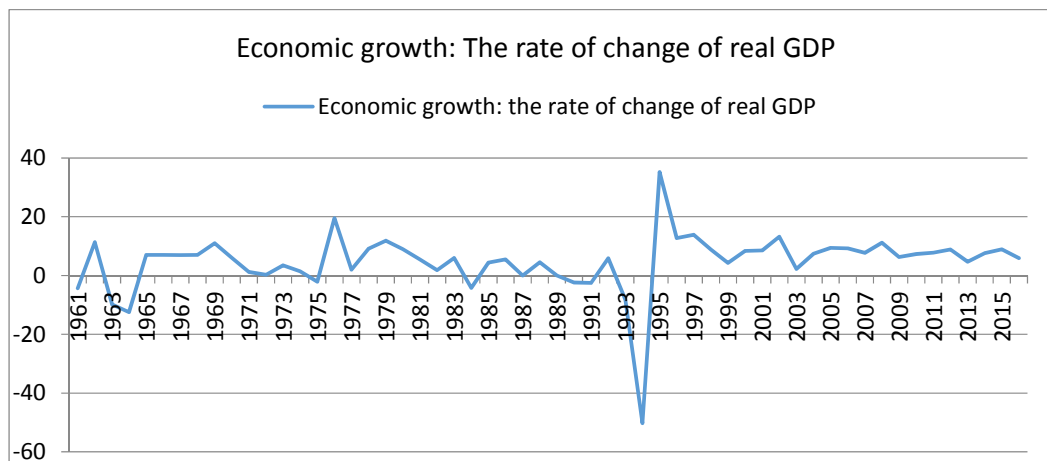
1.4 Economic growth

This section presents the rate of change in real GDP in 1961-2016 by comparing the current period and the previous one. World Bank data for Rwanda from 1961 to 2016 (Figure 4) shows that the average rate of change in real GDP during this period was 4.66 percent with a minimum of -50.25 percent in 1994 and a maximum of 35.22 percent in 1995. This drastic change coincided with the genocide and the post-genocide recovery periods.

Rwanda's economic growth recovered in the first three quarters of 2014. The economy grew at 7.1 percent (year-on-year), 2.4 percentage points faster than in 2013. Faster GDP growth was reflected in the higher growth of the service sector, at 9.1 percent, up from

5.4 percent in 2013, when the economy suffered from the lagged impact of the 2012 aid shortfall. Economic growth was projected to reach 7.5 percent in 2015 and 7.7 percent in 2016 which is close to the country's potential thanks to a continued stable macroeconomic framework and the ongoing implementation of priority policies. But it reached 8.9 and 5.9 percent respectively in 2015 and 2016 (also see Tables 3-5).

Figure 4. Economic growth (1960-2016)



Source: Authors' computations.

Regarding Rwanda's growth prospects for 2014, 2015 and 2016, the World Bank estimates that growth momentum was sustained in the fourth quarter of 2014 and projected that it will continue through 2016. The August 2014 edition of the Rwanda Economic Update said that Rwanda's economy would grow at 5.7 percent in 2014 and 6.6 percent in 2015. These projections assumed unfavorable agricultural harvests as a result of adverse weather condition in season B, lower international commodity prices of minerals and delayed implementation of government investment projects. Strong growth in the service sector supported by increased government spending and high agriculture production in seasons A and C along with leading indicators such as credit growth to the private sector and imports of capital goods, show that the growth momentum remained robust in the fourth quarter of 2014 and will continue to be so in 2015. Ongoing implementation of priority policy areas like agricultural productivity, export capacity, domestic resource mobilization and prioritization of expenditure will also reinforce growth. In light of these developments, the World Bank revised its growth projections to 7.0 percent for 2014, 7.5 percent for 2015, and 7.7 percent for 2016 (Rwanda Economic Update 8, 2016:8).

2. Disaggregated production by sectors

2.1 Agriculture

Rwanda is an agricultural society. The country experienced a 14 percentage point reduction in poverty (from 59 percent in 2001 to 45 percent in 2011) with the remaining poor much closer to the poverty line on average in 2011 than in 2001 (RWANDA Poverty Assessment, 2015). Developments in agriculture were key drivers of this reduction in poverty, with increased agriculture production (35 percent) and increased agriculture

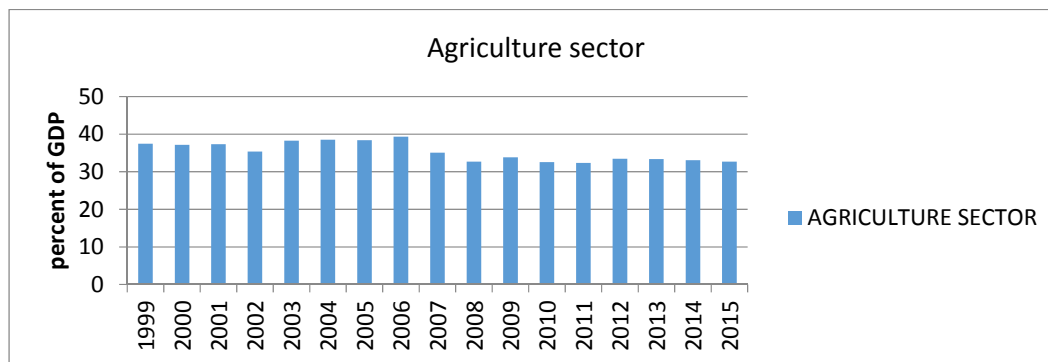
commercialization (10 percent) playing big roles. Self-employment in small, off-farm non-agricultural businesses accounted for an additional 13 percent in poverty reduction. Part of this self-employment was associated with agriculture value chain employment (Rwanda Economic Update 9, 2016:13).

The importance of agriculture in Rwanda's economy

Agriculture corresponds to the International Standard Industrial Classification (ISIC) divisions 1-5. It is measured as the value added of the agricultural sector as a percentage of GDP. Agriculture includes forestry, hunting and fishing, as well as the cultivation of crops and livestock production. Value added is the net output of a sector after adding all outputs and subtracting intermediate inputs (also see Tables 8 and 9). It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by ISIC, revision 3. For VAB countries, gross value added at factor cost is used as the denominator.

The World Bank provides data on agriculture's contribution to Rwanda's GDP from 1965 to 2015 (Figure 5). The average value of the contribution of agriculture to Rwanda's GDP was 44.17 percent with a minimum of 32.13 percent in 1991 and a maximum of 74.87 percent in 1966. Reduction in agriculture's share of the GDP is associated with the gradual transition of the society from agriculture to industry and services.

Figure 5. Agriculture sector's GDP contribution (1965-2015)



Source: Authors' computations.

Agricultural plots in Rwanda are very small (80 percent of the landholdings are less than 1 hectare, often divided into three or four plots) and more than 70 percent of the agricultural land is on hills or the side of hills, making mainstream commercial agriculture difficult (Rwanda Vision 2020). Rwandan agriculture is dominated by small-scale, subsistence farming; traditional agricultural practices (99.8 percent is farmed manually with traditional hand hoes); and rain fed agriculture. Irrigation is underdeveloped and not widespread (only 0.6 percent of the agricultural land is under irrigation); use of improved seeds is still constrained and only one-third of the farmers use fertilizers (although the number is rising). Production is labor-intensive and use of machinery is rare. As a result, average crop yields are well below potential. To tackle these structural bottlenecks for ensuring that growth translates into further poverty reduction, the government's Economic Development and Poverty Reduction Strategy 2 (EDPRS-2) envisages considerable investments in agriculture focusing on agricultural productivity and rural infrastructure.

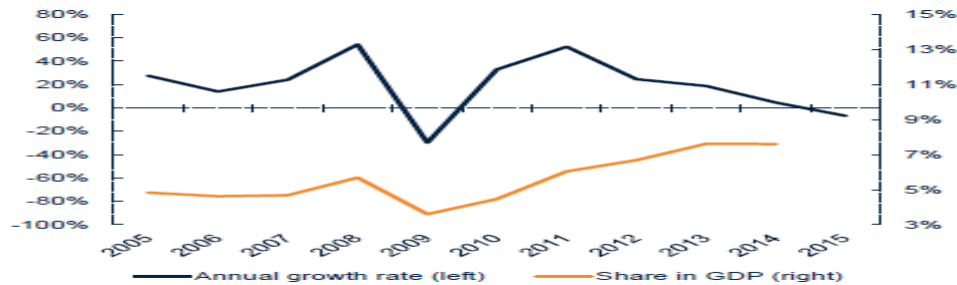
Total production of main crops (cereal yields, per kg per hectare) continued to increase during the study period, from 824.8 kg/per hectare to 1,919.90 kg/per hectare between 1999 and 2014, while fishing too had a constant increase in the same period. Irrigation (measured in sq. km) had an insignificant increase (see Table 10). Irrigation is a key strategic activity in strategic plan for transformation of agriculture in Rwanda (PSTA III). It is important for increasing agricultural productivity by allowing multiple cropping and reducing vulnerability to weather shocks. Therefore, the plan proposes continued investments in irrigated agriculture to harness Rwanda's freshwater resources to increase production and provide food security to rural households. The total area under irrigation was 27,796 hectares in 2013 including 3,075 hectares of hillside irrigation and 24,721 hectares of marshland irrigation. PSTA III plans to increase this by 20,340 hectares (15,000 hectares of marshland and 5,340 hectares of hillsides).

Agricultural mechanization

Currently domestic mechanization and the manufacture of the tools used in agriculture are at low levels. Only about 12 percent of the farms use mechanized tools. Operations are gradually being mechanized with the target being 25 percent mechanization by 2017 (Rwanda Economic Update 7, 2015:6).

Rwanda's exports have been dominated by traditional goods (coffee, tea, and minerals), though their share has been decreasing (Figure 6). The share of exports of traditional goods fell from 87 percent in 2004 to 53 percent in 2014 and to 46 percent in the first ten months of 2015 (Rwanda Economic Update 9, 2016:41/ EICV, 2006; 2011).

Figure 6. Rwanda's export growth (2005-15)



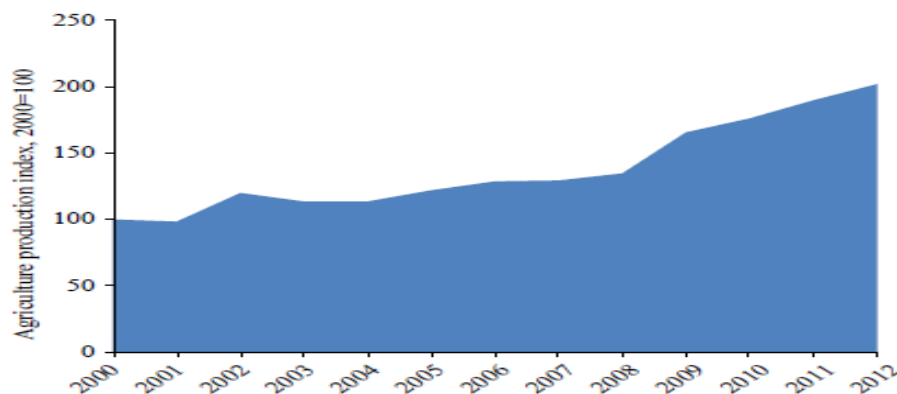
Source: BNR.

After a significant decline (-29.8 percent) in 2009 due to the global financial crisis, exports recovered and grew by 32.8 percent in 2010. However, export growth rates have continued to decelerate and turned negative in 2015 (-6.8 percent). Although the 2015 national account data has not yet been published, the share of exports in the economy in 2015 is likely to fall from the 7.6 percent of GDP in 2014.

Growth in the agriculture sector has been very strong since 2000 (Figure 7). Agriculture production in Rwanda almost doubled between 2000 and 2012 with most of the increase occurring since 2008 (see Table 3) in agriculture, forestry and fishing. Agricultural GDP grew at an average annual rate of 5.4 percent between 2008 and 2013 thanks to the impressive performance of the food crop sub-sector. Significant gains were also observed in the productivity of selected priority crops. Growth in agricultural production accounted for 35 percent of Rwanda's reduction in poverty over the past decade; increased commercialization of agriculture accounted for another 10 percent.

Transformation of agriculture into a modern, professionally operated and market-oriented economic activity can be undertaken through measures such as promotion of professionalism, specialization, technological innovations and public-private partnership programs.

Figure 7. Growth in the agriculture sector (2000-12)

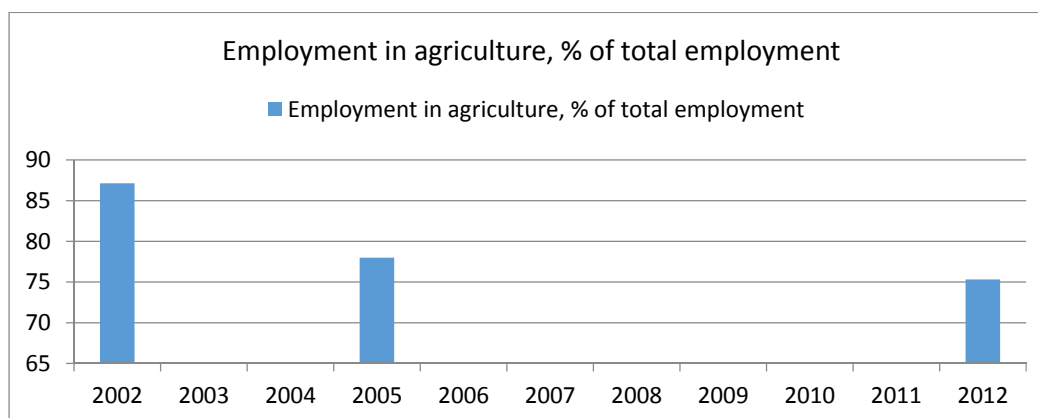


Sources: FAOSTAT and the World Bank staff calculations.

Data on employment in agriculture, measured as total employment, provided by the World Bank for 1989 to 2012 (see Figure 8) shows that the employment in agriculture averaged at 81.4 percent with a minimum of 75.3 percent in 2012 and a maximum of 90.1 percent in 1989 (Rwanda Economic Update 9, 2016:41/ EICV, 2006; 2011).

Results of the latest survey in 2014 suggest that the move to non-farm employment as a main job slightly levelled off after 2011. In 2014, there were about 0.55 million more workers than in 2011, half of whom took up main employment in agriculture (and half in the non-farm sectors). As a result, agriculture's share of main employment decreased by less than 2 percentage points between 2011 and 2014 compared to more than 6 percentage points between 2006 and 2011 (see Tables 2 and 3). However, job creation in the non-farm sectors remained healthy: the number of wage jobs outside farming, be it in main or secondary jobs, increased by about 0.34 million between 2011 and 2014 (Rwanda Economic Update 9, 2016:41/ EICV, 2006; 2011).

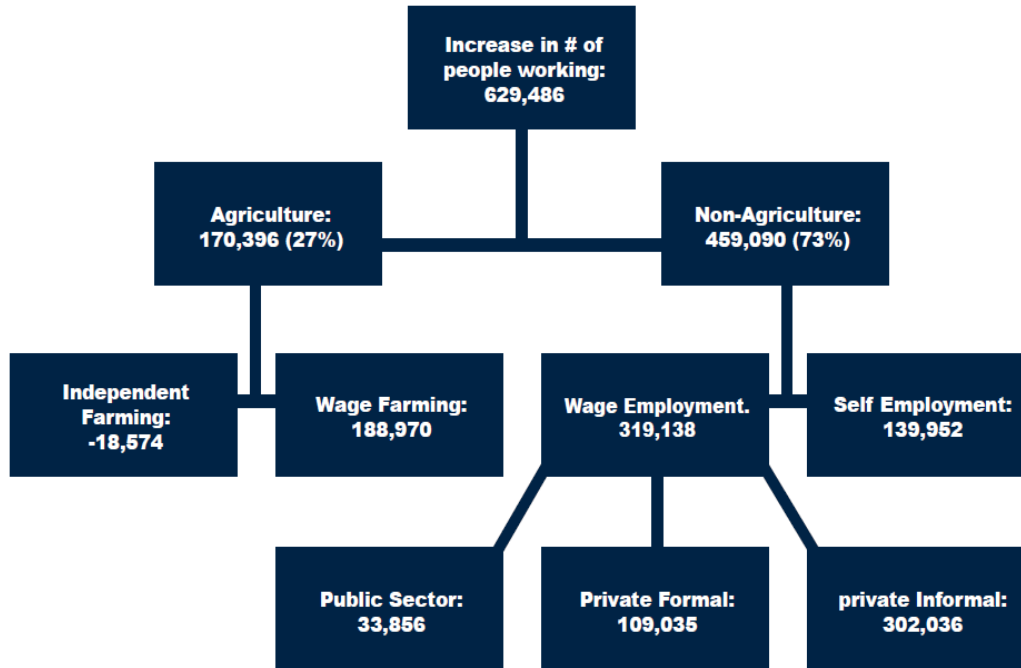
Figure 8. Agricultural employment (2002-12)



Source: Authors' computations.

As mentioned earlier Rwanda's agricultural society is transiting gradually to industry and services societies. Employment in agriculture and non-farm activities in 2006 is given in Figure 9.

Figure 9. Non-farm sector employment (2006)



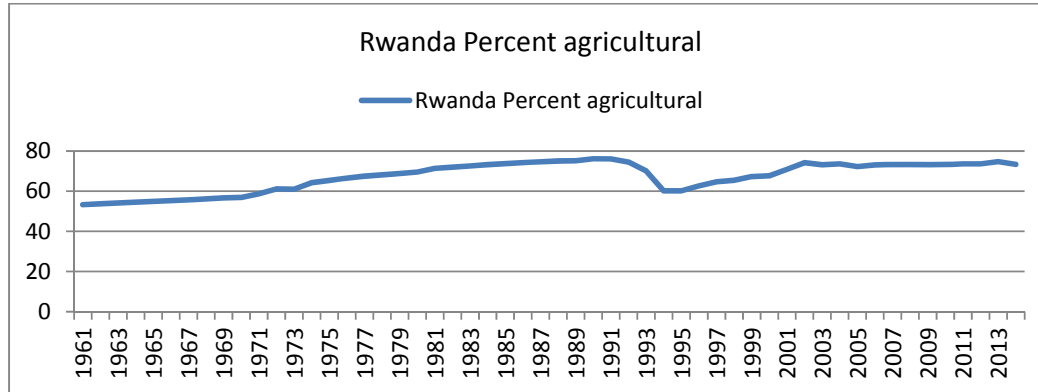
Source: EICV (2006, 2011).

Note: The category 'independent farming' pools independent farmers and unpaid family farm workers. For wage employment, the sub-categories do not add to the total new workers in wage employment, as the number of wage workers in 'other' wage jobs (not shown in the figure) have decreased substantially since 2006.

The World Bank data on agricultural land for Rwanda from 1961 to 2014 (Figure 10) shows that the average value for Rwanda during that period was 67.3 percent of arable land with a minimum of 53.3 percent in 1961 and a maximum of 76.17 percent in 1990.

Agricultural land refers to the share of land area that is arable and is under permanent crops and under permanent pastures. Arable land includes land defined by FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens and land temporarily fallow; land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest such as cocoa, coffee and rubber. This category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage including natural and cultivated crops.

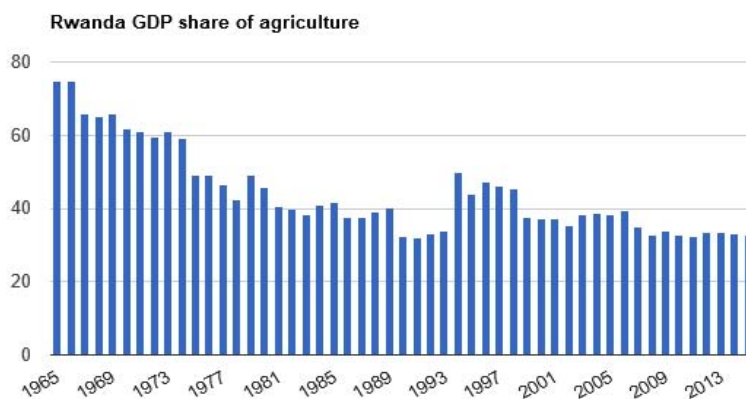
Figure 10. Percent agricultural land



Source: Authors' computations.

The Food and Agriculture Organization (FAO) provides data on precipitation measured in mm per year for Rwanda from 1962 to 2014. The average precipitation during this period was 1,212 mm per year with a minimum of 1,212 mm per year in 1962 and a maximum of 1,212 mm per year in 2014. Average precipitation is the long-term average in depth (over space and time) of annual precipitation. Precipitation is defined as any kind of water that falls from clouds in a liquid or solid form.

Figure 11. Agriculture's share in Rwanda's GDP



Source: TheGlobalEconomy.com, The World Bank

Source: Authors' computations.

The World Bank data for value added in agricultural sector as share of GDP for Rwanda from 1965 to 2015 (Figure 11) shows that the average share of value added in the agricultural sector as share of GDP was 44.17 percent with a minimum of 32.13 percent in 1991 and a maximum of 74.87 percent in 1966. Agriculture disaggregates show that agriculture, forestry and fishing contributed more than food crops and export crops.

Volatility in coffee prices had a major effect on Rwanda's export earnings (Figure 12). The value of coffee exports fell in 2001, 2002, 2007, 2009, 2012 and 2013 as a result of

a decline in both production and international coffee prices. During 2011 the quantity exported decreased but export earnings increased thanks to an increase in international coffee prices. In 2012 and 2013, the value of coffee exports declined even though the quantity exported increased because of a drop in international coffee prices.

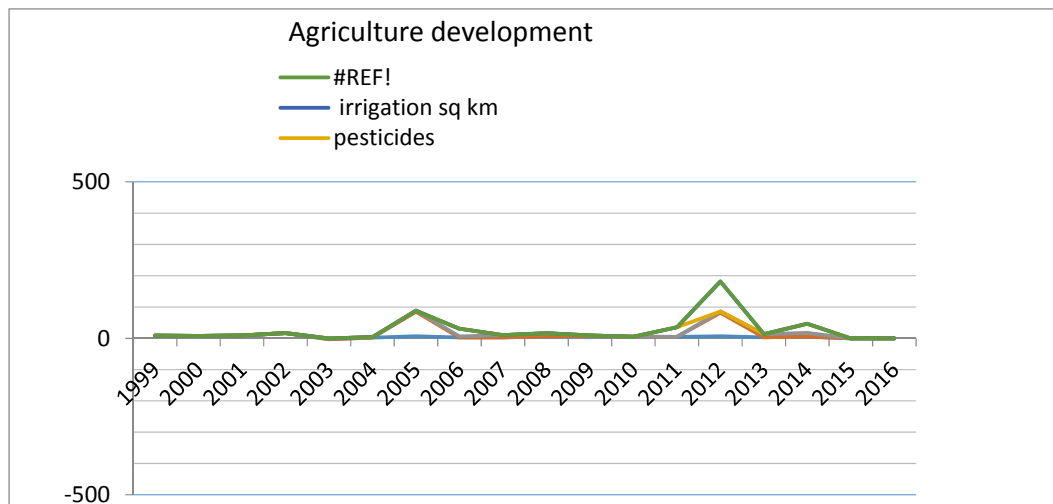
Figure 12. Coffee price volatility (2001-13)



Source: BNR.

This change in Rwanda's agriculture is a result of gradual modernization and use of modern factors of production like better seeds, saving irrigation, increased use of pesticides and fertilizers and public provided extension services (Figure 13).

Figure 13. Developments of production factor usage in agriculture (1999-2016)

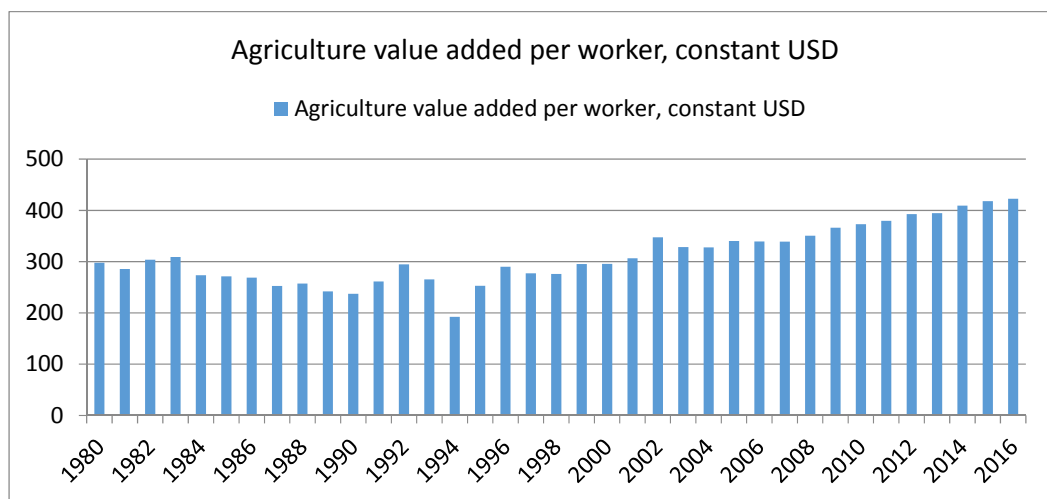


Source: Authors' computations.

Sufficient quantities and quality seeds are a critical resource for agricultural development. In Rwanda, there is strong public sector involvement in all seed sector components; however, private sector involvement is needed and should be encouraged as a source of investment to support agriculture and its productivity.

The World Bank data on agriculture value added per worker at constant USD for 1980 to 2015 shows that the average agriculture value during the period was US\$ 364.08 with a minimum of US\$ 236.35 in 1994 and a maximum of US\$ 470.71 in 2015. Figure 11 shows the progressive development of the agriculture value added per worker post the genocide recovery.

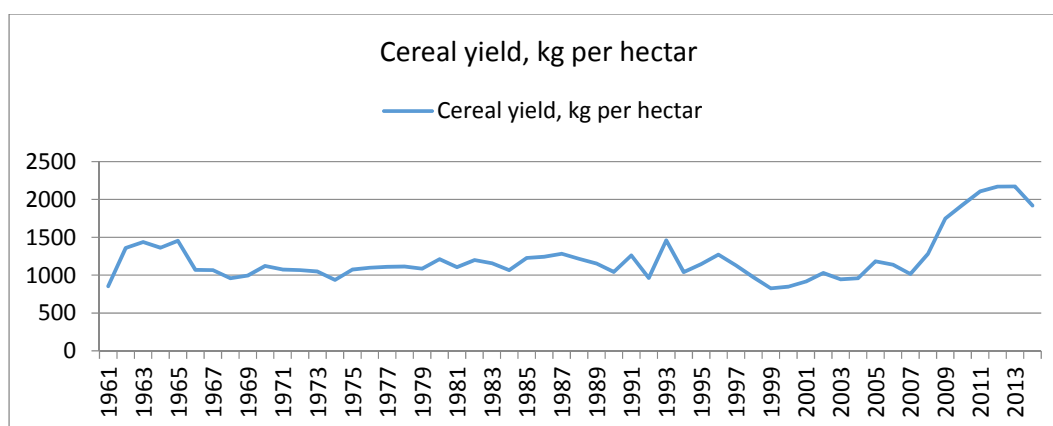
Figure 14. Agriculture value added per worker (constant USD)



Source: Authors' computations.

Cereal yields, kg per hectare, provided by FAO for Rwanda from 1961 to 2014 are reported in Figure 15. The average cereal yields per kg per hectare were 1,215.08 kg per hectare with a minimum of 824.8 kg per hectare in 1999 and a maximum of 2,171.8 kg per hectare in 2013. Figure 15 shows rapid productivity development in recent years.

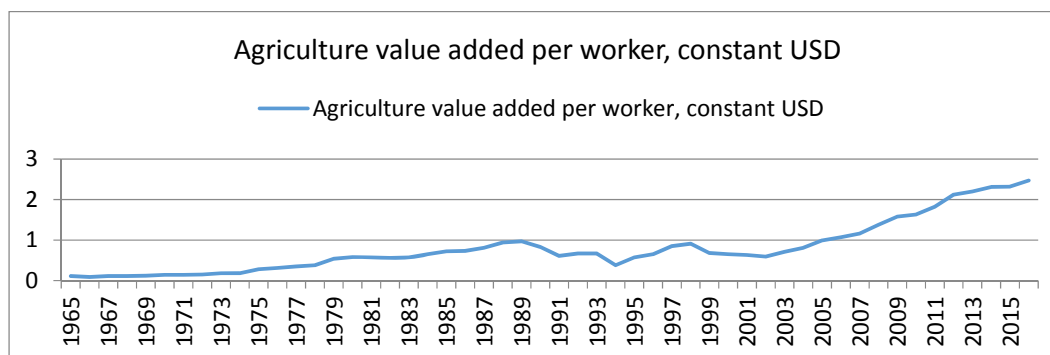
Figure 15. Cereal yield per hectare (1961-2014)



Source: Authors' computations.

The World Bank data for agricultural value added per worker from 1980 to 2015 (Figure 16) shows that the average agricultural value added per worker during the period was US\$ 364.08 with a minimum of US\$ 236.35 in 1994 and a maximum of US\$ 470.71 in 2015.

Figure 16. Agriculture value added per worker (1965-2015, constant USD)

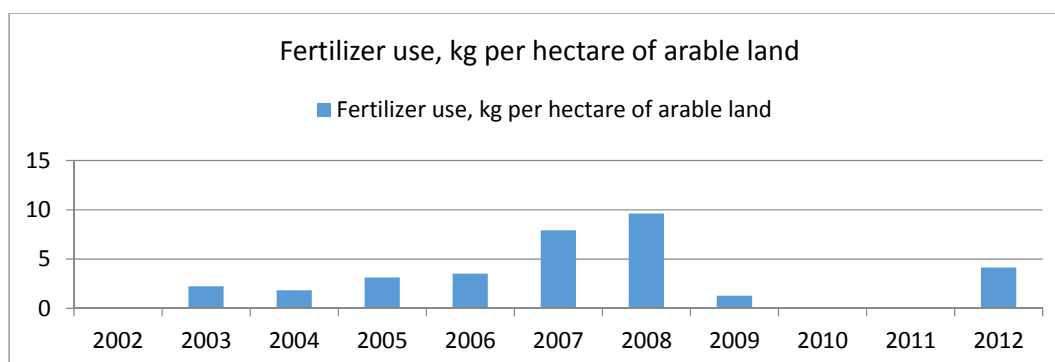


Source: Authors' computations.

Fertilizer use, kg per hectare of arable land has increased in Rwanda as per the FAO's data 2003 to 2013. The average fertilizer use during the period was 3.92 kg per hectare of arable land with a minimum of 0.08 kg per hectare of arable land in 2010 and a maximum of 9.62 kg per hectare of arable land in 2008. Fertilizer consumption measures the quantity of plant nutrients used per unit of arable land. Fertilizer products cover nitrogenous, potash and phosphate (including ground rock phosphate). Traditional nutrients--animal and plant manures--are not included. For the purpose of data dissemination, FAO has adopted the concept of a calendar year. Arable land includes land defined by FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pastures, land under market or kitchen gardens and land temporarily fallow; land abandoned as a result of shifting cultivation is excluded.

Fertilizer use has increased since 2007. Figure 17 shows that fertilizer application rate in the Crop Intensification Program (CIP) areas reached an annual average of 29 kg/ha/year in 2011-12 compared to a national average of 4.2 kg/ha/year in 1998-2005.

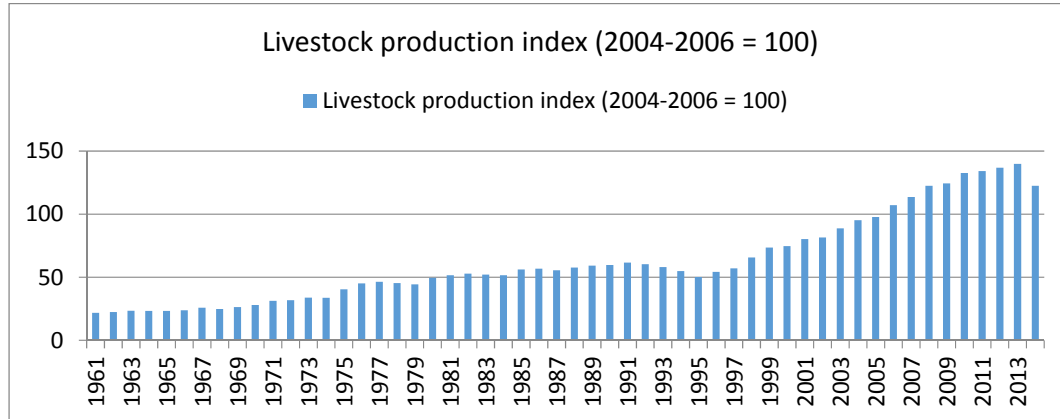
Figure 17. Fertilizer use (kg per hectare of arable land)



Source: Authors' computations.

FAO data on the livestock production index (2004-2006=100) for 1961 to 2013 is given in Figure 18. The average value of the livestock production index during the period was 61.14 index points with a minimum of 21.62 index points in 1961 and a maximum of 138.42 index points in 2013.

Figure 18. Livestock production index (2004-2006=100)



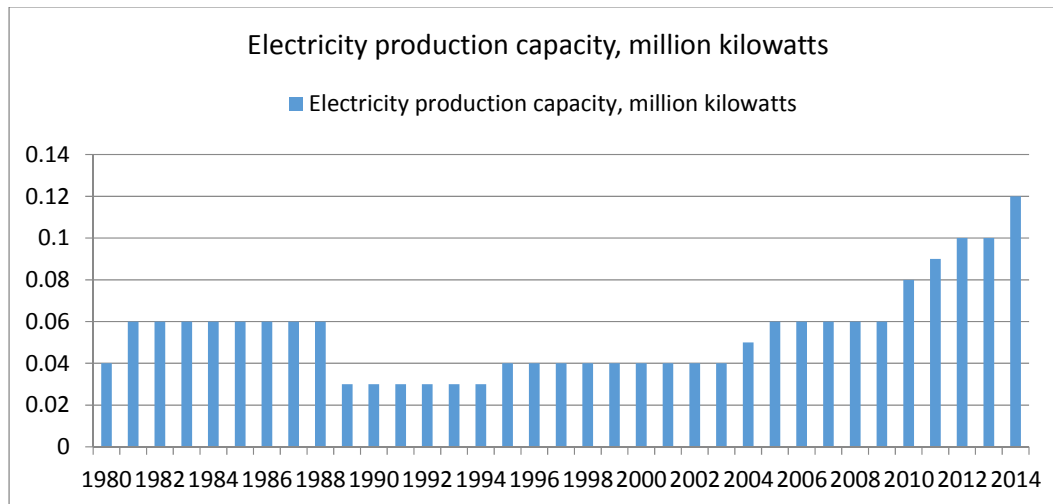
Source: Authors' computations.

2.2 Industry

The manufacturing sector in Rwanda is still small but it is growing steadily at an annual rate of 7 percent (see Table 11). Several policies and strategies such as the National Industrial Policy and the National Export Strategy have been developed to accelerate industrial and export growth. The National Industrial Policy aims at diversifying the economy by increasing the share of industry in the country's GDP, increasing exports to US\$ 1.5 billion by 2020 and increasing the number of off-farm jobs.

Electricity generation and use is a good indicator of industrial development. This is particularly true when looking at a country like Rwanda which has a large rural agriculture economy and a small urban economy influenced by industry and services. The electricity generation capacity for 1980-2014 is shown in Figure 19.

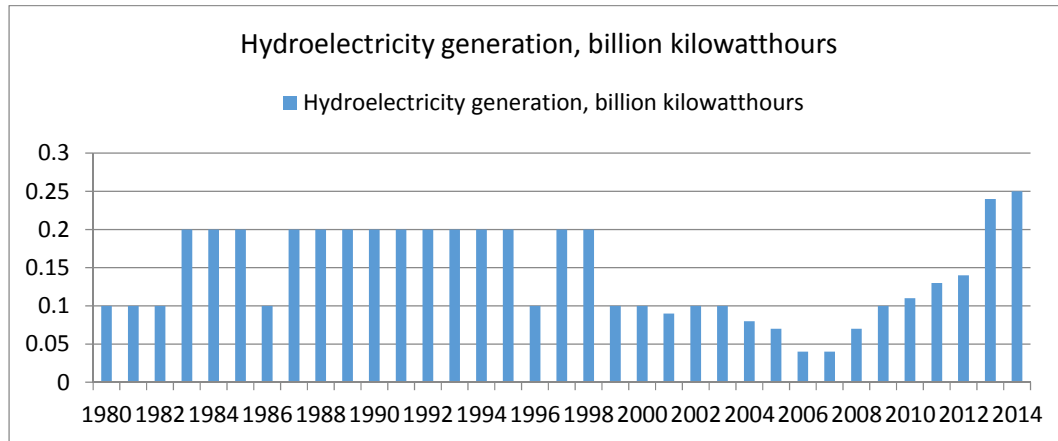
Figure 19. Electricity production capacity (1980-2014, million kilowatts)



Source: Authors' computations.

The US Energy Information Administration's data on electricity generation from 1980 to 2014 shows that the average electricity generation in the country during the period was 0.14 billion kilowatt hours with a minimum of 0.04 billion kilowatt hours in 2006 and a maximum of 0.25 billion kilowatt tours in 2014. The source of electricity was hydro. Development of hydroelectricity generation is shown in Figure 20.

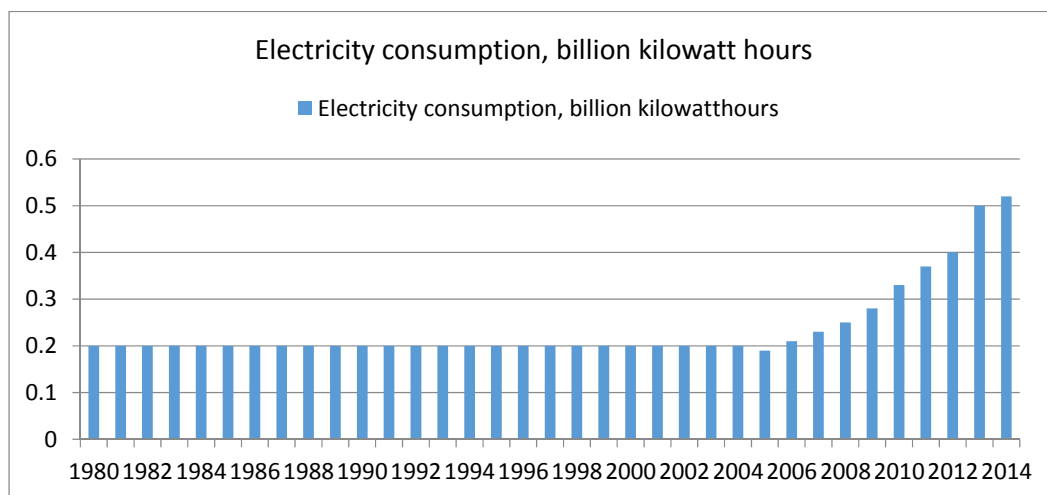
Figure 20. Hydroelectricity generation (1980-2014, billion kilowatt hours)



Source: Authors' computations.

In parallel with electricity production, electricity consumption also increased during this period. As per the US Energy Information Administration data reported in Figure 21 for 1980 to 2014, the average electricity consumption was 0.24 billion kilowatt hours with a minimum of 0.19 billion kilowatt hours in 2005 and a maximum of 0.52 billion kilowatt hours in 2014.

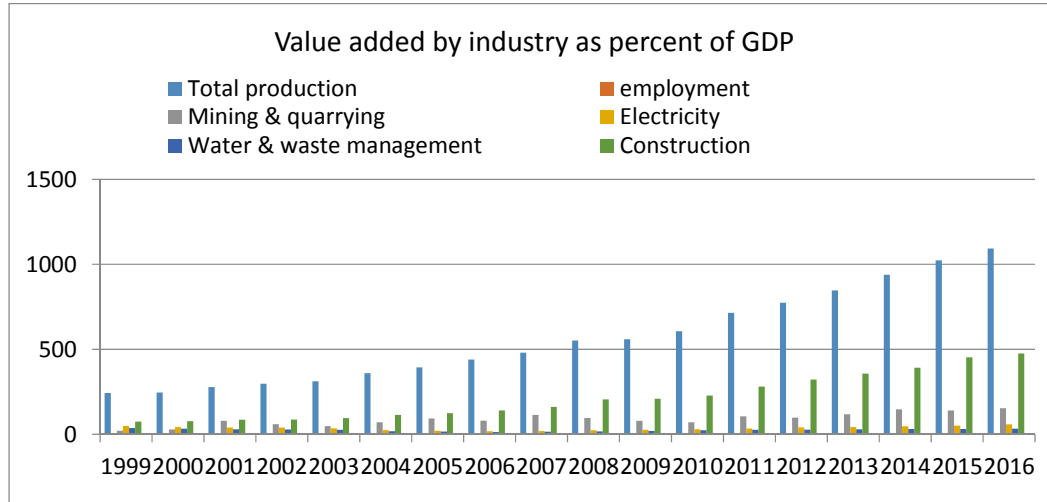
Figure 21. Electricity consumption (billion kilowatt hours)



Source: Authors' computations.

Figure 22 shows the industry value added over the period 1999-2016. The total value added is further divided into mining and quarrying, water and water management and electricity and construction. The figure also gives employment development patterns.

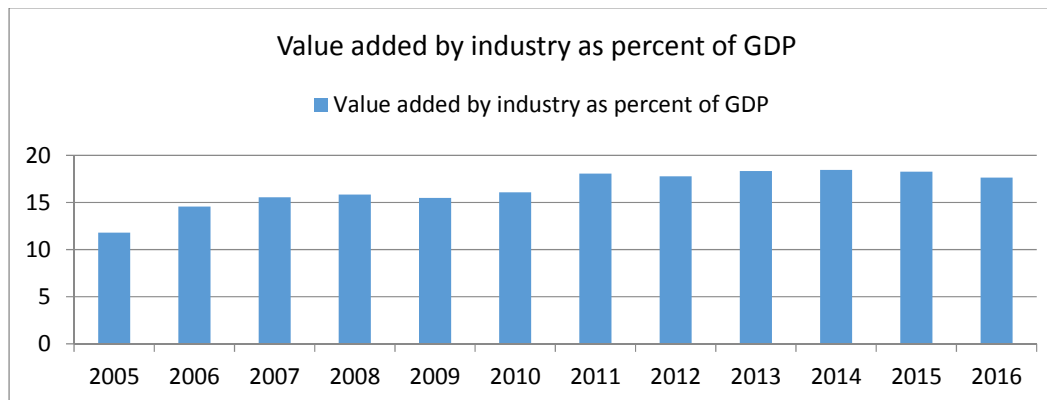
Figure 22. Value added by industry as percent of GDP



Source: Authors' computations.

As per the World Bank data for 2005 to 2016 (Figure 23), the average value of industry production during the period was 16.5 percent with a minimum of 11.81 percent in 2005 and a maximum of 18.45 percent in 2014. In industry, the construction growth rate has been accelerating in recent quarters. Given the high share of public investments (more than half the total investments), significant growth in construction indicates an increase in public investments.

Figure 23. Share of industry

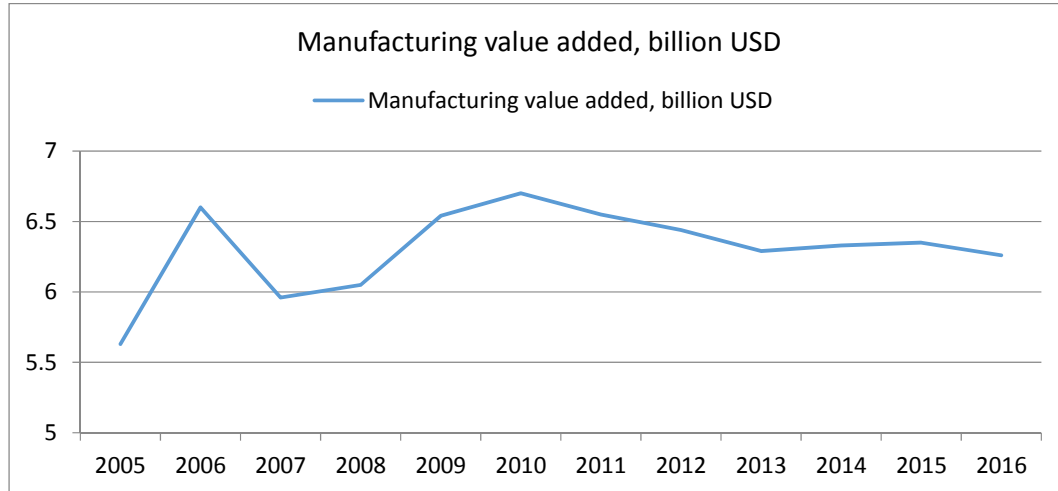


Source: Authors' computations.

2.3 Manufacturing

Modern manufacturing in Rwanda has almost been non-existent though it is growing now as a part of urbanization and industrial development. The value added by the manufacturing sector as percent of GDP from 2005 to 2016 is shown in Figure 24. Its average value was 6.31 percent with a minimum of 5.63 percent in 2005 and a maximum of 6.7 percent in 2010 (also see Table 12).

Figure 24. Manufacturing's share of GDP (2005-2016, in billion US dollars)

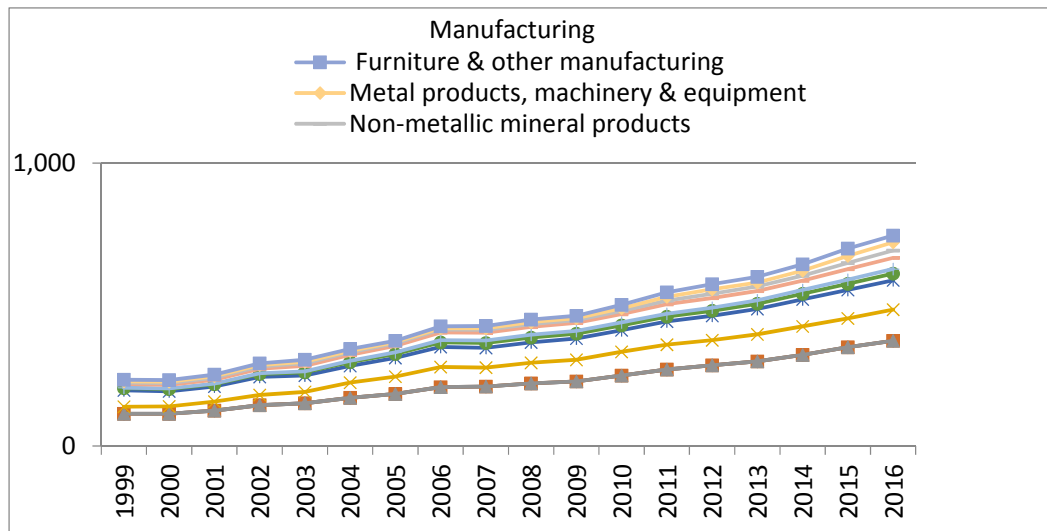


Source: Authors' computations.

Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by ISIC, revision 3.

For manufacturing value added, the World Bank data from 1965 to 2016 shows that its average value was US\$ 0.19 billion with a minimum of 0 in 1966 and a maximum of US\$ 0.49 billion in 2016. Development of the manufacturing value added components of furniture, metal products and non-metallic mineral products for 1999-2016 is reported in Figure 25.

Figure 25. Manufacturing components

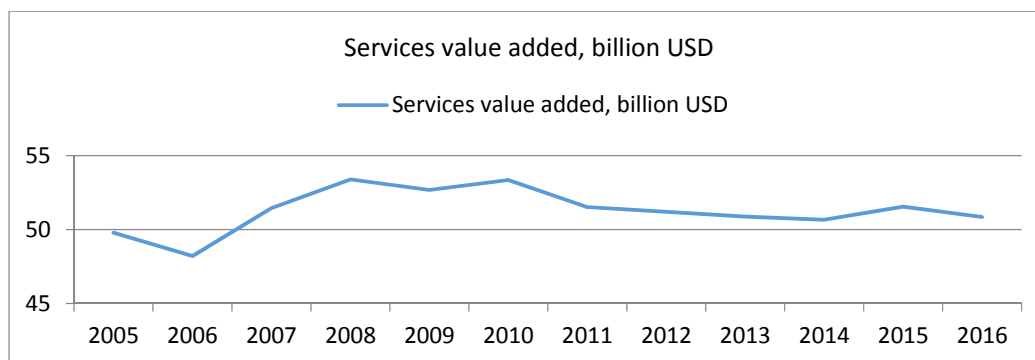


Source: Authors' computations.

2.4 Services

The service sector in Rwanda is expanding as urbanization is increasing. Value added in the service sector as percent of GDP is shown in Figure 26 and Table 13. The World Bank data for Rwanda's service sector from 2005 to 2016 shows its average value at 51.29 percent with a minimum of 48.21 percent in 2006 and a maximum of 53.39 percent in 2008 (Table 14). The average value of services during the period was US\$ 1.06 billion with a minimum of US\$ 0.02 billion in 1966 and a maximum of US\$ 3.99 billion in 2016. The highest growth rate in the service sector was in 2008-10. The service sector can further be divided into trade and transport and other services (see also Table 15).

Figure 26. Service sector's share in GDP (in billion USD, 2005-16)



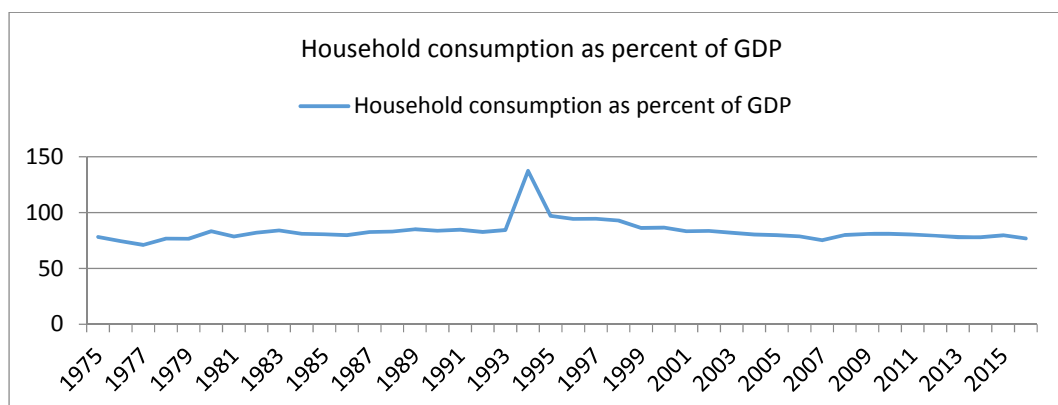
Source: Authors' computations.

3. Welfare

3.1 Consumption

In the last five years, household consumption has been the main consumption growth source contributing 4.5 percent to the annual growth at 7.1 percent and has increased to reach around 7 percent. Household consumption as percent of GDP for 1960-2016 is shown in Figure 27 and Tables 16 and 17. Its average value was 84 percent with a minimum of 71 percent in 1977 and a maximum of 137 percent in 1994.

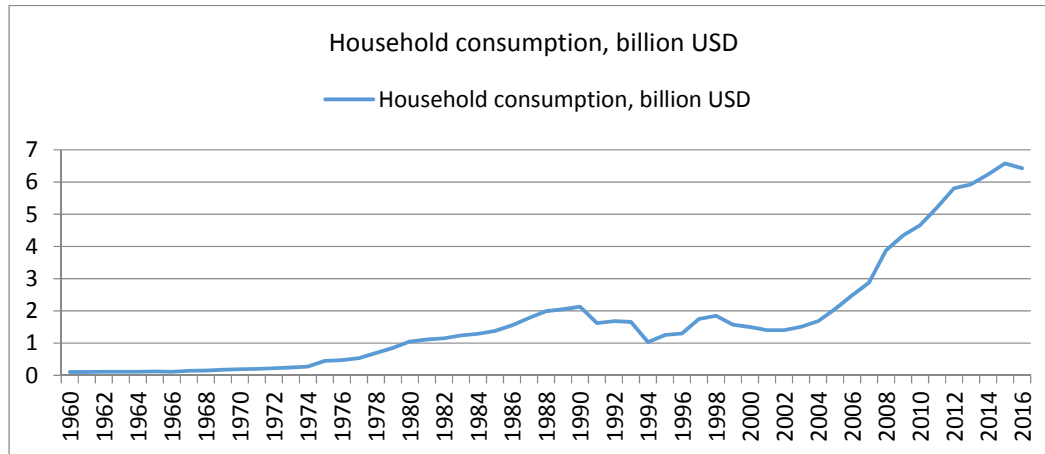
Figure 27. Household consumption as percent of GDP (1960-2016)



Source: Authors' computations.

Average household consumption during 1960-2016 was US\$ 1.75 billion with a minimum of US\$ 0.1 billion in 1960 and a maximum of US\$ 6.43 billion in 2016. Figure 28 shows that there were fast developments from 2004 onwards.

Figure 28. Household consumption (in billion USD)

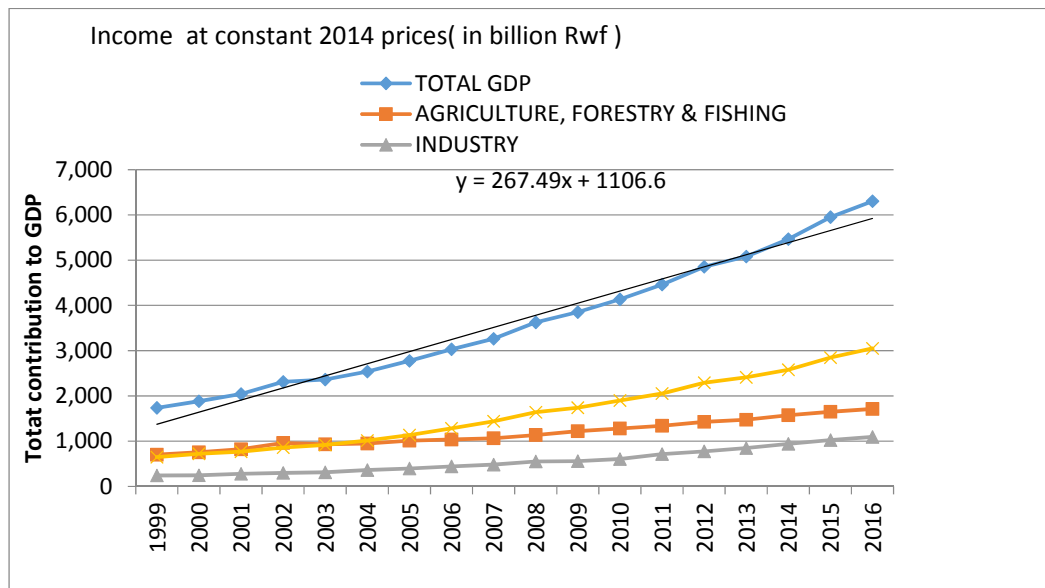


Source: Authors' computations.

3.2 Income, consumption and human development

Development of total GDP and its decomposition into agriculture, industry and services for Rwanda for 1999-2016 is shown in Figure 29. Agriculture and services were the main contributors.

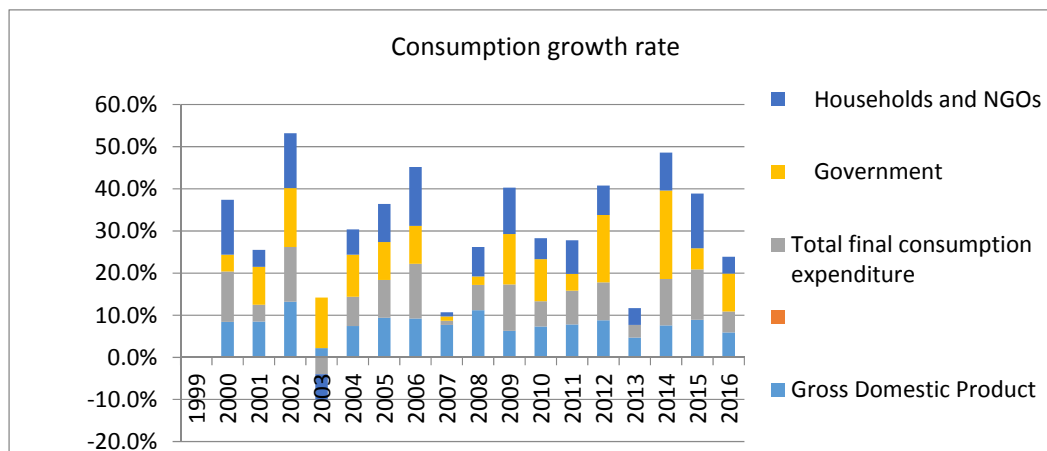
Figure 29. Income at constant 2014 prices (in billion Rwf)



Source: Authors' computations.

Figure 30 shows the growth rate in consumption and its effect on final consumption expenditures of the government, households and NGOs for 1999-2015. The growth rate varied in a non-systematic way and dominated in 2002, 2006 and 2014.

Figure 30. Consumption growth rate at constant 2014 prices.



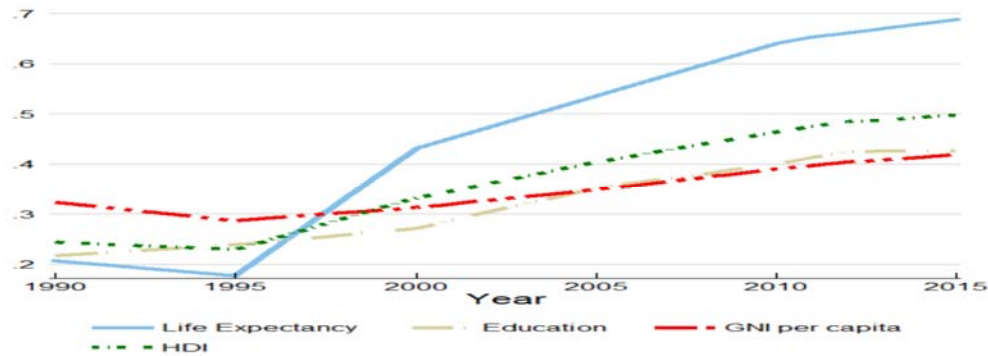
Source: National Institute of Statistics of Rwanda.

As Rwanda's experience over the last decade illustrates, what happens to inequality also matters for poverty reduction. Between 2001 and 2006, household consumption grew by 10 percent. In the subsequent five years, consumption grew by 16 percent and poverty fell by 12 percent. Government consumption also increased from 1.0 percent in 2013 to 24.3 percent in the first three quarters of 2014, reflecting increased current expenditures (Figure 30). Private consumption increased from 2.9 percent in 2013 to 5.6 percent. Investment accelerated from 7.7 percent in 2013 to 8.9 percent, led mainly by investments in durable goods, particularly related to farm mechanization. Growth in construction investment decelerated to 7.2 percent.

The HDI is a summary measure for assessing progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. A long and healthy life is measured by life expectancy at birth. The knowledge level is measured by mean years of education among the adult population and the standard of living is measured by gross national income (GNI) per capita expressed in constant 2011 international dollars converted using purchasing power parity (PPP) conversion rates. The index in its normalized form uses weights that vary in the interval 0-1.

As per the United Nations data from 1980 to 2015 Rwanda's average HDI value was 0.42 points with a minimum of 0.24 points in 1990 and a maximum of 0.51 points in 2013. Between 1990 and 2015, Rwanda's HDI increased from 0.244 to 0.498, an increase of 103.9 percent. Table 4 gives Rwanda's progress in each of the HDI indicators. Between 1990 and 2015, Rwanda's life expectancy at birth increased by 31.3 years, mean years of schooling increased by 2.0 years and expected years of schooling increased by 5.1 years. Rwanda's GNI per capita increased by about 90.9 percent between 1990 and 2015. Figure 31 shows the development of education and the longevity components of human development in Rwanda. Life expectancy showed the fastest growth over time (see Tables 18 and 19) (Human Development Report 2016:2).

Figure 31. Trends in Rwanda's HDI component indices (1990-2015)



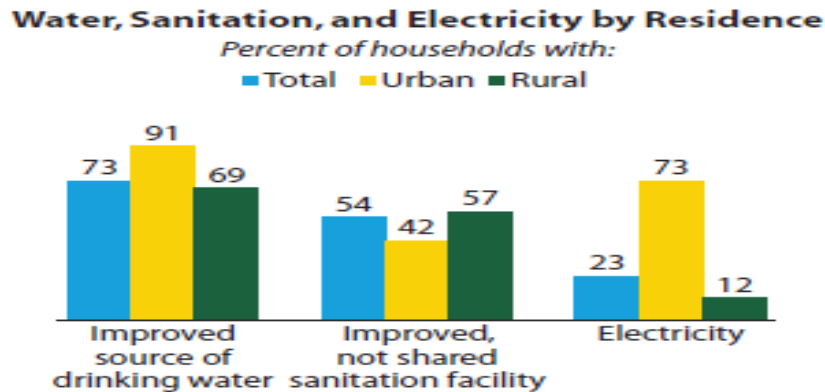
Source: Authors' computations.

4. Standard of living

4.1 Drinking water

In this section on standards of living we focus on water, sanitation and electricity. Nearly three-quarter of the households had access to an improved source of drinking water. More than 9 in 10 urban households had access to an improved source of drinking water, compared to nearly 7 in 10 rural households. Figure 32 and Tables 20 and 21 show that over half (54 percent) the households in Rwanda had an improved, not shared sanitation facility. Rural households were more likely than urban households to have an improved, not shared sanitation facility (57 and 42 percent respectively). In contrast, urban households were more likely than rural households to have a shared sanitation facility (44 and 12 percent respectively). Nearly 3 in 10 Rwandan households had a non-improved sanitation facility. Overall, 23 percent of the Rwandan households had access to electricity (Rwanda Demographic and Health Survey, 2014-2015).

Figure 32. Drinking water, sanitation and electricity access

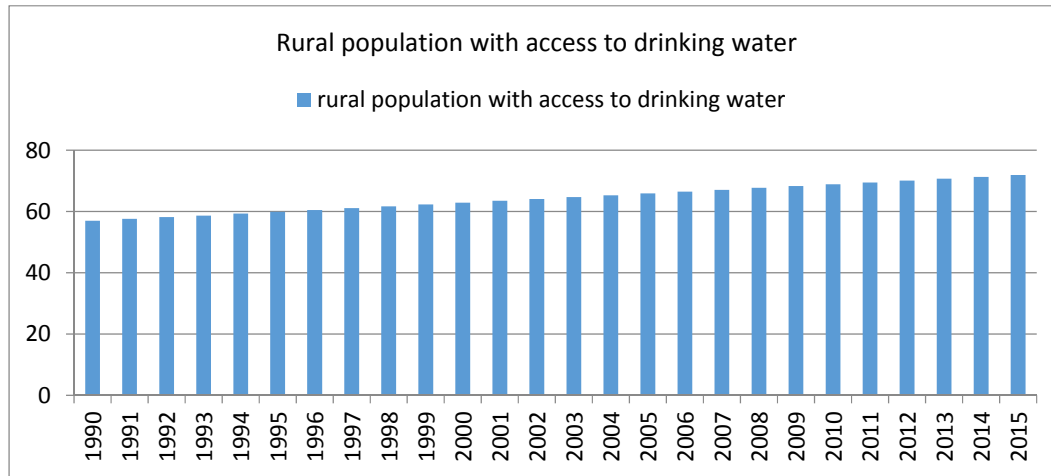


Source: Rwanda Demographic and Health Survey (2014-15).

Figure 33 gives the percentage of the rural population with access to drinking water (1990 to 2015). It shows that 64.41 per cent of the population had access to drinking water with

a minimum of 57 percent in 1990 and a maximum of 71.9 percent in 2015. This positive trend is consistent with the welfare objectives of the government.

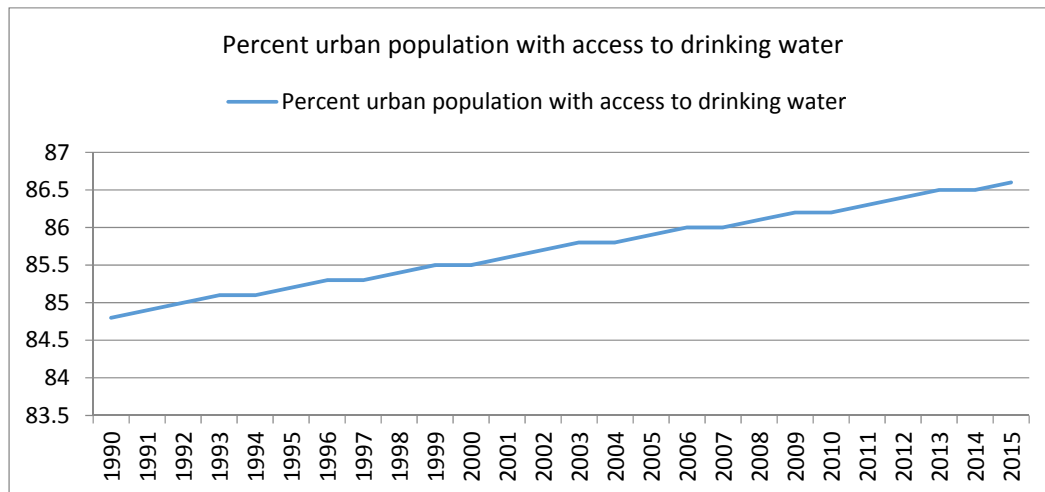
Figure 33. Rural population's access to drinking water (1990-2015)



Source: Authors' computations.

WHO/UNICEF data for Rwanda from 1990 to 2015 (see Figure 34) shows that 85.72 percent of the urban population had access to safe drinking water during the period with a minimum of 84.8 percent in 1990 and a maximum of 86.6 percent in 2015. This level is much higher than the corresponding level for the rural population.

Figure 34. Percentage of urban population with access to drinking water

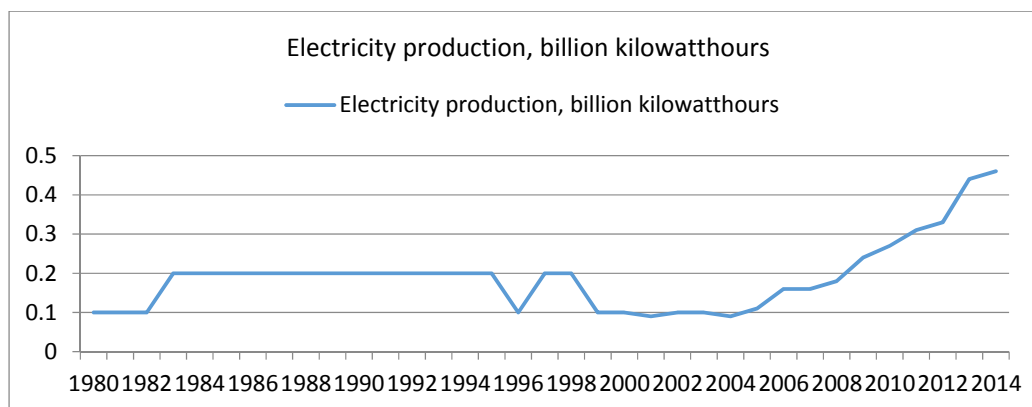


Source: Authors' computations.

4.2 Electricity consumption

The US Energy Information Administration's data from 1980 to 2014 shows that the average electricity consumption in the country was 0.19 billion kilowatt hours with a minimum of 0.09 billion kilowatt hours in 2001 and a maximum of 0.46 billion kilowatt hours in 2014 (Figure 35). As mentioned earlier the main source of electricity is hydro.

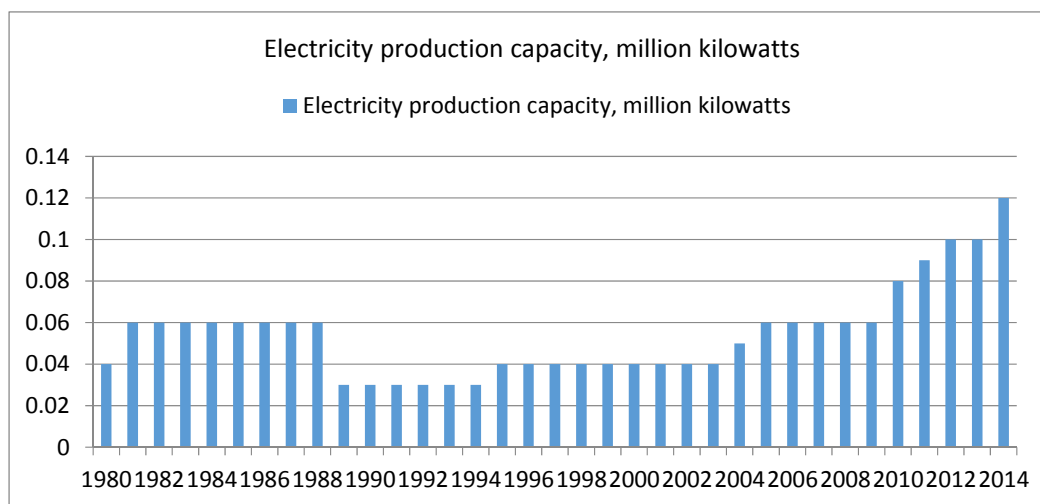
Figure 35. Electricity production (in billion kilowatt hours)



Source: Authors' computations.

The US Energy Information Administration's data for Rwanda from 1980 to 2014 on electricity consumption shows that the average consumption was 0.14 billion kilowatt hours with a minimum of 0.04 billion kilowatt hours in 2006 and a maximum of 0.25 billion kilowatt hours in 2014. Hydro's share increased from 20 per cent to more than 50 per cent. The energy production capacity for Rwanda from 1980 to 2014 has increased since 2004. Figure 36 shows that the average energy production in Rwanda during the period was 0.05 million kilowatts with a minimum of 0.03 million kilowatts in 1989 and a maximum of 0.12 million kilowatts in 2014.

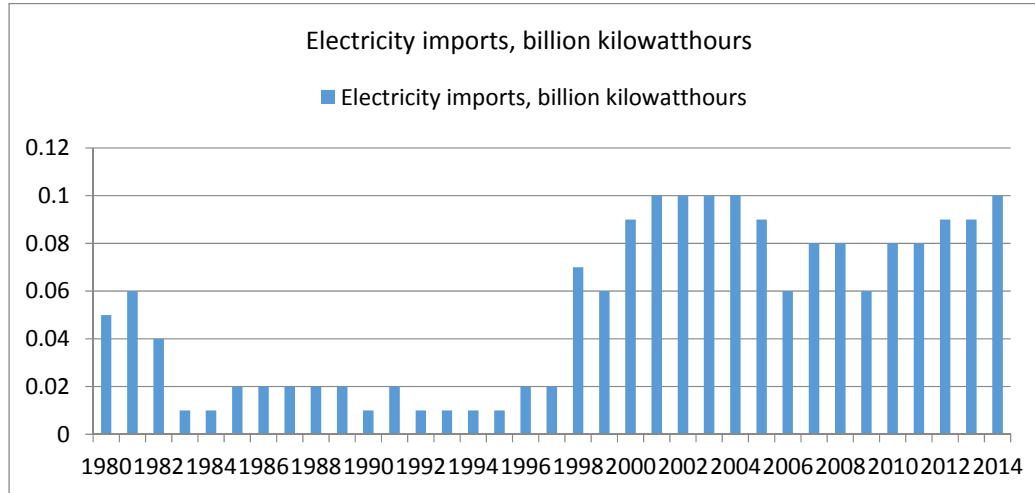
Figure 36. Electricity production capacity (1980-2014, in million kilowatts)



Source: Authors' computations.

Rwanda imported a large share of its electricity consumption from neighboring countries. Figure 37 shows that the average imports were 0.05 billion kilowatt hours with a minimum of 0.01 billion kilowatt hours in 1983 and a maximum of 0.1 billion kilowatt hours in 2001. The amount of electricity exported in 1982, 1995 and 2002 amounted to 0.01 billion kilowatt hours.

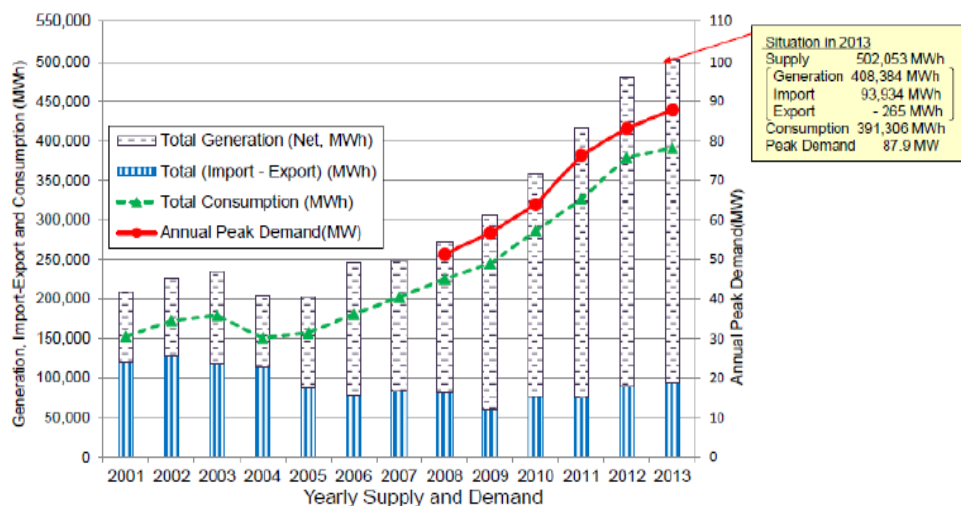
Figure 37. Electricity imports (in billion kilowatt hours)



Source: Authors' computations.

The total annual energy consumption in 2001-13 is reported in Figure 38. The figure gives consumption decomposed into net exports and domestically sourced energy. It also shows the peak demand in recent years.

Figure 38. Total energy consumption, net export and peak demand (2001-13)

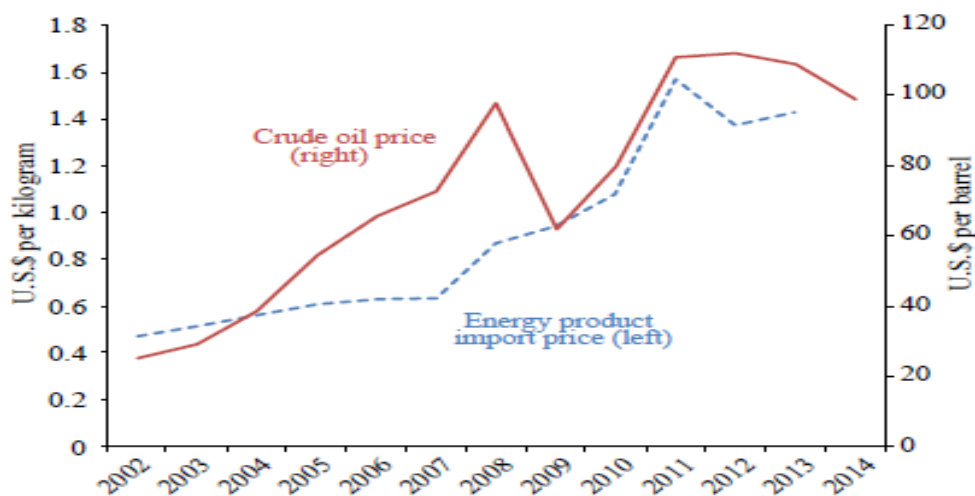


Source: Authors' computations.

The current decline in oil prices is expected to have a net positive impact on global economic growth and also on Rwanda's economy. Unlike in 2009, the current decline in oil prices is mainly due to supply factors (for example, shift in the OPEC policy and availability of US technologies for extracting oil and gas from tight rock formations and tar sand) rather than demand factors leading to a decline Rwanda's trading partners' economic activities. Because Rwanda is a net importer of oil, a decline in the cost of oil imports will improve its balance of payments, reduce inflation and take pressure off the exchange rate. The budget is likely to benefit from smaller electricity subsidies to the

Rwanda Energy Group. Crude oil price energy products' import prices for 2002-14 are given in Figure 39 (Rwanda Economic Update 7, 2015:23).

Figure 39. Imported crude oil and energy product prices (2002-14)



Source: Authors' computations.

These impacts should promote macroeconomic stability and increase the flexibility of the fiscal and monetary policy. However, if commodity prices of Rwanda's main export items (coffee, tea and minerals) also decline, the positive impacts will be offset by a decline in exports.

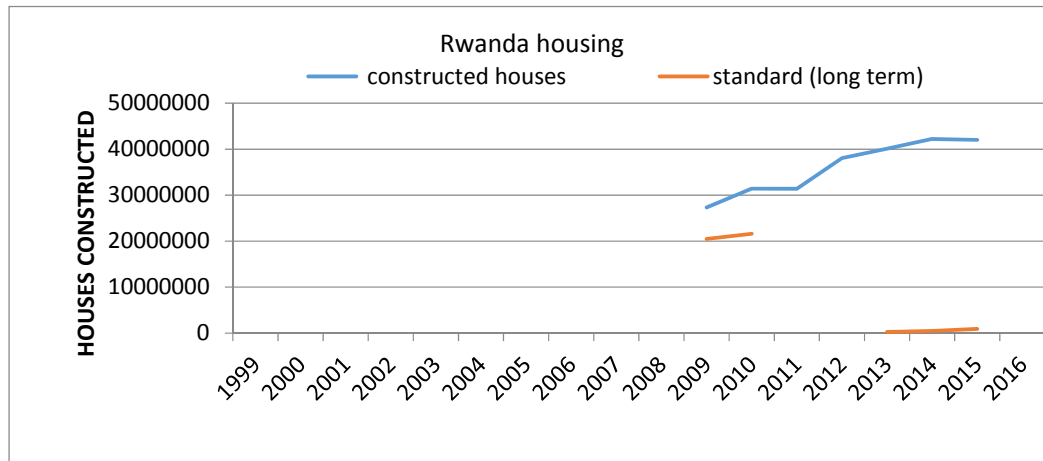
Rwanda imported US\$ 385 million of energy products in 2013 (269,000 tons at a unit import price of US\$1.40 per kilogram). Crude oil prices and Rwanda's energy product import prices are highly correlated. Energy product import prices are therefore assumed to decline with crude oil prices.

Data on renewable power generation for Rwanda from 1980 to 2014 shows that the average renewal power generation during the period was 0.14 billion kilowatt hours with a minimum of 0.04 billion kilowatt hours in 2006 and a maximum of 0.25 billion kilowatt hours in 2014. There was a gap between the generation and consumption of renewable energy. The average renewable energy consumption during the period was 0.13 billion kilowatt hours with a minimum of 0.04 billion kilowatt hours in 2006 and a maximum of 0.17 billion kilowatt hours in 1989. The pattern changed over time but no stable and positive trend is observable.

4.3 Housing

In most countries, housing constitutes a major sector of the economy. The construction sector has strong employment, trade and service production implications. There are not many statistics available on housing in Rwanda but housing as a means of improving standards of living is a major component of state policy. Figure 40 shows the number of constructed houses from 2008 to 2016. The data does not cover the pre-2008 period.

Figure 40. Housing construction (1999-2016)



Source: Authors' computations.

4.4 Poverty

Between 2006 and 2011, the Gini index of consumption per adult equivalent decreased from 52.4 to 49.6 which can be considered a substantial decline (Table 22). The Lorenz curves for 2006 and 2011 do not cross which means consumption distribution was more equal in 2011 than in 2006 for any standard measure of inequality. Inequality was substantially lower in rural areas (40.2) as compared to urban areas (58.2) and it also decreased faster there. The Gini index decreased by 4.3 percent in rural areas compared to 2.7 percent in urban areas (Rwanda statistical year book, 2016:3/ *NISR/EICV4*).

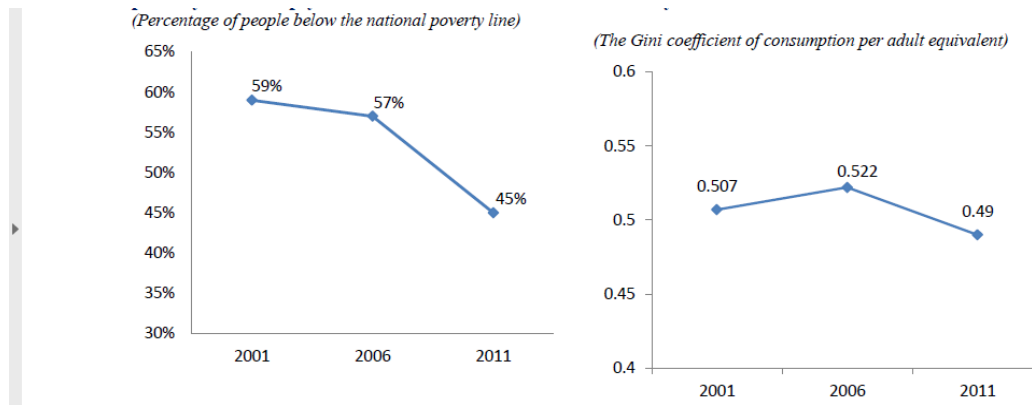
Between 2006 and 2011, inequality dropped in all provinces except the Northern Province. Gini dropped the most in the Southern (12 percent decrease) and Western provinces (16 percent decrease), the provinces with the highest poverty headcount in 2011. The Northern Province experienced an 8 percent increase in inequality, but was nevertheless the province with the fastest poverty reduction since 2005 (poverty dropped by 18 percent). Inequality in Kigali City decreased only marginally.

Inequality in Rwanda is high but decreasing. Rwanda's Gini index of inequality (50.7) was substantially higher than the average level of inequality in Africa (Gini of 43.3 in 21 African countries with a comparable consumption survey around the same period) and the average inequality in low-income countries. Since 2006, inequality has decreased faster in Rwanda (decrease of 2.3 percentage points) than the average African country decrease (average decline of 0.7 percentage points between 2005 and 2010) (Rwanda Statistical Year Book, 2016:3/ *NISR/EICV4*).

This decrease in inequality was the most salient among both the very poor and the wealthiest. While the Gini coefficient was most responsive to changes in inequality in the middle of the distribution, the so-called generalized entropy (GE) measures of inequality highlights changes in inequality for different levels of consumption. GE(-1) focuses on inequality at the very bottom of the consumption distribution, while GE(2) focuses on the top of the distribution. GE(0) and GE(1) are the intermediate cases. Inequality decreased the most among the very poor (18 percent decrease in GE(-1)) and very rich (22 percent decrease in GE(2)). This pattern is especially salient in rural areas.

Figure 41 shows the percentage of people below the national poverty line and inequality based on the three most recent household surveys conducted in 2001, 2006 and 2011. It shows that poverty declined while inequality was an inverted U shaped.

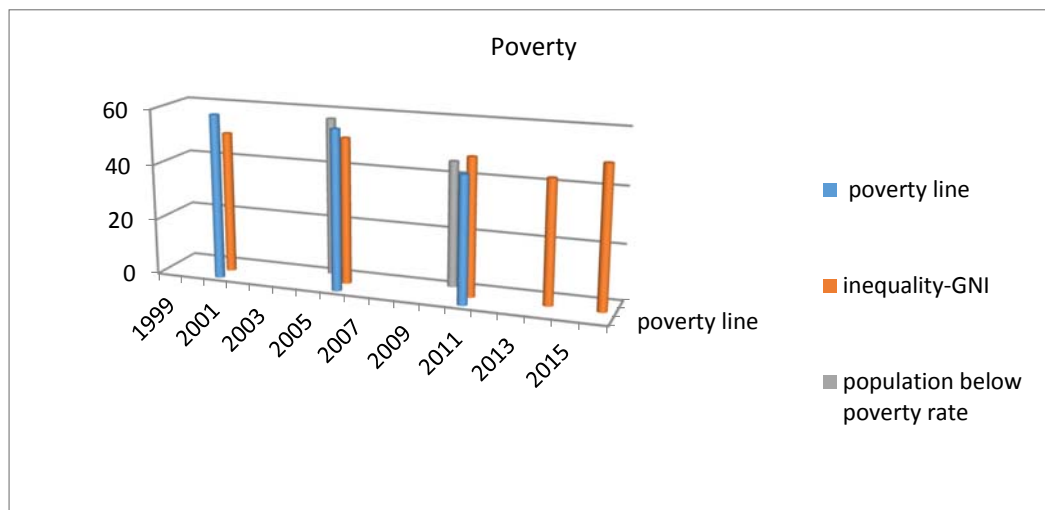
Figure 41. Poverty and inequality (2001, 2006 and 2011)



Source: Authors' computations.

Poverty line, share of the poor population below the poverty line and inequality based on gross national income for selected years during 1999-2015 is shown in Figure 42 and Table 23. Despite a relatively low poverty line (\$1.25) the poverty rate was extremely high which declined till 2014 but increased again in 2015.

Figure 42. Poverty line and inequality based on GNI (1999-2015)

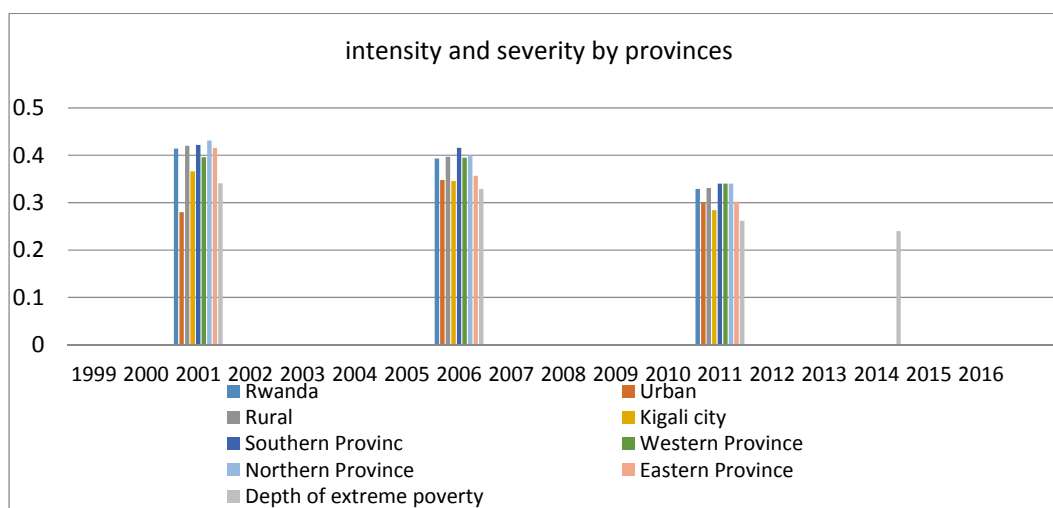


Source: Authors' computations.

In 2010 and 2011 (the most recent living standards survey years), 45 percent of the population lived below the national poverty line and 24 percent was considered extremely poor (lived below the national food poverty line). The national poverty line was a poor measure as witnessed by the large differences between poverty based on the national poverty line (45 percent) and poverty based on the international \$1.25 a day poverty line (63 percent). Poverty was concentrated in the south-west of the country (Rwanda Poverty Assessment, April 2015:12).

While poverty in Rwanda is still high, the declining trends over the past decade have been firmly positive. Between 2001 and 2011, Rwanda's economy grew at more than 8 percent per year, earning the country a spot on the list of the ten fastest-growing countries in the world. Strong pro-poor growth resulted in rapid poverty reduction with the share of the population below the national poverty line dropping from 59 percent in 2001 to 45 percent in 2011 (Figure 43 and Tables 24 and 25). The fact that poverty is still high in Rwanda is hence a reflection of where the country came from (the high initial poverty levels) rather than of lack of progress. Growth in consumption was higher for poor than for non-poor households resulting in a decrease in inequality, although only modestly. Qualitative focus group discussions conducted in the framework of this poverty assessment largely confirmed the results of the statistical analysis.

Figure 43. Intensity and severity of poverty in selected years by provinces (1999-2016)



Source: Authors' computations.

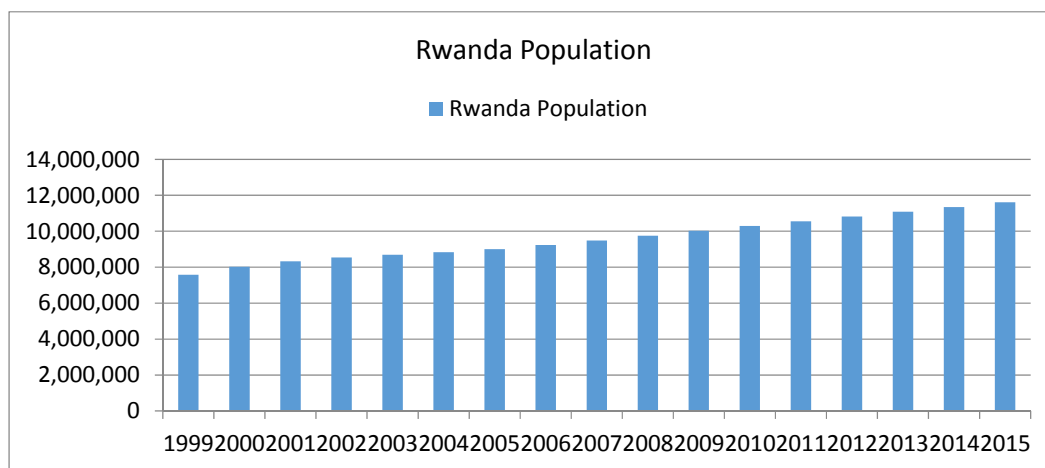
Agriculture is most frequently mentioned as the main driver of poverty reduction, followed by the growth of different kinds of savings and credit vehicles (cooperatives, village savings and loans associations, etc.) which are perceived as the main drivers of increased non-farm activities. The increased availability of contraception to limit family size is also a frequently mentioned driver of improved living standards (Rwanda Poverty Assessment, April 2015:17).

Measured by the United Nations' data for Rwanda from 1980 to 2015, the average index value of human development was 0.42 points with a minimum of 0.24 points in 1990 and a maximum of 0.51 points in 2013. The index is a composite measure including life expectancy, educational attainments and income levels. It measures not only income but life quality as well.

5. Demography and the labor market

The total population of Rwanda was 11,610,000 in 2015. As Figure 44 shows over the last 55 years this indicator reached a maximum level of 11,610,000 in 2015 starting from 2,933,424 in 1960. The figures are mid-year estimates (World Bank Report, 2016/

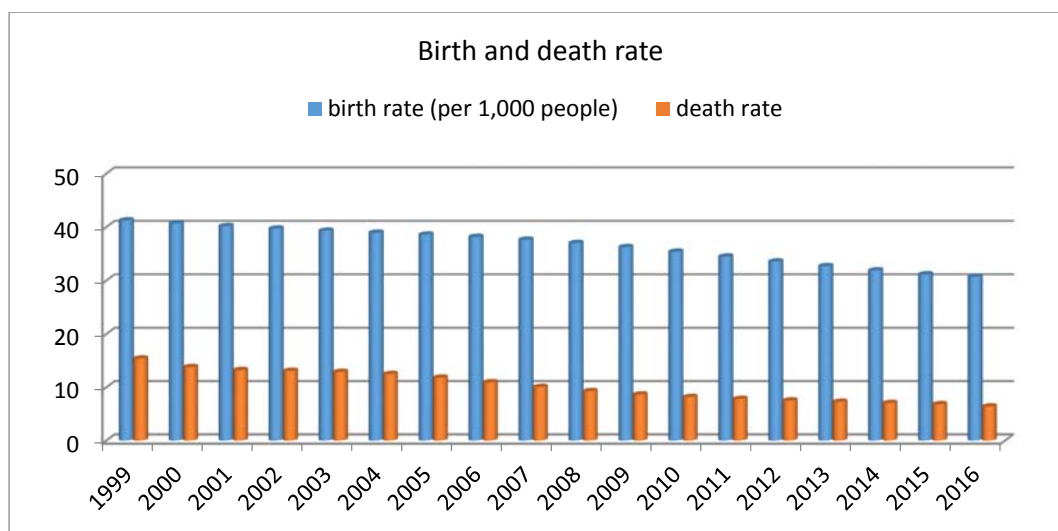
Figure 44. Rwanda's population (1999-2015)



Source: Authors' computations.

Fertility rate, or births per woman and death rate by the World Bank provided data from 1960 to 2014 is given in Figure 45. The average fertility rate was 6.97 births per woman with a minimum of 3.9 births per woman in 2014 and a maximum of 8.45 births per woman in 1979. The birth rate declined continuously in the post 1984 period. The birth rate per 1,000 people declined from around 40 in 1999 to 30 in 2016.

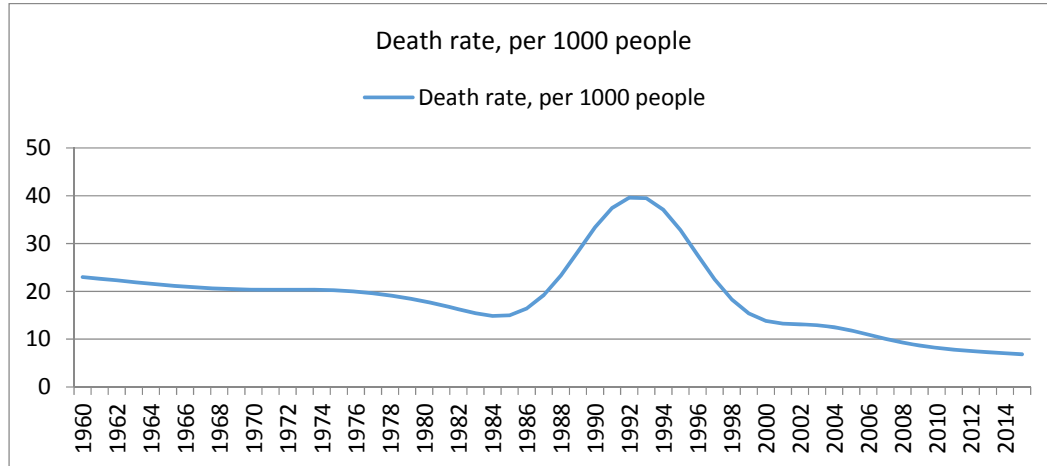
Figure 45. Birth and death rates



Source: Authors' computations.

Data for Rwanda from 1960 to 2015 shows that its death rate during the period was 18.99 deaths per 1,000 people with a minimum of 6.83 deaths per 1,000 people in 2015 and a maximum of 39.6 deaths per 1,000 people in 1992. The death rate has been declining since 1960 with an exception in the years related to the genocide (Figure 46) (Fourth Rwanda Population and Housing Census, 2012:19).

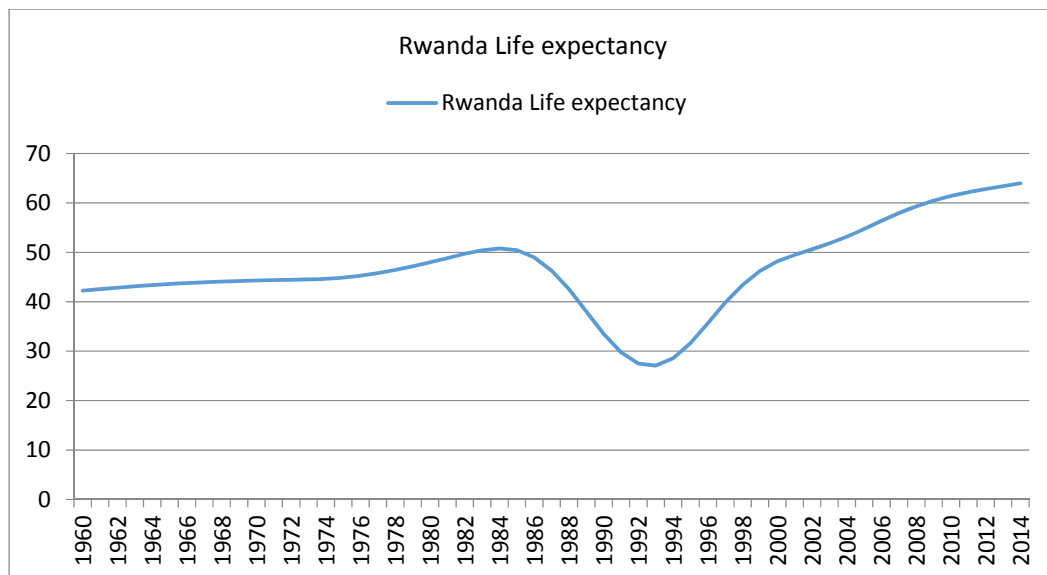
Figure 46. Death rate (1960-2015)



Source: Authors' computations.

The life expectancy data for Rwanda from 1960 to 2014 shows an opposite development compared to the death rate. The average life expectancy was 46.52 years with a minimum of 27.08 years in 1993 and a maximum of 63.97 years in 2014. The positive trend in life expectancy (except for the genocide period) is shown in Figure 47.

Figure 47. Life expectancy (1960-2014)

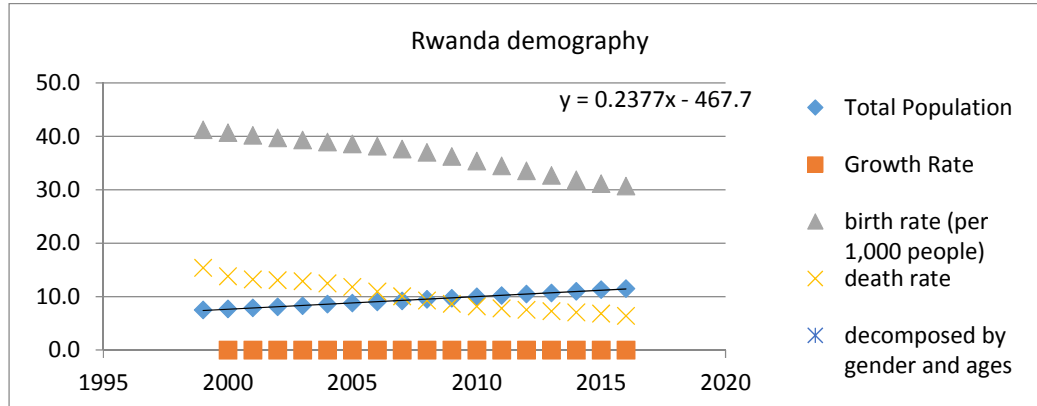


Source: Authors' computations.

5.1 Population

Rwanda's population in millions, its growth rate in percent, death rate per 1,000 people and birth rate per 1,000 population for the period 1999-2016 is reported in Figure 48. The figure shows a positive trend in total population, but negative trends in death rate, fertility rate and the population growth rate.

Figure 48. Population growth, fertility and death rates (1999-2016)

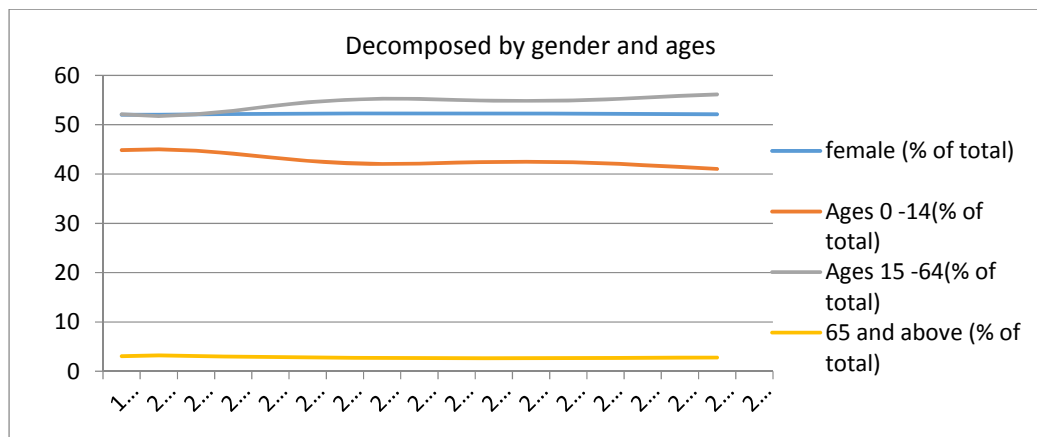


Source: Authors' computations.

As of 1 January 2017, the population of Rwanda was estimated at 12,033,749 people. This is an increase of 2.40 percent (or 282,385 people) compared to population of 11,751,364 in the previous year. In 2016 the net increase in the country's population was positive as the number of births exceeded the number of deaths by 298,485. Due to external migration the population declined by 16,099. The sex ratio was 0.965 (or 965 males per 1,000 females) which was lower than the global sex at 1,016 males to 1,000 females as of 2016. Figure 49 gives the decomposed population by gender and different age cohorts of children, the working age group and retired elderly for the period 1999-2015.

Figure 49 shows that the share of children in the total population decreased, while the share of the working age and the elderly increased over time. Dependency ratio of the population is a ratio of people who are generally not in the labor force (the dependents) of a country (the productive part of the population). The dependent part includes population under 15 years old and people aged 65 years and over. The productive part of the population consists of the population between 15 and 64 years (Fourth Rwanda Population and Housing Census).

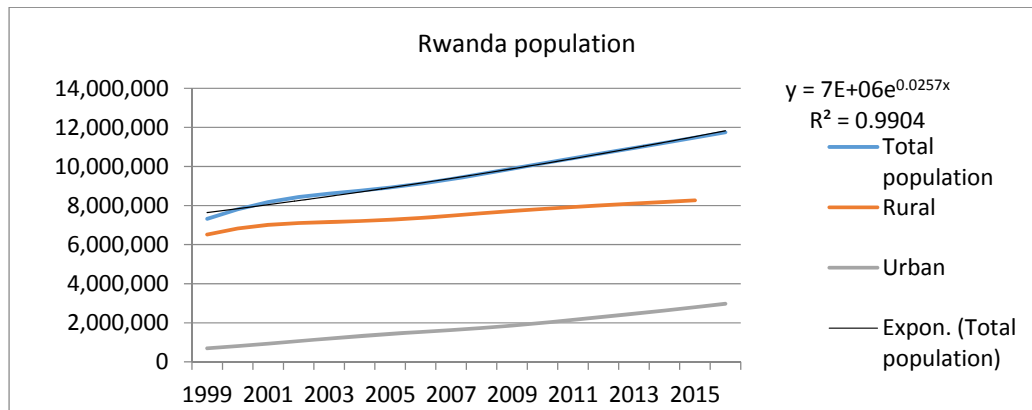
Figure 49. Population by gender and age groups (1999-2015)



Source: Authors' computations.

Rwanda's population density was 456.9 people per sq. km (1,183.3/mi²) as of September 2017. Density of population is calculated as the permanently settled population divided by the total area of the country. Rwanda's total area was 26,340 km² (10,170 mi²). The urban population was very small compared to the rural population but its growth rate was higher. In 2015 around 3 million people lived in urban areas while the remaining 9 million lived in rural areas (Figure 50).

Figure 50. Urban-rural population division (1999-2015)

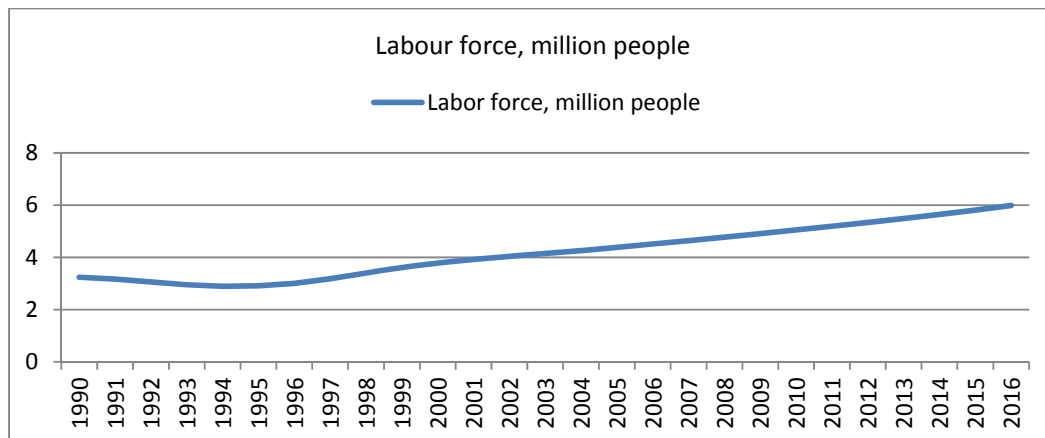


Source: Authors' computations.

5.2 Labor market

Labor force comprises people aged 15 years and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time job-seekers. Not everyone who works is included, however. Unpaid workers, family workers and students are often left out and some countries do not count members of the armed forces. Labor force size tends to vary during the year as seasonal workers enter and leave. The labor force in Rwanda is young and low-skilled. Half of the labor force is between 15 and 25 years of age.

Figure 51. Labor force (1990-2016)



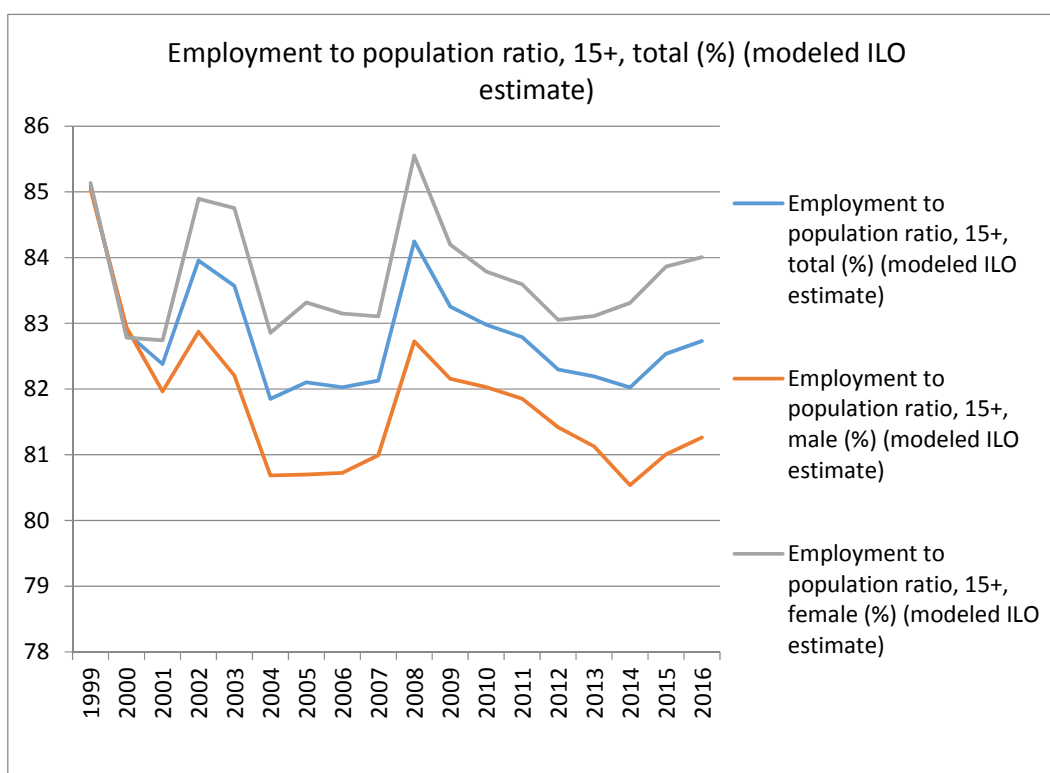
Source: Authors' computations.

Data on labor force participation suggests that from 1990 to 2016 the average labor force participation was 85.89 percent with a minimum of 84.15 percent in 2005 and a maximum of 88.98 percent in 1990.

Statistics also show that from 1990 to 2016 Rwanda had a labor force of 4.2 million people with a minimum of 2.89 million people in 1994 and a maximum of 5.99 million people in 2016. Figure 51 shows that this trend increased post the genocide.

Figure 52 provides information on the employment to population ratio of ages 15-64 years and its decomposition by gender for 1999-2016. The indicators changed over time mainly prior to 2009 but have been more stable post the 2008 crisis.

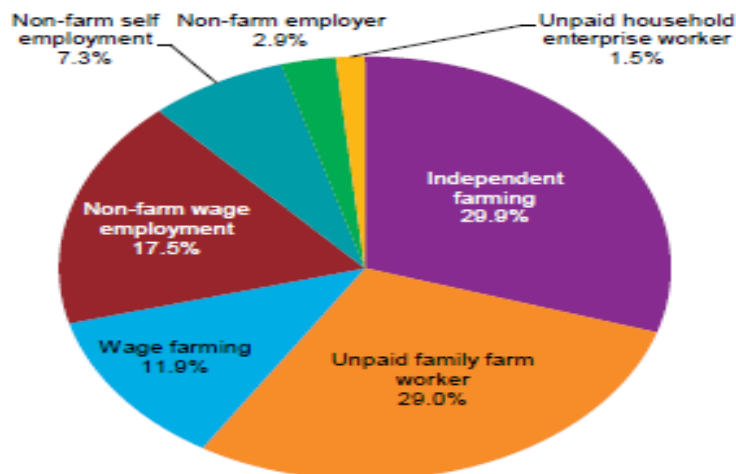
Figure 52. Employment to population ratio, 15+, total and by gender (1999-2016)



Source: Authors' computations.

Agriculture and the informal sector provide employment to a bulk of working Rwandans. Independent family farming (people cultivating their own or their family's land without a wage) represents the main employment for 2.9 million working-age Rwandans, accounting for almost 60 percent of overall employment. Wage farming (people cultivating other people's land for a wage) provides employment to another 0.6 million people (12 percent of total employment). Taken together, 70 percent of the workers have their main occupation in agriculture (the sum of the shares of independent farming, unpaid family farming and wage farming (Figure 53) (Rwanda Economic Update: Edition 9, 2016:34).

Figure 53. Proportion of workers by employment type in agriculture (2011)

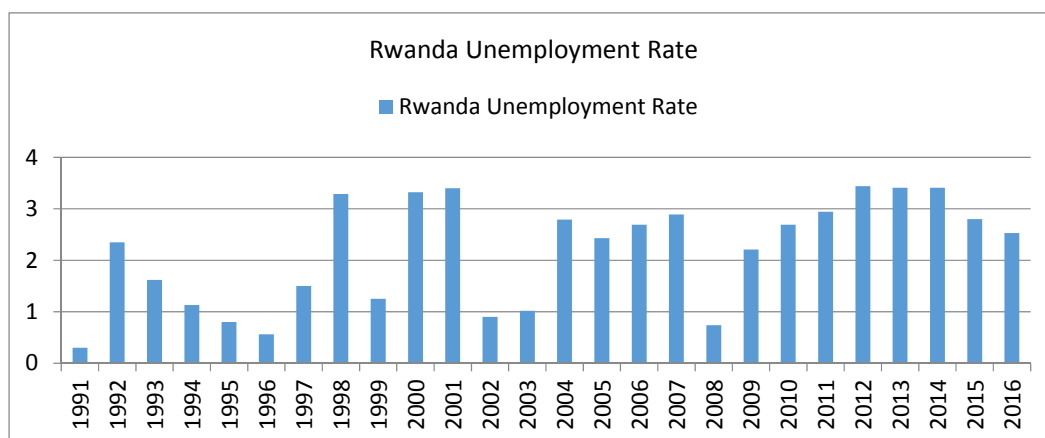


Source: Authors' computations.

5.3 Unemployment

The unemployment rate measures the number of people actively looking for a job as a percentage of the labor force. The data for 1991-2016 shows that the unemployment rate during the period was 2.17 percent with a minimum of 0.3 percent in 1991 and a maximum of 3.44 percent in 2012 (Figure 54). The unemployment rate seldom declines below the natural rate of unemployment, or the 10-year average rate of unemployment. There are always people who move between different sectors of the economy or between cities. When the economy goes into recession, unemployment can reach much higher numbers and during a boom it declines to low levels.

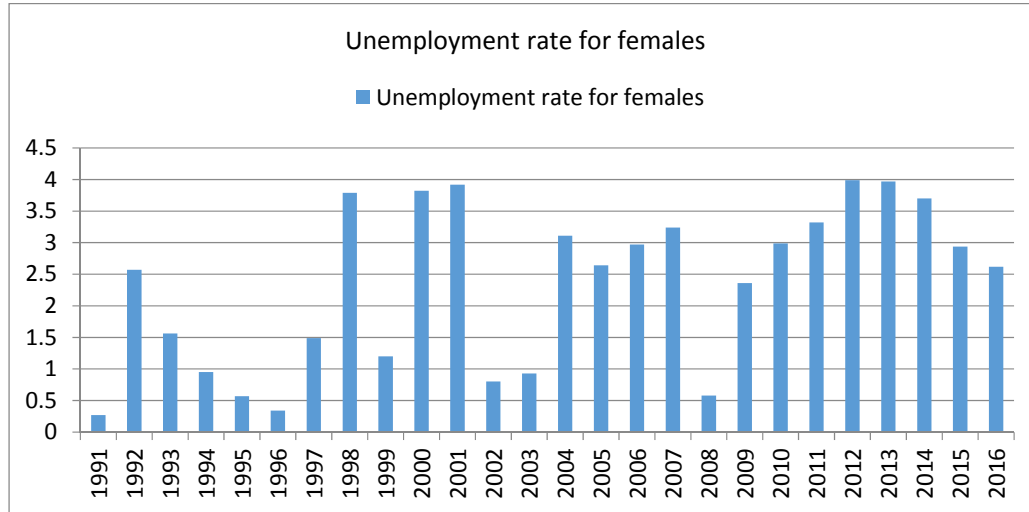
Figure 54. Unemployment rates (1991-2016)



Source: Authors' computations.

The unemployment rate differs significantly by gender. Statistics in Figure 55 for the period 1991 to 2016 show that the average unemployment rate for females was 2.33 percent with a minimum of 0.27 percent in 1991 and a maximum of 3.99 percent in 2012.

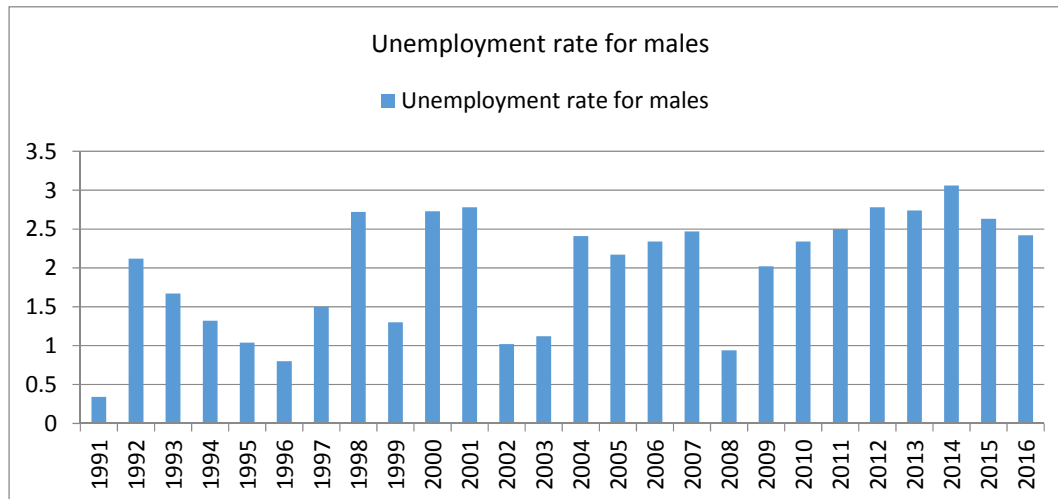
Figure 55. Female unemployment rate (1991-2016)



Source: Authors' computations.

Figure 56 shows that the unemployment rate for males was lower than that for females from 1991 to 2016. The average unemployment rate for males during the period was 1.97 percent with a minimum of 0.34 percent in 1991 and a maximum of 3.06 percent in 2014. The pattern of change over time is business cycle related and similar among males and females.

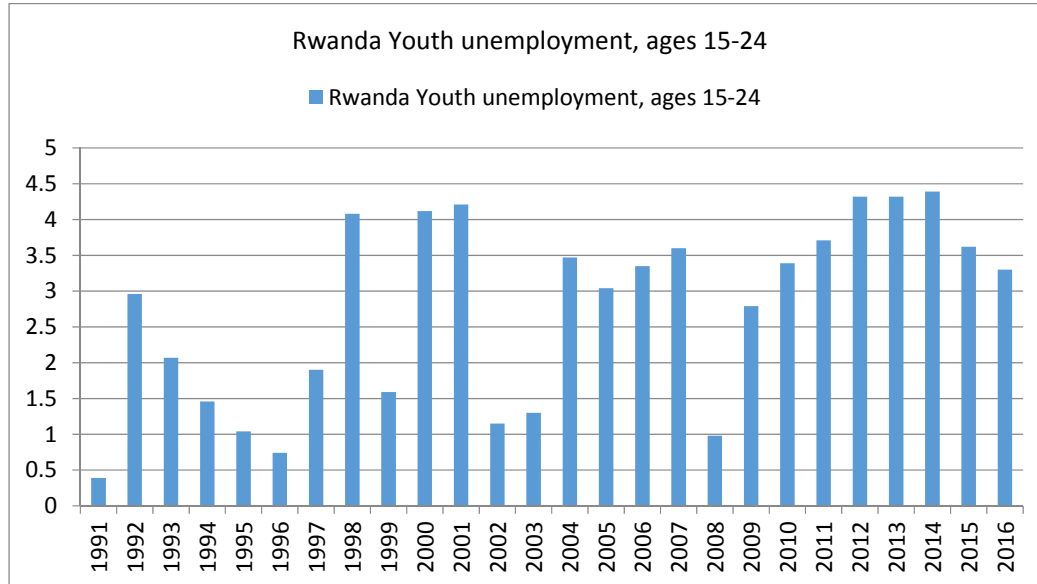
Figure 56. Male unemployment rate (1991-2016)



Source: Authors' computations.

Youth unemployment is a major issue in most countries. In Rwanda the rate of unemployment is higher than the average for the working age population. Figure 57 covering the period 1991 to 2016 shows that the average youth unemployment rate, aged 15-24 years, was 2.74 percent with a minimum of 0.39 percent in 1991 and a maximum of 4.39 percent in 2014. The development follows the same patterns as those of higher ages of 25 years and above.

Figure 57. Youth unemployment (15-24 years)

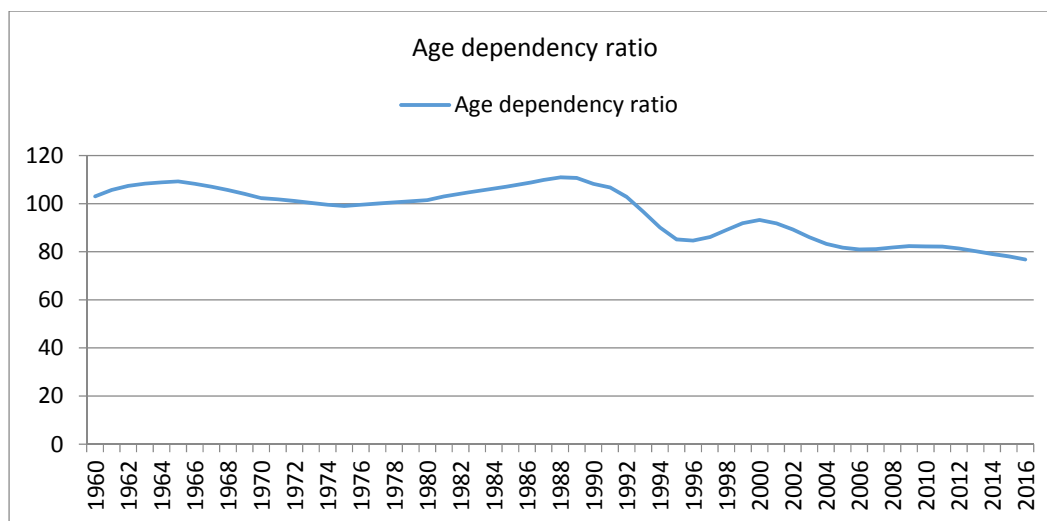


Source: Authors' computations.

5.4 Dependency ratio

Dependent people are measured as a percentage of the working age population. The age dependency ratio is calculated as the ratio of people younger than 15 years and older than 64 years divided by working age people aged 15-64 years. A higher value means that employed people have to support more non-working people, either young or old. Figure 58 shows that from 1960 to 2016 the average dependency ratio was 96.37 percent with a minimum of 76.79 percent in 2016 and a maximum of 110.92 percent in 1988.

Figure 58. Age dependency ratio (1960-2016)



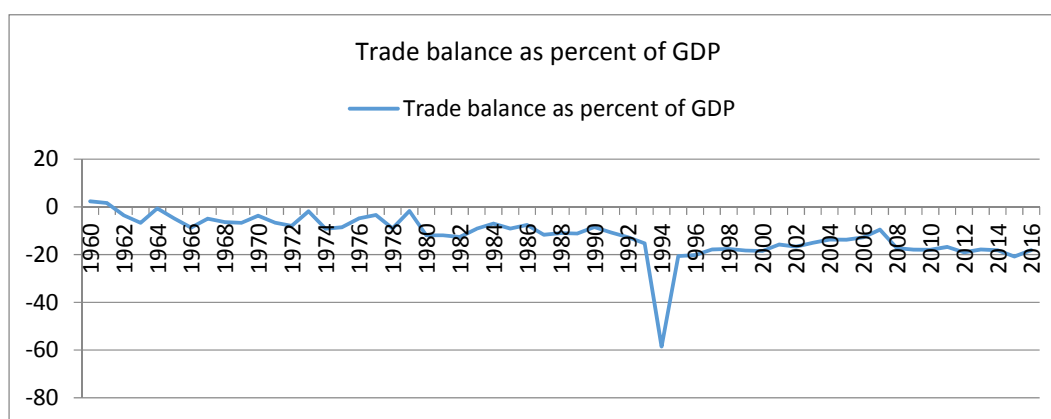
Source: Authors' computations.

6. The external sector

6.1 Trade balance

The recent development of the external sector calls for careful monitoring. The balance of payments (BoP), summarizing an economy's transactions with the rest of the world, significantly deteriorated in 2014. The current account deficit deteriorated from 7.4 percent of GDP in 2013 to 11.8 percent in 2014, the worst since at least 1998. The decline in public current transfers (mainly grant aid) contributed more than half to the deterioration. The World Bank data for Rwanda from 1976 to 2015 on the trade balance is given in Figure 59 and Table 27. Trade balance is calculated as the difference between the exports and imports of goods and services as percent of GDP. A positive number means a trade surplus and a negative number means a trade deficit. The average trade balance for Rwanda during the period was US\$ -0.45 billion with a minimum of US\$ -1.5 billion in 2013 and a maximum of US\$ -0.03 billion in 1976.

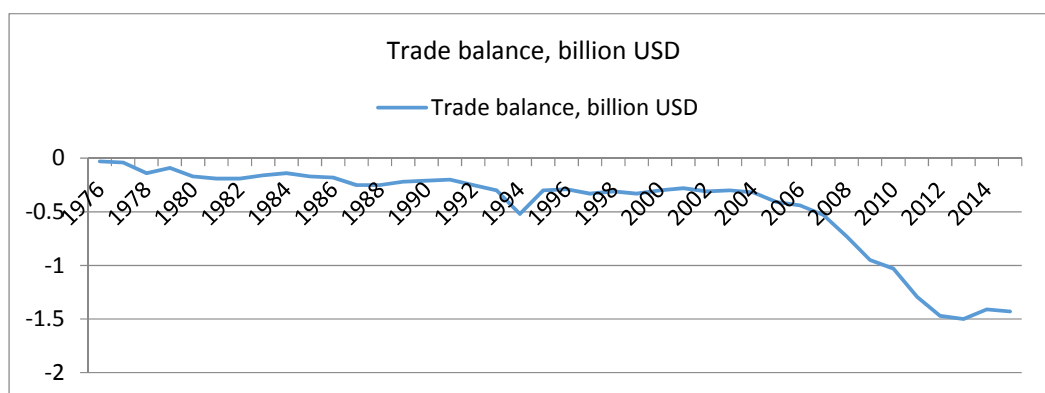
Figure 59. Trade balance (1960-2016)



Source: Authors' computations.

Figure 60 gives Rwanda's trade balance. The data from 1976 to 2015 shows that Rwanda's average trade balance during the period was US\$ -0.45 billion with a minimum of US\$ -1.5 billion in 2013 and a maximum of US\$ -0.03 billion in 1976.

Figure 60. Trade balance (1976-2015, in billion USD)



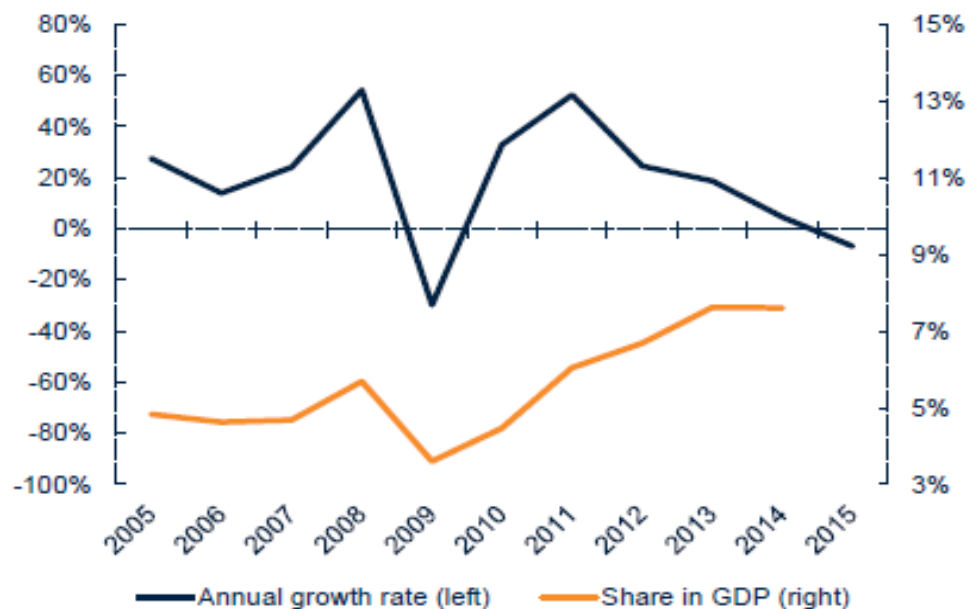
Source: Authors' computations.

6.2 Trade openness

Export growth rates have been decelerating in the past few years. After a significant decline (-29.8 percent) in 2009 due to the global financial crisis, exports grew by 32.8 percent in 2010. However, export growth rates continued to decelerate and turned negative (-6.8 percent) in 2015. Although the 2015 national account data has not yet been published, the share of exports in the economy in 2015 is likely to fall from its 7.6 percent share of GDP in 2014 (BNR/Rwanda Economic Update 9, 2016:16)

In 2015, Rwanda's export growth rate was -6.8 percent. Developments since 2013 clearly show a downward trend (Figure 61). While tea (40.0 percent) showed positive growth rates, mineral exports fell by 42.1 percent and accounted for more than 200 percent of the total decline in exports. Mineral exports declined due to a combination of price (-16.7 percent) and volume (-30.5 percent). However, the increase in volume of re-exports (50.5 percent) more than offset the decreased prices of re-exports. As DRC is the main export destination for Rwanda's re-exports, this increased volume reflects DRC's strong growth. The significant growth in tea exports is due to a combination of volume increase (8.9 percent) and price (28.6 percent) (BNR/Rwanda Economic Update 9, 2016:16).

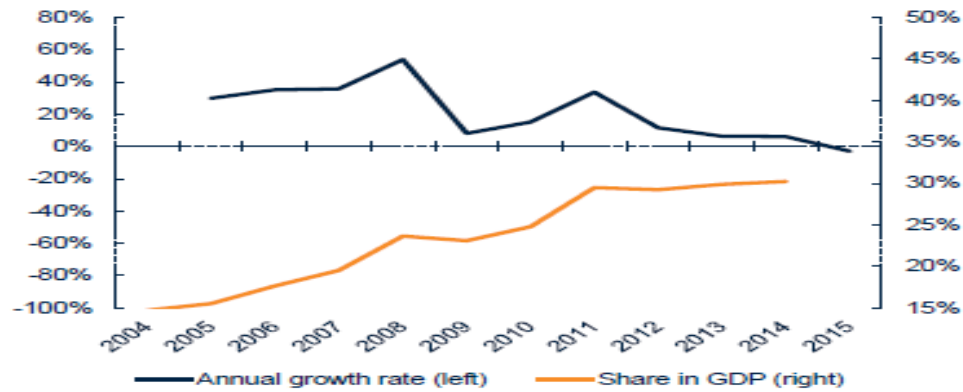
Figure 61. Decelerating export growth (2005-15)



Source: Authors' computations.

Rwanda's import structure has remained almost unchanged in the past decade with imports of consumer goods, capital goods and intermediary goods being almost equally divided. Fluctuations in the share of energy imports may be a result of price changes. Like export trends, import growth rates decelerated from their recent peak at 33.8 percent in 2011 to -2.8 percent in 2015 registering a negative import growth for the first time since 2002. As a result, the share of imports in the economy is likely to decelerate in 2015 (Figure 62) (BNR/Rwanda Economic Update 9, 2016:16).

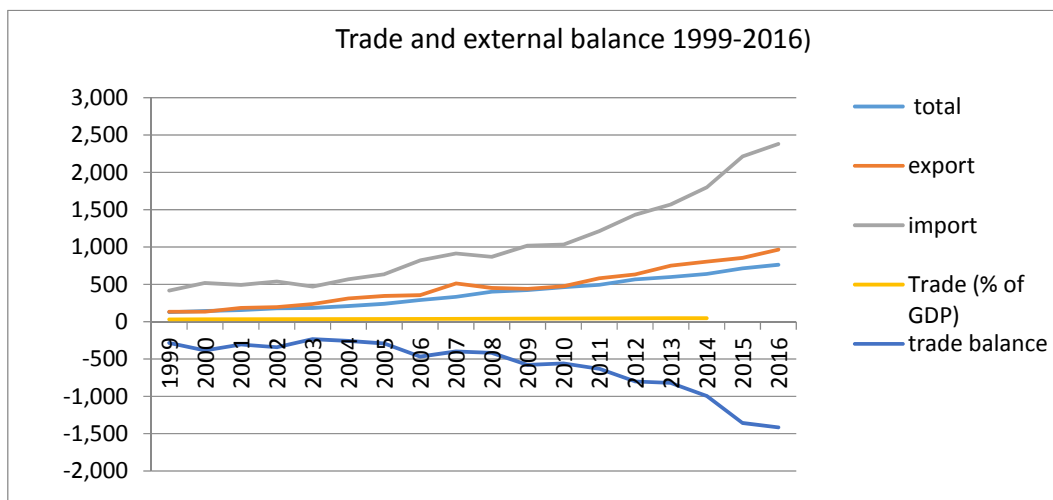
Figure 62. Decelerating import growth (2004-15)



Source: Authors' computations.

The overall balance has turned negative (Figure 63), which means that international reserves in absolute value have fallen. In the first four months of 2015, there were a few signs of export recovery in formal trade data. The figures show that trade increased over time. However, a large gap between imports and exports led the large and growing trade deficit. Trade as share of GDP was also relatively small. Development of informal cross-border trade will have to be carefully monitored as well. The government has formulated the revised National Export Promotion Strategy to revive the export sector.

Figure 63. Trade and external balance (1999-2016)



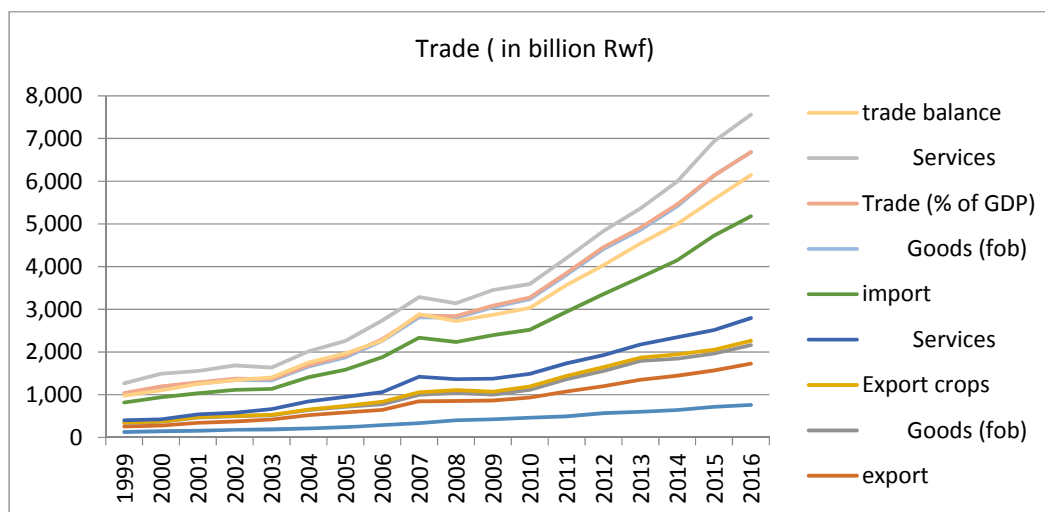
Source: Authors' computations.

Rwanda has had persistent trade deficits in the last decade. As the import growth rates have been higher than those of exports, the trade deficit has been widening. It increased from US\$211 million (10.1 percent of GDP) in 2004 to US\$1.8 billion in 2014 and 2015 (Figure 64 and Table 28) (BNR/Rwanda Economic Update 9, 2016:19).

However, trade deficit as a share of GDP has been stable since 2011. The high and widening trade deficit reflects the development of the tradable sectors the share of which fell from 47 percent in 2004 to 39 percent in 2014 in the economy. In 2015, the trade

deficit reduced by 1.3 percent. The decline in imports (US\$67 million) exceeded that in exports (US\$42 million) (Tables 29 and 30).

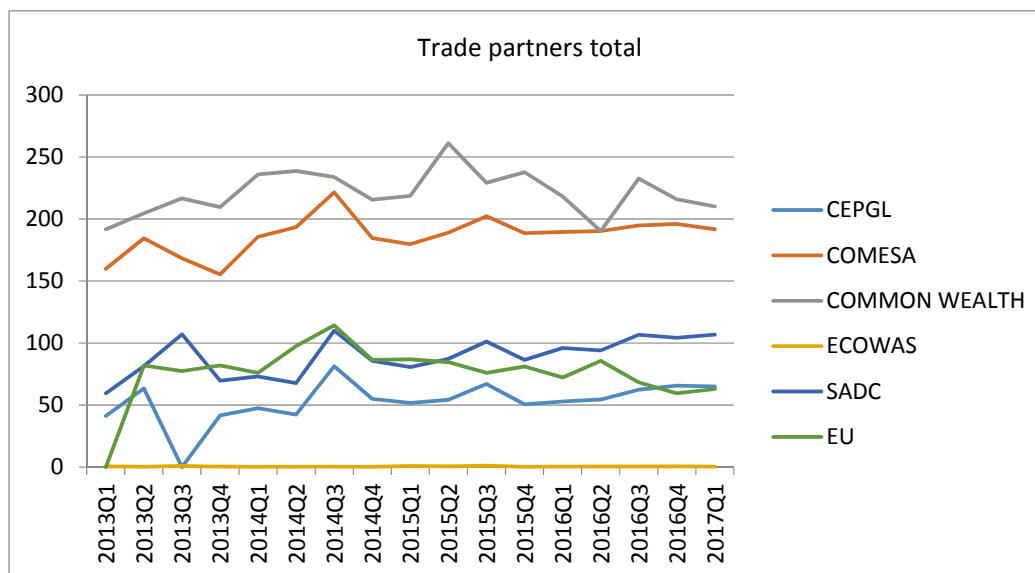
Figure 64. Rwandan trade (in billion Rwf)



Source: Authors' computations.

Rwanda's trade with its partners during 2013Q1-2017Q1 is shown in Figure 65 and Table 31. The trade flows changed over time; while trade with COMESA remained stable, it increased with SADC but decreased with EU over time.

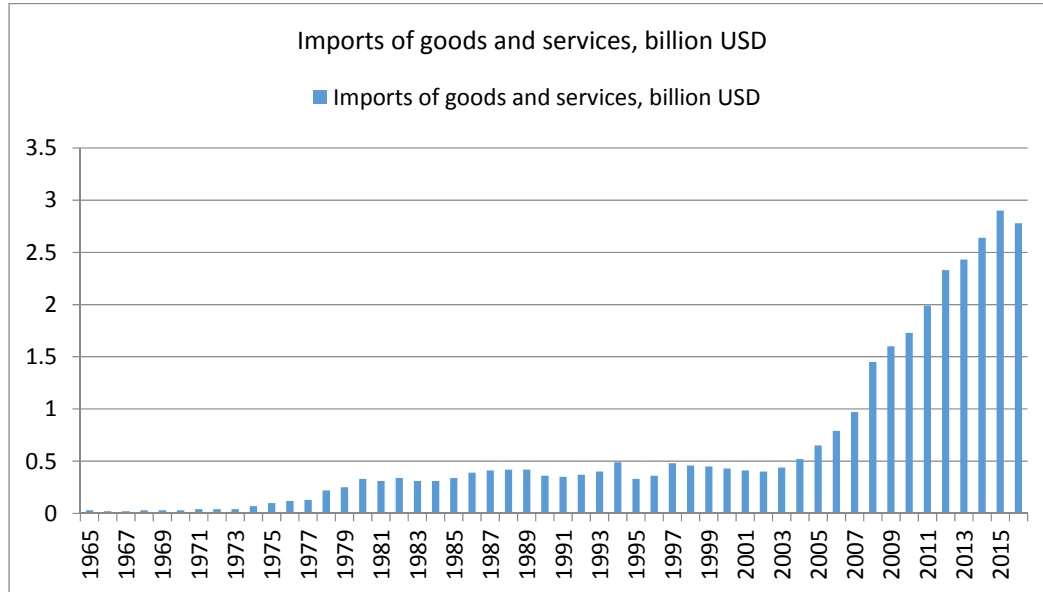
Figure 65. Trade partners' total



Source: Authors' computations.

Figure 66 and Tables 32-34 show that Rwandan imports of goods and services is increasing. Figures suggest that from 1960 to 2016 Rwanda's average imports were US\$ 0.58 billion with a minimum of US\$ 0.01 billion in 1960 and a maximum of US\$ 2.78 billion in 2016.

Figure 66. Imports of goods and services (in billion USD)



Source: Authors' computations.

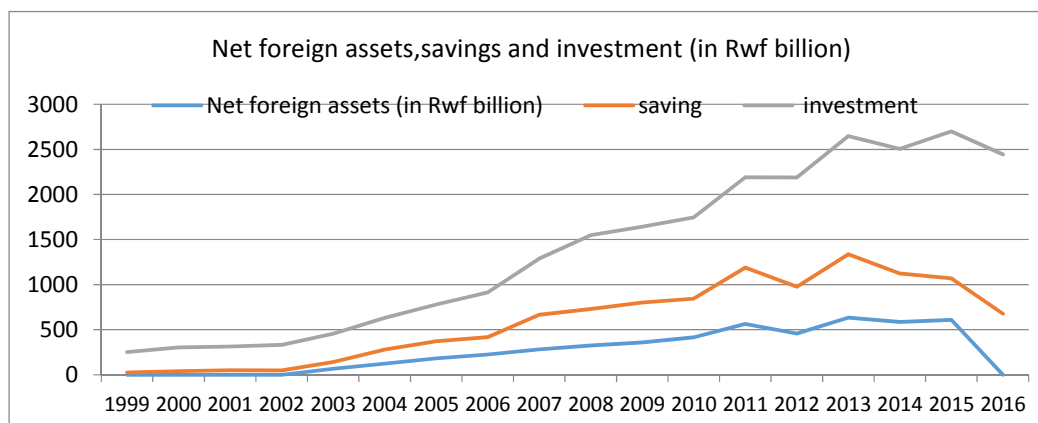
7. International relations

Foreign aid has been an important ingredient in Rwanda's progress. Over the past decade Rwanda has received significantly more aid than other African countries and has used it effectively to boost development. While Rwanda's ability to attract this level of aid is a result of the tangible results on the ground, the dependence on aid accounted for between 35 and 40 percent of the budget which made progress vulnerable to fluctuations in external assistance and the amount that the national government owes to domestic and international lenders. We report it as percent of GDP so that we can evaluate its magnitude relative to the size of the economy. Government debt of about 60 percent or less of GDP is not considered a problem as the government can make payments without any strain and even have some room to borrow more. If debt levels reach 80-90 percent that may have negative effects on the economy. Debt above 120 percent of GDP is detrimental to the development of the country.

7.1 Finances

Figure 67 and Table 35 show net foreign assets, savings and investments in Rwanda in 1999-2016. Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government. The figure shows that investments exceeded savings by the amount of net foreign assets which was positive during the entire period from 2002 to 2016.

Figure 67. Net foreign assets, savings and investment (1999-2016, in Rwf billion)



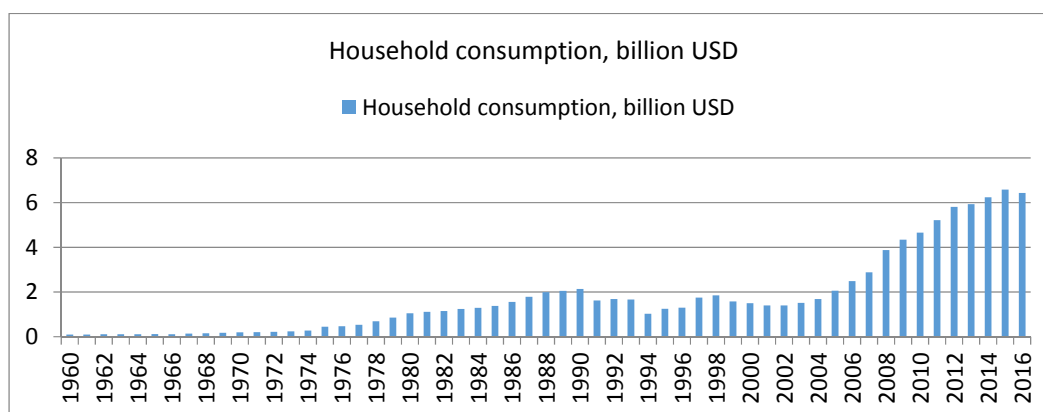
Source: Authors' computations.

Credit growth can be seen across key sectors. In the service sector, credit growth in the commerce, business and hotels sub-sectors increased from 14.6 percent in the second half of 2013 to 22.9 percent in the first half of 2014. Credit growth in the industry sub-sectors increased in the first half of 2014, with credit to the construction sub-sector growing 57.8 percent, up from -3.6 percent in the second half of 2013. However, credit growth in the construction sub-sector did not result in high sectoral growth because of continued delays in the government's construction activities. Credit to the manufacturing sub-sector also increased.

7.2 Private sector finances

Household final consumption expenditure is the market value of all goods and services including durable products purchased by households. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. It also includes payments and fees to the government for permits and licenses. Figure 68 shows that the average household consumption was US\$ 1.75 billion with a minimum of US\$ 0.1 billion in 1960 and a maximum of US\$ 6.43 billion in 2016.

Figure 68. Household consumption (1960-2016, in billion USD)

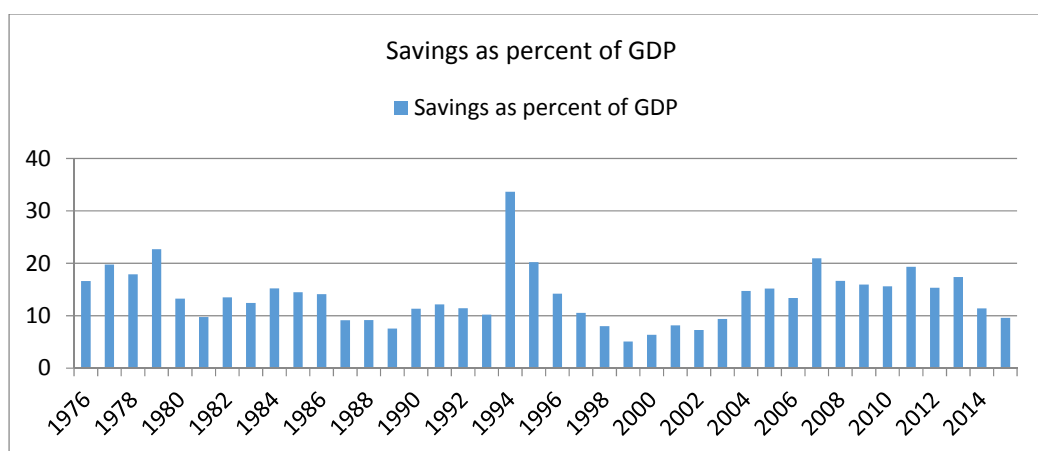


Source: Authors' computations.

Rwanda's saving rate is relatively high and a challenge for the country, especially due to a likely decline in the aid part of foreign savings in the coming period. According to the latest debt sustainability analysis (DSA), in late 2014 it became apparent that external grants, as a share of GDP were projected to decline from 8.6 percent in 2013 to 3.3 percent in 2018, when EDPRS 2 gets over although part of this reflects a shift from grants to loans. In other words, all things being equal, to maintain the same level of investments, alternative financing sources of about 5 percent of GDP will have to be found from a combination of domestic and foreign savings.

Statistics for Rwanda from 1976 to 2015 show that average savings as percent of GDP during this period were 13.73 percent with a minimum of 5.08 percent in 1999 and a maximum of 33.66 percent in 1994 (see Figure 69). The saving rate varied mainly in the interval of 5 to 20 percent of GDP.

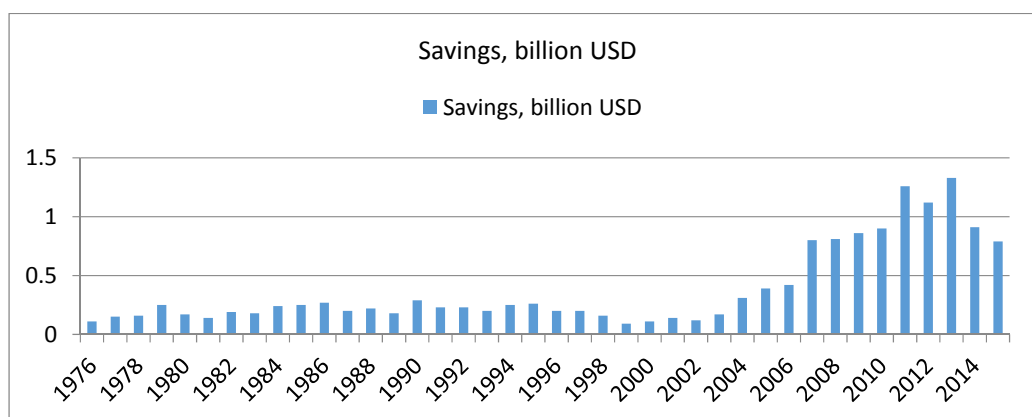
Figure 69. Savings as percent of GDP (1976-2015)



Source: Authors' computations.

The total savings are shown in Figure 70 which on average were US\$ 0.38 billion with a minimum of US\$ 0.09 billion in 1999 and a maximum of US\$ 0.79 billion in 2015. This amount is declining in recent years due to a decline in the aid received.

Figure 70. Rwanda's savings (1976-2015, in billion USD)



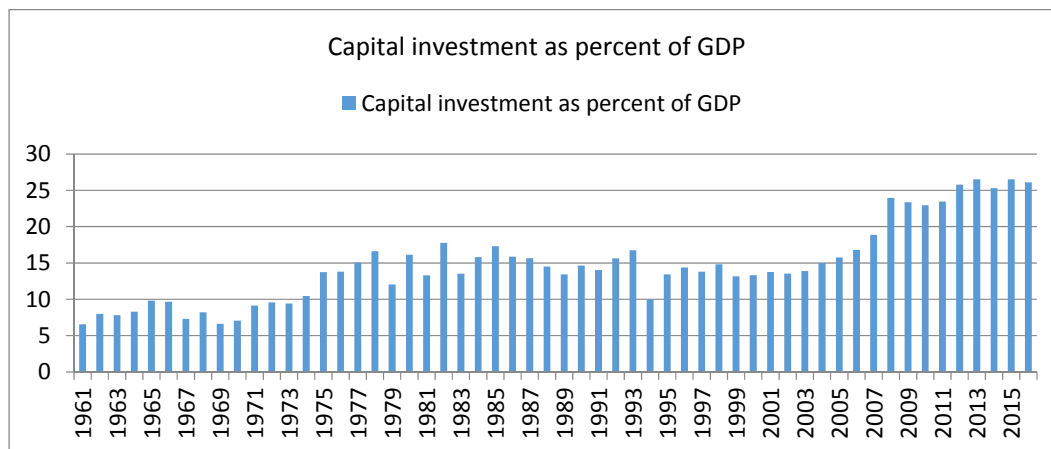
Source: Authors' computations.

Capital investments in Rwanda and other countries are calculated as the purchase of new plant and equipment by firms as percent of GDP. A high number is good for long-term economic growth as current investments lead to greater future production. Gross capital formation consists of outlays on additions to the economy's fixed assets plus net changes in the level of inventories. Fixed assets include land improvements, purchase of plant, machinery and equipment and the construction of roads, railways and the like.

In 2010-14, investments (gross fixed capital formation) as a share of GDP reached 24.2 percent. Private investments accounted for 10.9 percent and government (public) investments accounted for 13.4 percent. Investments should be financed by savings. Thus, savings (including both domestic and foreign) are equal to investments and the saving rate should also be 24.2 percent of GDP. Of the saving rate, the gross domestic saving rate (GDP minus consumption) was 9.2 percent. Thus, the foreign saving rate should equal 15.1 percent (Rwanda Economic Update 8, 2015:28).

Figure 71 shows capital investments as share of GDP from 1960 to 2016. The average GDP share was 14.63 percent with a minimum of 6.05 percent in 1960 and a maximum of 26.52 percent in 2013.

Figure 71. Capital investments (1961-2016, in percent of GDP)



Source: Authors' computations.

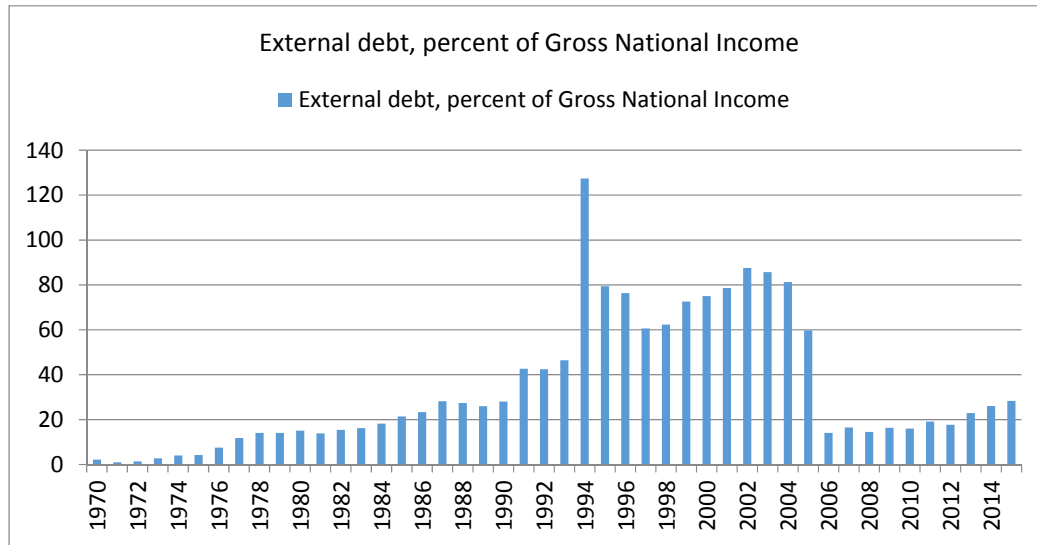
Rwanda's external debt is reported as the country's total international obligations as percent of its GDP. External debt of less than 60 percent of GDP is less of a problem but at higher levels paying the interest on the debt may become difficult.

The expenditure account consists of domestic demand (private consumption, government consumption and gross fixed capital formation) and external demand (exports minus imports). Domestic demand contributed 9.9 percentage points to the overall growth rate of 7.1 percent. External demand reduced growth by 2.8 percentage points.

Total external debt is the sum of public, publicly guaranteed and private non-guaranteed long-term debt, use of IMF credit and short-term debt. Total external debt is debt owed to non-residents repayable in currency, goods or services. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. GNI is the sum of value added by all resident producers plus any product taxes not included in the valuation of output plus net receipts of primary income from abroad.

Figure 72 shows that external debt as percent of GNI on average was 34.05 percent with a minimum of 0.9 percent in 1971 and a maximum of 127.41 percent in 1994.

Figure 72. Total external debt (1970-2015, as percent of GNI)

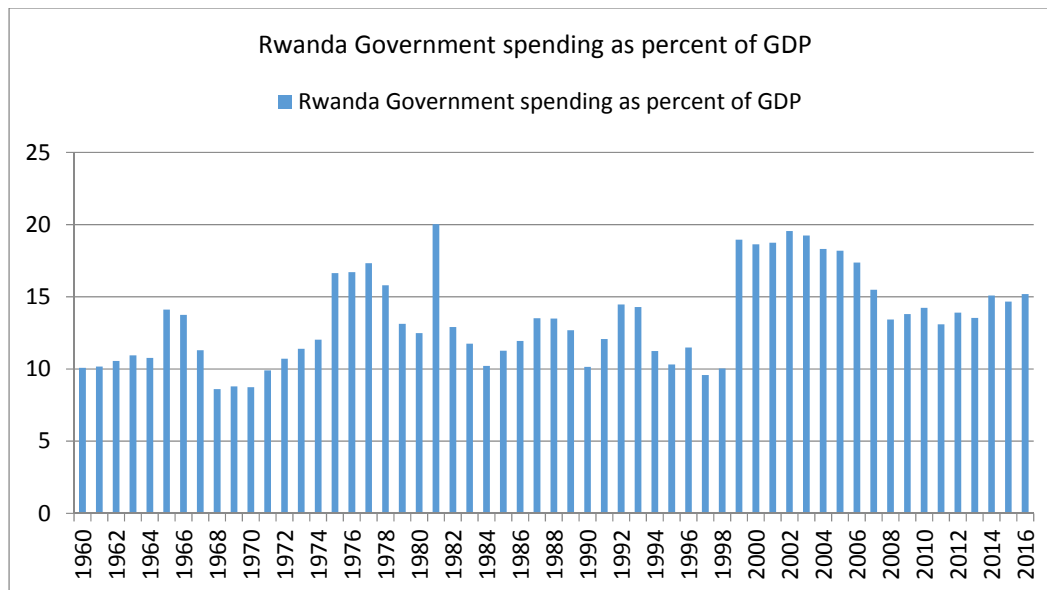


Source: Authors' computations.

7.3 Public sector finances

The government's size is calculated as the total government spending as percent of GDP (Figure 73). General government final consumption expenditure includes all government current expenditure on purchase of goods and services. It also includes most expenditures on national defense and security.

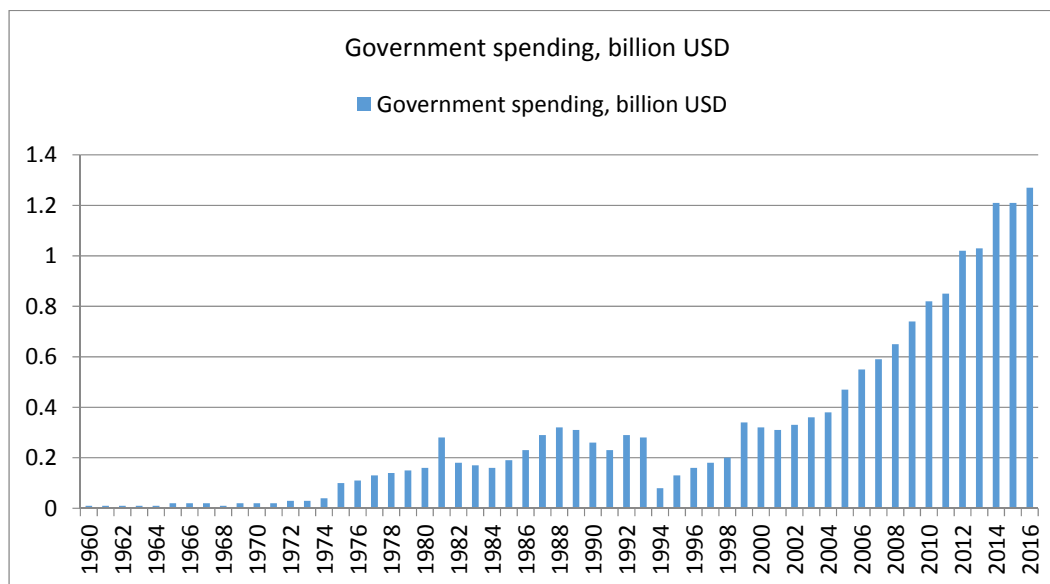
Figure 73. Government expenditure (1960-2016, as percent of GDP)



Source: Authors' computations.

General government final consumption expenditure is shown in Figure 74. The data for 1960 to 2016 shows that the average government expenditure was US\$ 0.31 billion with a minimum of US\$ 0.01 billion in 1960 and a maximum of US\$ 1.27 billion in 2016.

Figure 74. Government spending (1960-2016, in billion USD)



Source: Authors' computations.

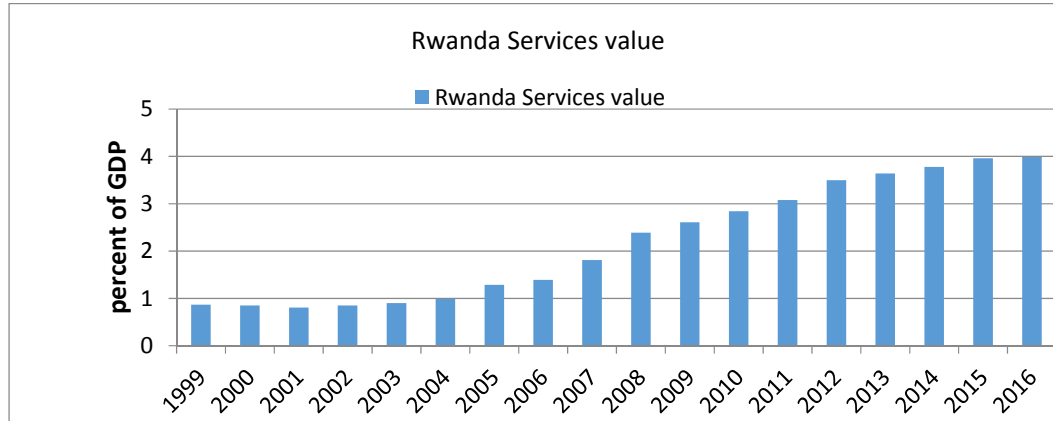
7. The service sector's development

Services correspond to ISIC divisions 50-99. The information includes value added in wholesale and retail trade (including hotels and restaurants), transport and government, financial, professional and personal services such as education, healthcare and real estate services. Also included are imputed bank service charges, import duties and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources.

The available data suggests that from 1965 to 2016 the yearly average growth for Rwanda's service sector was US\$ 1.06 billion with a minimum of US\$ 0.02 billion in 1966 and a maximum of US\$ 3.99 billion in 2016. Growth in the service sector fell from 11.5 percent in 2012 to 5.4 percent in 2013. As a result, the economy grew by just 4.7 percent in 2013.

The service sector has been the single biggest contributor to Rwanda's economic growth since 2003 and accounted for 47 percent of GDP growth. Its contribution was 9.1 percent in the first three quarters of 2014, up from 5.4 percent in 2013 (Figure 75 and Table 36). Due to its high share in the economy the service sector contributed to the overall growth by 4.4 percentage in the first three quarters of 2014, up from 2.6 percentage points in 2013. Higher government consumption in the first half of 2014 contributed to accelerated growth for Rwanda (Rwanda Economic Update 8, 2015:65).

Figure 75. Services' value (1999-2016, as percentage of GDP)

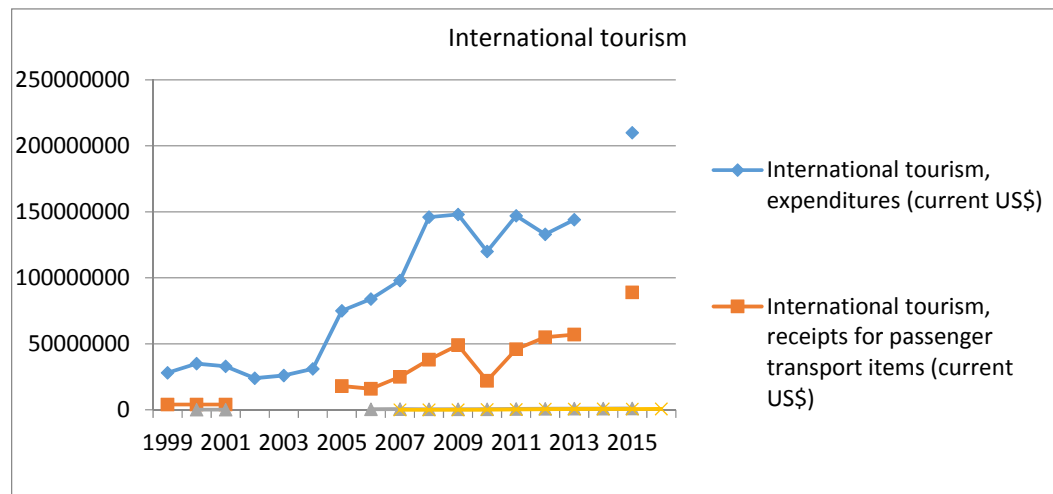


Source: Authors' computations.

8.1 Tourism

Between 2010 and 2014, the total number of tourists to Rwanda increased from 604,000 to 1.22 million with an annual growth rate at 19 percent. In 2014, the main purpose of visiting Rwanda was visiting families and relatives (33 percent) followed by business (32 percent) and transit/others (26 percent) with holidays or vacations accounting for 9 percent (Figure 76 and Table 37).

Figure 76. Rwanda's International tourism (1999-2016)



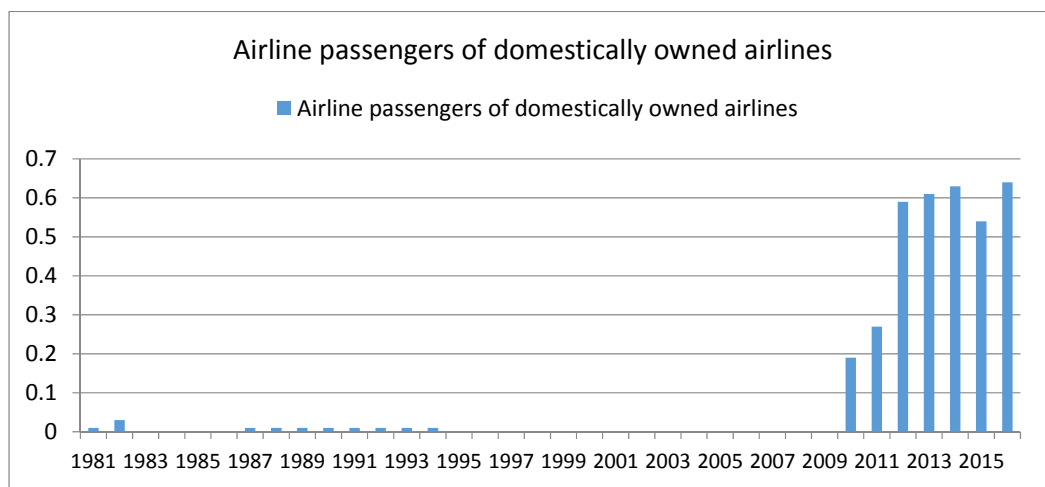
Source: Authors' computations.

Travel for transit and other reasons increased by 85 percent on an annual basis. The government has placed emphasis on MICE (meetings, incentives, conferences and events) and hence tourists with a business purpose increased by 7 percent on an annual basis. In 2014, the total number of tourists reached 1.29 million, higher by 8.7 percent compared to 1.12 million in 2013. Nationals from African countries accounted for 89 percent followed by Europe (5 percent) and America (3 percent). EAC countries had the dominant share of 43 percent (Rwanda Economic Update 8, 2015: 65).

Total revenue from tourism increased from US\$200 million in 2010 to US\$304 million in 2014 with an annual average growth rate of 11 percent. While tourists coming for holidays and vacations accounted for only 9 percent of the total tourists, they generated 47 percent of the total revenue. On the other hand, those visiting families and relatives generated 12 percent of the total revenue, despite being 33 percent of the total. Tourists for holidays and vacations spent US\$1,374 per person, per visit, while those visiting families and relatives spent US\$95 per person, per visit.

The International Civil Aviation Organization provides data from 1981 to 2016 which shows that average number of tourists during this period was 0.17 million with a 0 minimum of passengers in 1986 and a maximum of 0.64 million passengers in 2016 (Figure 77 and Tables 38 and 39).

Figure 77. Air passengers (1981-2016, in million)



Source: Authors' computations.

Quality of air transport infrastructure is measured by the scale: 1(low)-7(high). World Economic Forum provides data for Rwanda's air transport infrastructure from 2010 to 2015 which shows an average of 4.21 points with a minimum of 3.92 points in 2010 and a maximum of 4.45 points in 2015. The quality shows a positive and improving trend.

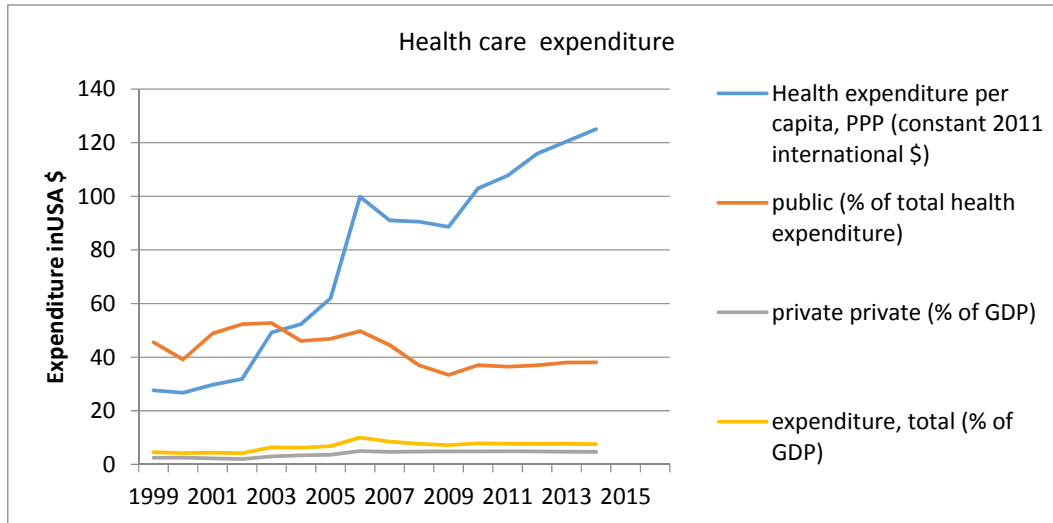
The quality of roads is measured by the scale: 1(low)-7(high). Data from the World Economic Forum from 2010 to 2015 shows Rwanda's average at 4.68 points with a minimum of 4.15 points in 2010 and a maximum of 4.96 points in 2012. The road quality indicator is one of the components of the Global Competitiveness Index. It represents an assessment of the quality of roads in a given country based on global survey data. Transport and road quality and accommodations can be a constraint on tourist inflows (Rwanda Economic Update 7, 2015:55/Rwanda Development Board).

8.2 Healthcare

According to a Ministry of Health report, the health expenditure per capita PPP increased from 22.67 in 1999 to 125.1 in 2016. In 2015, the number of medical doctors was 742 up from 709 in 2014 and the number of population per one doctor was 15,479 up from 15,510 in 2014. The number of nurses as well as hospitals also increased. This shows the

contribution of the government's health expenditure to improve the lives of people. The share of private spending on healthcare increased while the public share remained almost constant (Figure 78 and Table 40) (World Health Organization Global Health Expenditure database).

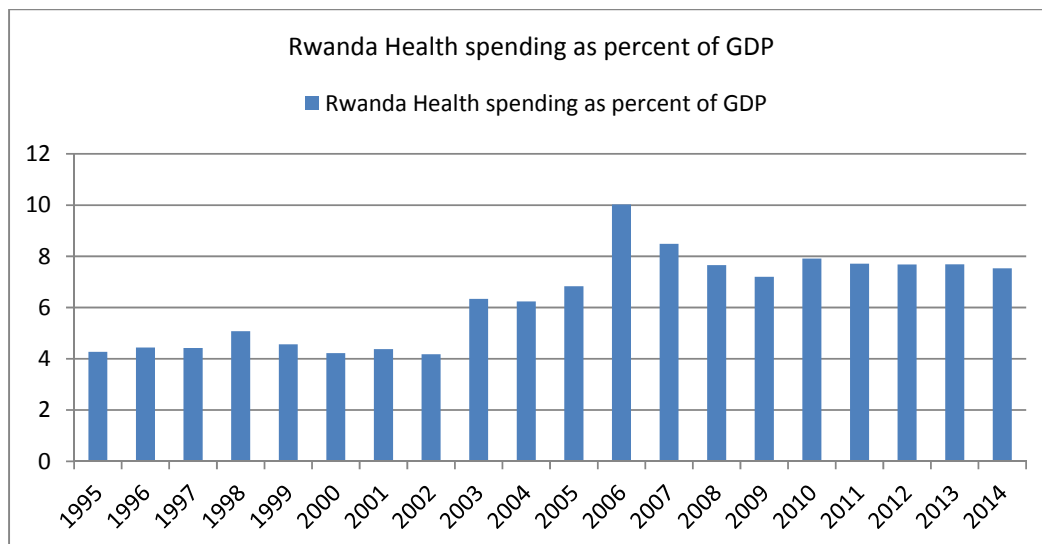
Figure 78. Healthcare expenditure (1999-2014)



Source: Authors' computations.

Data on healthcare spending as percent of GDP from 1995 to 2014 shows that it was 6.34 percent on average with a minimum of 4.18 percent in 2002 and a maximum of 10.02 percent in 2006 (Figure 79).

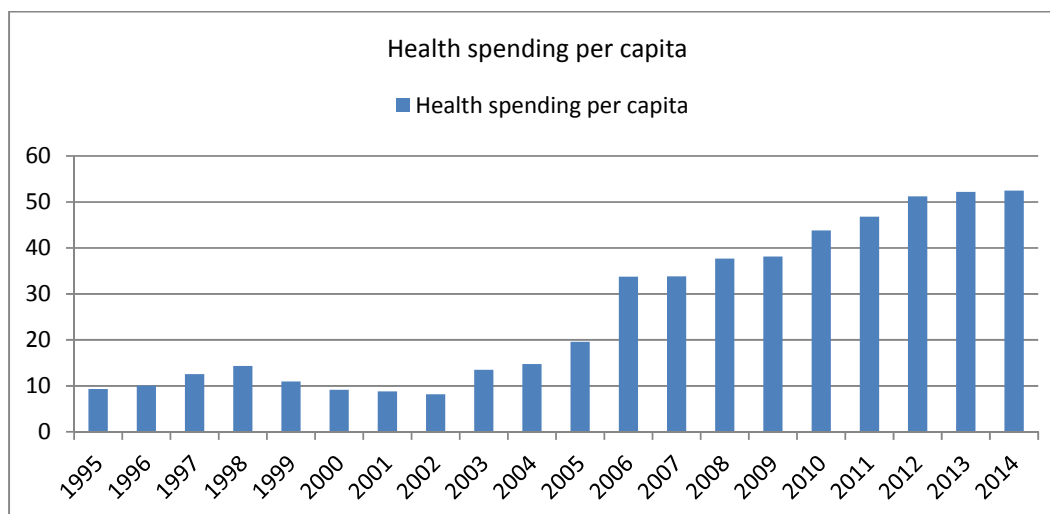
Figure 79. Health spending as percent of GDP (1995-2014)



Source: Authors' computations.

The World Bank data from 1995 to 2014 on healthcare spending per capita (not PPP) shows that the average spending was US\$ 26.06 with a minimum of US\$ 8.2 in 2002 and a maximum of US\$ 52.48 in 2014 (Figure 80).

Figure 80. Health spending per capita (1995-2014)



Source: Authors' computations.

8.3 Education

Total enrolment increased at the pre-primary, primary, secondary, tertiary and adult literacy levels. Though total enrolments increased in secondary grades in general, enrolments in upper secondary decreased. A decrease in enrolments is also observed in TVET schools.

Net enrolment rate in pre-primary schools increased from 14.20 to 17.52 and the pupil-teacher ratio improved from 34:1 in 2015 to 32:1 in 2016. The primary gross enrolment rate (139.6) was still high compared to the 2016-17 ESSP target of 106 and the pupil-qualified teacher ratio stood at 62 pupils per teacher.

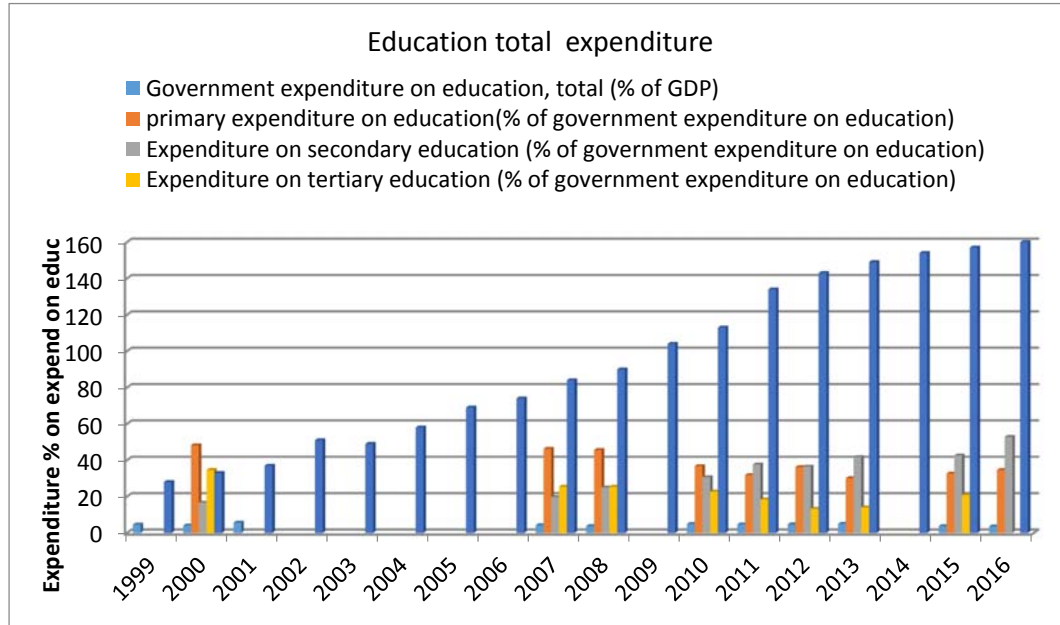
The secondary school gross enrolment rate decreased at both the lower and upper secondary levels from 45.9 in 2015 to 42.5 in 2016 and from 33.2 in 2015 to 31.2 in 2016 respectively. The pupil-qualified teacher ratio improved in secondary schools from 29:1 in 2015 to 28:1 in 2016.

Total enrolment increased in tertiary education from 86,315 in 2015 to 90,803 in 2016. The number of students enrolled in public tertiary institutions represented 43 percent of the whole tertiary enrolment, while the number of students enrolled in private tertiary institutions represented 57 percent of the whole tertiary enrolment (Rwanda statistical year book-2016:8-9/Education statistical year book 2016:27-28/MINEDUC/world bank report 2016/United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics).

In 2014, expenditure on primary and secondary education levels had a slight increase while tertiary education had a slight decrease.

Figure 81 and Table 41 provide information on the total education expenditure in 1999-2016. The expenditure is further divided into primary, secondary and tertiary.

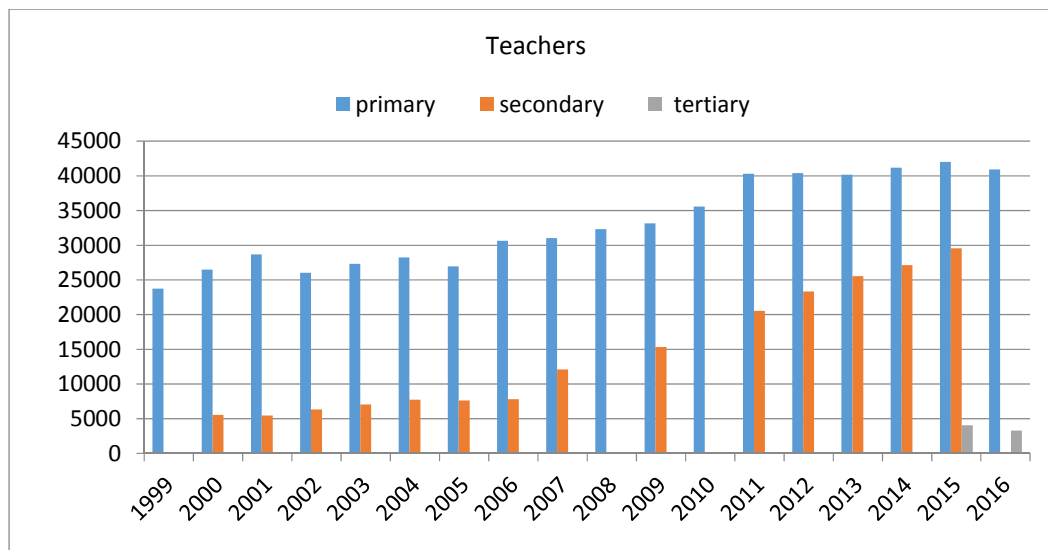
Figure 81. Education expenditure



Source: Authors' computations.

Information about the number of teachers in 1999-2016 is shown in Figure 82. The data is further divided into primary, secondary and tertiary education levels. The figure shows a positive trend over time suggesting improved enrolment and participation in education.

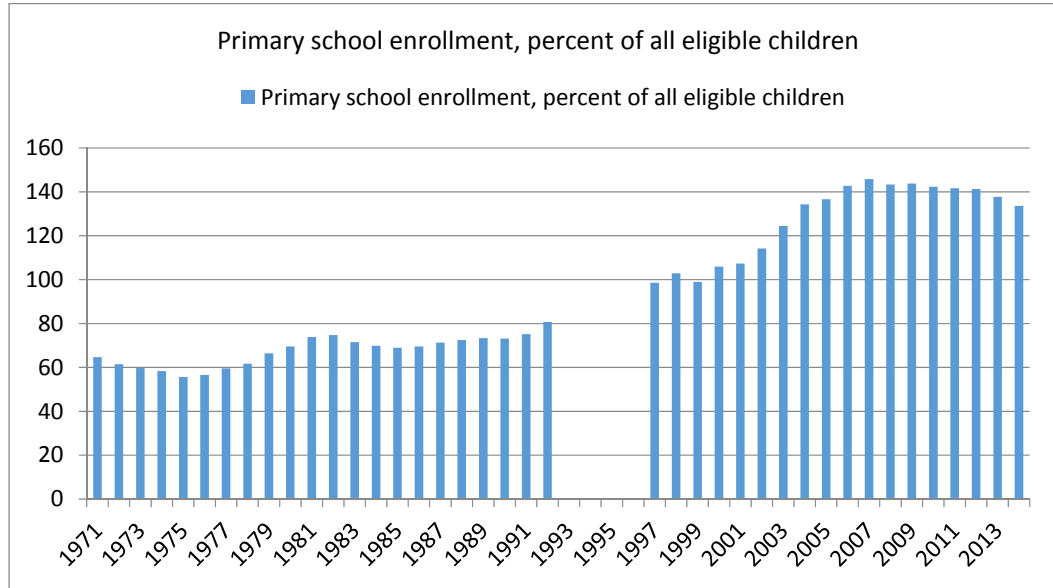
Figure 82. Number of teachers (1999-2016)



Source: Authors' computations.

UNESCO data on primary school enrolments as percent of all eligible children from 1971 to 2014 (Figure 83) shows that the average primary enrolment rate for Rwanda was 94.61 percent with a minimum of 55.62 percent in 1975 and a maximum of 145.85 percent in 2007. Statistics for 1993-96 are not available.

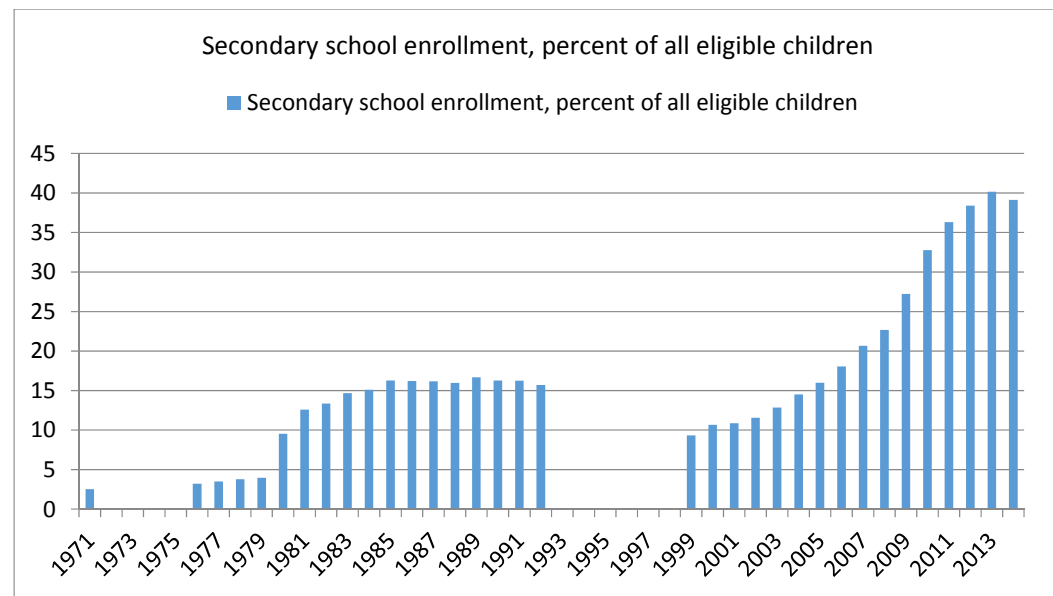
Figure 83. Primary school enrolment (1971-2014, percent of all eligible children)



Source: Authors' computations.

In Figure 84 UNESCO data shows that secondary school enrolment as percent of all eligible children in Rwanda from 1971 to 2014 had an average secondary enrolment of 16.85 percent with a minimum of 2.53 percent in 1971 and a maximum of 40.16 percent in 2013. Again, statistics for 1993-98 are not available.

Figure 84. Secondary school enrolment (1971-2014, percent of all eligible children)

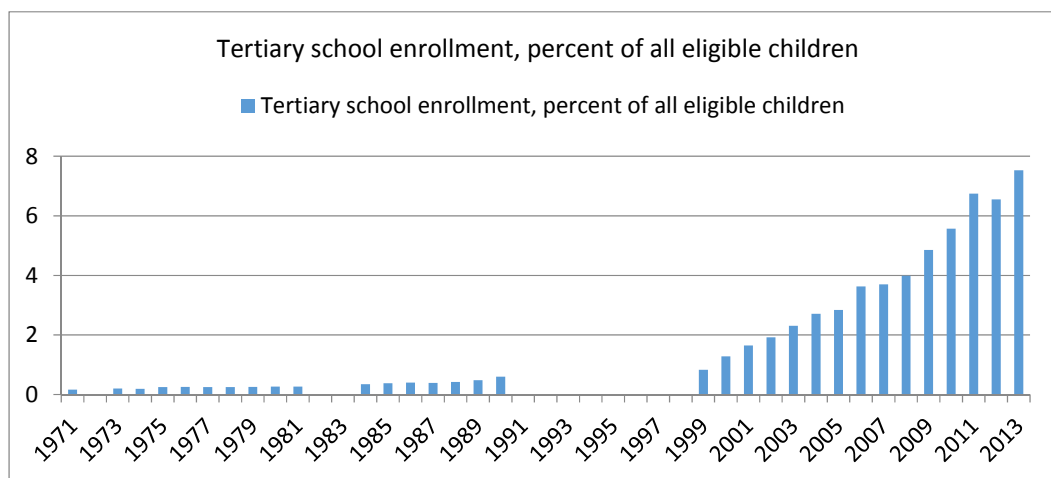


Source: Authors' computations.

UNESCO data in Figure 85 for tertiary school enrolment as percent of all eligible children, from 1971 to 2013 shows that average enrolment was 1.92 percent with a

minimum of 0.16 percent in 1971 and a maximum of 7.53 percent in 2013. Statistics for 1991-98 are not available.

Figure 85. Tertiary school enrolment (1971-2013, percent of all eligible children)



Source: Authors' computations.

9. Summary

This chapter provided a brief descriptive presentation of the Rwandan economy and its development from 1960 to 2016. The review covered the aggregate economy and further decomposed it into agriculture, industry, manufacturing and service sectors. It focused on the performance of the sectors and their development over time by further decomposing them into their components.

Since the Rwandan agricultural society is transiting to industry and services societies, we paid attention to the path of development by presenting the main service sector components in more detail. We focused specifically on demography, the labor market, trade openness, balance of trade, state finances, the financial market, education, health, tourism and housing.

The World Bank revised its global growth forecast for Rwanda by 0.4 percent to 2.4 percent for 2015 and by 0.4 percent to 2.9 percent for 2016, although the 2017 (3.1 percent) forecast remains unchanged. The growth forecast for 2015 was revised down in both high-income countries (from 1.9 percent to 1.6 percent) and developing countries (from 4.7 percent to 4.3 percent). Rwanda's growth rates during the past few years exceeded the growth rates of developing countries, except in 2013 when its growth decelerated to 4.7 percent. Among the 181 economies for which the 2014 GDP growth rate data is available, Rwanda's growth rate of 7.0 percent was more than twice the average of the 181 economies (3.2 percent) and it ranked 20th globally (Rwanda Economic Update 9, 2016:8). Rwanda's growth rate is projected to exceed global growth rates in 2015-17. This high growth rate is consistent with the convergence theory which suggests that countries with low GDP per capital grow faster.

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Appendices

Table 1. Rwanda Administrative Entities

Province	District	Number of sectors	Number of cells	Number of villages
Kigali City	Gasabo	15	73	494
	Kicukiro	10	41	355
	Nyarugenge	10	47	327
Southern	Gisagara	13	59	524
	Huye	12	77	508
	Kamonyi	12	59	317
	Muhanga	12	63	331
	Nyamangabe	17	92	536
	Nyanza	10	51	420
	Nyaruguru	14	72	332
	Ruhango	9	59	533
Western	Karongi	14	88	538
	Ngororero	13	73	419
	Nyabihu	12	73	473
	Nyamasheke	15	68	588
	Rubavu	12	80	525
	Rusizi	18	94	596
	Rutsiro	13	62	485
Northern	Burera	17	69	571
	Gakenke	19	97	617
	Gicumbi	21	109	630
	Musanze	15	68	432
	Rulindo	17	71	494
Eastern	Bugesera	15	72	581
	Gatsibo	14	69	603
	Kayanza	12	50	421
	Kirehe	12	60	612
	Ngoma	14	64	473
	Nyagatare	14	106	628
	Rwamagana	14	82	474
Total	30	416	2,148	14,837

Table 2. Aggregate GDP and its growth

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP	1,881	2,041	2,310	2,361	2,537	2,775	3,031	3,262	3,626	3,853	4,135	4,459	4,852	5,079	5,466	5,951	6,304
AGRI., FORES & FISHING	754	821	960	930	947	1,009	1,036	1,063	1,132	1,219	1,280	1,340	1,427	1,474	1,572	1,650	1,714
INDUSTRY	246	278	298	312	360	394	440	480	552	559	606	714	774	846	939	1,023	1,093
SERVICES	720	769	858	918	1,012	1,132	1,282	1,439	1,638	1,740	1,900	2,052	2,290	2,410	2,578	2,847	3,049
Economic growth,	8.4	8.5	13.2	2.2	7.4	9.4	9.2	7.6	11.2	6.2	7.3	7.8	8.8	4.7	7.6	8.9	5.9

Source: National Institute of Statistics of Rwanda

Table 3. Growth rates at constant 2014 prices

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP	8.4	8.5	13.2	2.2	7.4	9.4	9.2	7.6	11.2	6.2	7.3	7.8	8.8	4.7	7.6	8.9	5.9
AGRI., FORESTRY & FISHING	8	9	17	-3	2	7	3	3	6	8	5	5	7	3	7	5	4
Food crops	8	9	19	-4	0	8	1	4	6	9	5	5	7	4	9	4	3
Export crops	16	13	5	-16	62	-23	33	-29	29	-15	14	3	9	-5	-2	14	2
Livestock & livestock products	5	7	4	4	4	4	4	3	3	3	5	3	6	7	8	9	10
Forestry	5	8	10	9	9	8	8	3	4	2	3	3	4	3	3	4	4
Fishing	3	8	3	3	3	3	3	3	3	3	3	3	-2	5	4	3	3
INDUSTRY	2	13	7	5	16	9	12	9	15	1	8	18	8	9	11	9	7
Mining & quarrying	41	172	-24	-21	50	30	-14	43	-16	-18	-11	50	-7	20	25	-5	10
TOTAL MANUFACTURING	0	10	15	5	12	9	13	1	6	3	9	8	6	5	8	8	7
Electricity	-11	-10	-1	-9	-33	-11	-13	5	18	15	15	15	17	8	9	8	16
Water & waste management	-11	-10	-1	-9	-33	-11	-13	5	18	15	15	15	9	5	3	1	5
Construction	4	10	3	8	20	9	13	15	28	1	9	24	15	11	10	15	5
SERVICES	12	7	12	7	10	12	13	12	14	6	9	8	12	5	7	10	7
TRADE & TRANSPORT	14	8	15	3	14	14	21	15	21	5	9	7	15	6	7	12	7
Maint. and repair of motor vehicles	13	6	14	2	13	13	18	15	19	4	9	8	8	6	4	5	7
Wholesale & retail trade	13	6	14	2	13	13	18	15	19	4	9	8	14	6	8	13	6
Transport services	16	14	18	6	18	17	23	15	24	9	9	4	19	7	4	10	8
OTHER SERVICES	12	5	8	10	7	11	1	11	10	7	9	9	10	5	7	10	7
Hotels & restaurants	3	4	46	51	26	37	23	3	6	-6	8	4	6	3	12	9	11
Financial services	22	5	-2	21	8	1	10	12	2	-4	24	20	13	10	4	12	3
Real estate activities	3	3	5	5	3	8	4	11	16	8	1	0	0	1	6	5	6
Adm. and support service activities	3	3	5	5	3	8	4	11	16	8	1	0	7	4	15	16	10
Education	18	12	39	-5	19	18	7	15	7	16	9	18	7	4	3	2	2
Human health and soc work act	2	14	9	20	8	-3	8	14	12	15	16	2	23	6	8	10	6
Information & communication	16	14	18	6	18	17	23	15	23	9	9	4	33	0	7	18	9
TAXES-SUBSIDIES ON PROD	8	8	10	-1	4	6	9	4	11	10	5	2	2	-3	8	14	4

Source: National Institute of Statistics of Rwanda

Table 4. Growth rates, in constant 2014 prices, percent.

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Domestic Product	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total final cons.expenditure	105	102	103	101	99	98	96	91	93	95	95	93	93	91	93	94	92
Government	19	19	20	19	18	18	17	15	13	14	14	13	14	14	15	15	15
Households and NGOs	87	83	84	82	80	80	79	75	80	81	81	80	79	78	78	80	77
Gross capital formation	13	14	13	14	15	16	17	19	24	23	23	23	26	27	25	27	26
Gross fixed capital formation	13	14	13	14	15	16	16	18	23	23	22	23	25	25	24	26	26
Construction	10	10	10	10	11	12	12	13	15	14	15	16	17	18	17	19	18
Other	4	4	4	4	4	4	4	5	8	8	8	6	8	7	7	7	8
Change in inventories	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
Resource balance	-19	-16	-17	-15	-14	-14	-13	-10	-17	-18	-18	-17	-19	-18	-18	-21	-18
Exports of goods & services	6	8	7	8	11	11	12	16	13	12	12	14	13	14	15	14	15
Goods (fob)	4	6	4	3	5	5	5	5	6	4	5	7	7	8	7	6	6
Services	2	3	3	5	7	7	8	11	7	8	7	7	6	6	7	8	9
Imports of goods & services	25	24	24	24	25	25	25	25	30	30	30	31	32	32	33	35	33
Goods (fob)	13	14	13	13	13	14	14	16	19	20	21	22	24	23	23	22	21
Services	12	11	11	11	11	11	11	10	11	10	9	9	8	9	10	13	12

Source: National Institute of Statistics of Rwanda

Table 5. Growth rates at constant 2014 prices summary, percent.

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP	8.4	8.5	13.2	2.2	7.4	9.4	9.2	7.6	11.2	6.2	7.3	7.8	8.8	4.7	7.6	8.9	5.9
AGRICULTURE, FORESTRY & FISHING	8	9	17	-3	2	7	3	3	6	8	5	5	7	3	7	5	4
INDUSTRY	2	13	7	5	16	9	12	9	15	1	8	18	8	9	11	9	7
TOTAL MANUFACTURING	0	10	15	5	12	9	13	1	6	3	9	8	6	5	8	8	7
SERVICES	12	7	12	7	10	12	13	12	14	6	9	8	12	5	7	10	7

Source: National Institute of Statistics of Rwanda

Table 6. GDP component shares at current prices (percentages)

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GGD	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
AGRI, FORESTRY & FISHING	37	37	35	38	39	38	34	30	28	29	28	28	29	29	29	28	30
Food crops	32	32	30	33	33	32	18	17	15	16	15	16	17	17	17	17	18
Export crops	1	1	1	1	1	1	4	2	3	2	2	2	2	2	2	2	2
Livestock & livestock products	2	2	3	2	2	2	4	3	3	4	3	3	3	3	3	3	3
Forestry	1	1	2	2	2	2	10	8	9	8	8	7	7	7	6	6	6
Fishing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRY	13	14	14	13	14	14	13	14	15	14	15	17	17	17	17	17	17
Mining & quarrying	0	1	0	0	1	1	1	2	2	1	1	3	2	3	3	2	2
TOTAL MANUFACTURING	7	7	8	7	7	7	6	6	6	6	6	6	6	6	6	6	6
Of which: Food	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Beverages & tobacco	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Textiles, clothing & leather	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Wood & paper; printing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chemicals, rubber & plastic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Non-metallic mineral products	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Metal products, machinery& equ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Furniture & other manufacturing	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity	2	2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Water & waste management	2	2	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
Construction	5	5	5	4	5	5	5	5	6	6	6	7	7	7	7	7	7
SERVICES	47	46	47	45	44	44	44	47	49	49	49	48	48	48	47	48	48
TRADE & TRANSPORT	9	9	10	9	9	10	10	11	12	12	12	12	12	12	12	12	12
Maintenance and repair of motor veh	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0
Wholesale & retail trade	6	6	6	6	6	6	6	7	8	7	8	8	8	8	8	8	7

Transport services	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4
OTHER SERVICES	37	36	37	35	34	34	34	38	37	37	37	36	35	36	36	36	36
Hotels & restaurants	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Information & communication	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1
Financial services	3	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3	3
Real estate activities	14	13	13	12	10	10	9	11	12	13	12	11	9	8	8	8	8
Prof., scientific and techn activ	4	4	4	4	3	3	3	3	4	4	4	3	3	3	3	3	3
Admin and support service activities	5	4	4	4	4	3	3	4	4	4	4	4	4	4	4	4	4
Public administration and defence; compulsory social security	7	7	6	6	5	5	4	4	4	4	4	4	5	5	5	5	5
Education	1	1	2	1	1	2	2	2	2	2	2	2	2	3	3	3	3
Human health and social work act.	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2
Cultural, domestic & other services	4	4	4	5	5	6	6	6	5	5	5	4	4	4	5	5	5
TAXES-SUBSIDIES ON PROD.	7	8	8	8	8	8	7	8	8	8	8	8	7	6	7	7	6

Source: National Institute of Statistics of Rwanda

Table 7. Rwanda consumption expenditure in US\$ dollars

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
RWANDA cons. Exp. in US\$ dollars	1.24	1.29	1.38	1.55	1.78	1.99	2.05	2.13	1.62	1.68	1.66	1.03	1.25	1.3	1.75	1.85	1.57
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
RWANDA cons. Exp. in US\$ dollars	1.5	1.4	1.4	1.51	1.68	2.06	2.48	2.88	3.88	4.34	4.66	5.21	5.81	5.93	6.24	6.58	6.43

Source: National Institute of Statistics of Rwanda

Table 8. Agriculture production disaggregate sectors

Activity description	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total agriculture (in billion Rwf)	702	754	821	960	930	947	1,009	1,036	1,063
land (sq. km)	3'414	3'440	3'522	3'604	3'686	3'768	3'850	3'972	4'094
Agricultural land (sq. km)	16,610	16,700	17,490	18,310	18,040	18,159	17,829	18,030	18,049
Arable land (hectares)	866000	900000	1000000	1116000	1094000	1110880	1082900	1102950	1114880
Agriculture development									
Growth		9	7	9	17	-3	2	6	3
employment							78.8		
fertilizer (kilograms per hectare of arable land)				0	2.24	1.83	3.14	3.52	7.91
pesticides								24.4	
irrigation sq km									
production									
Total agri contribution to GDP (in billion Rwf)	702	754	821	960	930	947	1,009	1,036	1,063
Aquaculture production (metric tons)	6.67	7.20	7.92	8.82	9.13	9.35	9.53	9.69	9.82
production of main crops (Cereal yield (kg/ha)	824.8	848.3	914.1	1,027.40	944.3	959.3	1,183.60	1,137.90	1,013.70
Food crops	398	428	466	553	533	531	573	581	604
Export crops	60	69	79	83	69	112	87	115	82
Livestock & livestock products	88	92	98	102	107	111	116	121	124
Forestry	153	161	174	190	207	225	244	264	272
Fishing	13	13	14	15	15	16	16	16	17
Coffee(Tons)							17,414.00	22,223.00	14,683.00
Tea (Tons)							16,458.00	16,976.00	20,474.00
Sugar cane (Tons)							58,665.00	58,011.00	97,010.00
AGRICULTURE, FORESTRY & FISHING	702	754	821	960	930	947	1,009	1,036	1,063

Source: National Institute of Statistics of Rwanda

Table 9. Agriculture production disaggregates

Activity description	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total agriculture (in billion Rwf)	1,132	1,219	1,280	1,340	1,427	1,474	1,572	1,650	1,714
land (sq. km)	4'216	4'338	4'460	4'528	4'596	4'664	4'732	4'800	
Agricultural land (sq. km)	18,074	18,089	18,039	18,164	18,157	18,425			
Arable land (hectares)	1117440	1118870	1123920	1141440	1150730	1182500	1149500		
Agriculture development									
growth	6	8	5	5	6	3	5	5	4
employment					75.3				
fertilizer (kilograms per hectare of arable land)	9.62	1.29	0.08	0.10	4.14	10.12	11.75		
pesticides				30.5			29.3		
irrigation sq km						27.7			
Aquaculture production (metric tons)	9.94	10.06	10.19	10.33	10.47	10.62	10.78	10.81	10.85
production of main crops (Cereal yield (kg per hectare)	1,278.10	1,747.90	1,930.10	2,106.20	2,169.50	2,171.80	1,919.90		
Food crops	642	702	737	774	829	859	934	968	997
Export crops	106	90	102	105	114	109	107	122	125
Livestock & livestock products	128	132	138	142	151	160	174	189	208
Forestry	283	289	299	306	317	326	337	350	363
Fishing	17	18	18	19	18	19	20	21	21
Coffee(Tons)	20,724.00	16,000.00	19,319.00	16,372.00	19,955.00	18,346.00	16,379.00	21,801,913	
Tea (Tons)	19,965.00	20,535.00	22,248.00	24,066.00	22,502.00	22,184.00	24,751.00	25,410,554	
Sugar cane (Tons)	63,001.00	100,663.00	115,304.00	-	0.00	0.00	0.00	0	
AGRICULTURE, FORESTRY & FISHING	1,132	1,219	1,280	1,340	1,427	1,474	1,572	1,650	1,714

Source: National Institute of Statistics of Rwanda

Table 10. Contribution of agriculture disaggregate to the GDP

Activity	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP	1,881	2,041	2,310	2,361	2,537	2,775	3,031	3,262	3,626	3,853	4,135	4,459	4,852	5,079	5,466	5,951	6,304
AGRI, FOREST & FISH.	754	821	960	930	947	1,009	1,036	1,063	1,132	1,219	1,280	1,340	1,427	1,474	1,572	1,650	1,714
Food crops	428	466	553	533	531	573	581	604	642	702	737	774	829	859	934	968	997
Export crops	69	79	83	69	112	87	115	82	106	90	102	105	114	109	107	122	125
Livestock & livest.prod	92	98	102	107	111	116	121	124	128	132	138	142	151	160	174	189	208
Forestry	161	174	190	207	225	244	264	272	283	289	299	306	317	326	337	350	363
Fishing	13	14	15	15	16	16	16	17	17	18	18	19	18	19	20	21	21
Agriculture growth	8	9	17	-3	2	7	3	3	6	8	5	5	7	3	77	5	4

Source: National Institute of Statistics of Rwanda

Table 11. Disaggregate of Industry sector

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total production	246	278	298	312	360	394	440	480	552	559	606	714	774	846	939	1,023	1,093
employment			2.75			3.8							6.7				
Mining & quarrying	29	79	60	48	71	93	80	114	96	79	71	106	98	118	147	140	154
Electricity	43	39	39	35	24	21	18	19	23	26	30	34	40	43	47	51	59
Water & waste manag.	33	30	29	27	18	16	14	15	17	20	23	26	28	30	31	31	33
Construction	77	85	87	95	114	124	140	161	206	209	228	281	322	357	392	453	475
growth (industry)	13	7	5	16	9	12	9	15	1	8	18	8	9	11	9	7	7

Source: National Institute of Statistics of Rwanda

Table 12. Manufacturing components

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total manufacturing production	114	125	144	151	170	184	208	210	221	228	249	270	285	299	322	349	372
Growth	0	10	15	5	12	9	13	1	6	3	9	8	6	5	8	8	7
employment																	
Food	26	32	36	40	54	61	71	67	73	77	84	88	89	96	101	102	110
Beverages & tobacco	53	53	64	58	59	66	71	70	72	75	76	82	86	89	95	101	104
Textiles, clothing & leather goods	8	8	10	11	13	14	16	17	17	17	17	17	18	19	20	21	23
Wood & paper; printing	2	2	3	4	5	6	8	9	10	10	11	10	11	12	14	15	17
Chemicals, rubber & plastic prod	13	14	16	19	21	23	27	27	28	28	29	34	34	33	32	37	39
Non-metallic mineral products	6	7	8	9	9	9	10	10	10	10	11	13	15	16	18	22	26
Metal products, machinery & equ	5	5	5	6	5	4	5	6	7	7	10	13	16	14	18	25	29
Furniture & other manufacturing	6	6	6	7	7	5	7	8	9	8	12	16	18	20	22	26	24

Source: National Institute of Statistics of Rwanda

Table 13. The components of services

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
TOTAL SERVICE production	720	769	858	918	1,012	1,132	1,282	1,439	1,638	1,740	1,900	2,052	2,290	2,410	2,578	2,847	3,049
Growth	12	7	12	7	10	12	13	12	14	6	9	8	12	5	7	10	7
employment			9.5			16.4							16.2				
TRADE & TRANSPORT	144	156	179	184	210	240	290	333	401	423	461	493	566	599	640	714	762
Maintenance and repair of motor vehicles	6	7	8	8	9	10	12	13	16	16	18	19	21	22	23	24	26
Wholesale & retail trade	101	107	122	124	140	158	187	215	256	267	291	314	358	378	410	462	491
Transport services	37	42	49	52	62	72	89	102	126	138	150	157	186	199	207	227	245
OTHER SERVICES	681	714	773	847	904	1,005	1,016	1,126	1,237	1,321	1,443	1,569	1,725	1,811	1,938	2,134	2,287
Hotels & restaurants	14	15	21	32	40	55	68	70	74	70	75	78	82	85	96	105	116
Information & communication	13	15	18	19	23	27	33	37	46	50	55	57	75	75	80	94	102
Financial services	52	54	53	64	69	70	77	86	87	84	103	124	140	154	159	179	185
Real estate activities	231	239	250	264	271	293	305	338	390	422	427	426	425	428	452	472	501
Professional, scientific and technical activities	77	79	83	88	90	97	101	112	130	140	142	141	150	156	144	165	175
Administrative and support service activities	87	90	94	99	102	110	114	127	146	158	160	160	170	176	202	235	258
Public admin. defence; compul. social security	94	98	98	104	104	107	117	124	130	140	160	183	223	244	260	275	307
Education	33	37	51	49	58	69	74	84	90	104	113	134	143	149	154	157	160
Human health and social work activities	32	37	40	48	52	50	54	62	69	80	92	94	116	123	133	146	155
Cultural, domestic & other services	48	51	64	82	95	127	152	173	177	167	179	178	197	221	257	306	328
TAXES-SUBSIDIES ON PRODUCTS	182	197	217	216	226	240	261	272	304	333	349	354	361	349	377	430	449

Source: National Institute of Statistics of Rwanda

Table 14. Contribution of service to the GDP

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP.	1,881	2,041	2,310	2,361	2,537	2,775	3,031	3,262	3,626	3,853	4,135	4,459	4,852	5,079	5,466	5,951	6,304
Total Service Prod.	720	769	858	918	1,012	1,132	1,282	1,439	1,638	1,740	1,900	2,052	2,290	2,410	2,578	2,847	3,049
Trade & Transport	144	156	179	184	210	240	290	333	401	423	461	493	566	599	640	714	762
Other Services	681	714	773	847	904	1,005	1,016	1,126	1,237	1,321	1,443	1,569	1,725	1,811	1,938	2,134	2,287
Growth	12	7	12	7	10	12	13	12	14	6	9	8	12	5	7	10	7

Source: National Institute of Statistics of Rwanda

Table 15. Summary of GDP components (GDP at constant 2014 prices)

Activity descry.	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total GDP	1,881	2,041	2,310	2,361	2,537	2,775	3,031	3,262	3,626	3,853	4,135	4,459	4,852	5,079	5,466	5,951	6,304
Agri, Fores&Fish.	754	821	960	930	947	1,009	1,036	1,063	1,132	1,219	1,280	1,340	1,427	1,474	1,572	1,650	1,714
Industry	246	278	298	312	360	394	440	480	552	559	606	714	774	846	939	1,023	1,093
Services	720	769	858	918	1,012	1,132	1,282	1,439	1,638	1,740	1,900	2,052	2,290	2,410	2,578	2,847	3,049

Source: National Institute of Statistics of Rwanda

Table 16. Total consumption (GDP at constant 2014 prices)

Activity	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total GDP	1,881	2,041	2,310	2,361	2,537	2,775	3,031	3,262	3,626	3,853	4,135	4,459	4,852	5,079	5,466	5,951	6,304
Total Consumption	2,079	2,358	2,272	2,429	2,647	3,000	3,039	3,222	3,592	3,792	4,088	4,438	4,588	5,078	5,680	5,953	
Public (Gov.)	266	304	340	372	407	446	451	461	515	568	590	684	682	824	866	945	
Private	1,813	2,054	1,932	2,057	2,240	2,554	2,588	2,761	3,077	3,224	3,497	3,754	3,905	4,254	4,814	5,008	
Household and NGO	1,751	1,813	2,054	1,932	2,057	2,240	2,554	2,588	2,761	3,077	3,224	3,497	3,754	3,905	4,254	4,814	5,008

Source: National Institute of Statistics of Rwanda

Table 17. Percentage of Total consumption to the GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Gross Domestic Product	8.4	8.5	13.2	2.2	7.4	9.4	9.2	7.7	11.2	6.3	7.3	7.8	8.8	4.7	7.6	8.9	5.9
Total final cons. Exp.	12	4	13	-4	7	9	13	1	6	11	6	8	9	3	11	12	5
Government	4	9	14	12	10	9	9	1	2	12	10	4	16	0	21	5	9
Households and NGOs	13	4	13	-6	6	9	14	1	7	11	5	8	7	4	9	13	4

Source: National Institute of Statistics of Rwanda

Table 18. Human development indicators in Rwanda. GDP at constant 2014 prices

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
HDI trends,1990-2015											0.46	0.48	0.49	0.49	0.49	0.50	
education	33	37	51	49	58	69	74	84	90	104	113	134	143	149	154	157	160
Expected years of schooling	7.1					9.3					10.2	10.5	10.8	10.8	10.8	10.8	11
Growth	12	39	-5	19	18	7	15	7	16	9	18	7	4	3	2	2	
longevity	48.2	49.5	50.6	51.8	53.2	54.8	56.4	57.9	59.3	60.5	61.4	62.2	62.8	63.4	64.0	64.5	64.7
GDP/capita.(in current USD)	225	211	206	221	245	295	350	414	513	554	579	635	698	710	728	735	729
inequality	48.6					52.0					51.3	0.5		50.4			50.4
poverty	24						57					45			39		
HDI trends,1990-2015											0.5	0.5	0.5	0.5	0.5	0.5	
education	33	37	51	49	58	69	74	84	90	104	113	134	143	149	154	157	160
Growth	12	39	-5	19	18	7	15	7	16	9	18	7	4	3	2	2	
longevity	48.2	49.5	50.6	51.8	53.2	54.8	56.4	57.9	59.3	60.5	61.4	62.2	62.8	63.4	64.0	64.5	
HDI trends,1990-2015											0.5	0.5	0.5	0.5	0.5	0.5	
education	33	37	51	49	58	69	74	84	90	104	113	134	143	149	154	157	160
Expected years of schooling	7.1					9.3					10.2	10.5	10.8	10.8	10.8	10.8	
longevity	48.2	49.5	50.6	51.8	53.2	54.8	56.4	57.9	59.3	60.5	61.4	62.2	62.8	63.4	64.0	64.5	64.7
inequality	48.6					52.0					51.3	0.5		50.4	0.4		50.4

Source: National Institute of Statistics of Rwanda

Table 19. Rwanda's HDI trends based on consistent time series data

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP\$)	HDI value
1990	33.4	5.7	1.8	847	0.244
1995	31.5	6.2	2.0	669	0.230
2000	48.1	7.1	2.3	792	0.332
2005	54.9	9.3	2.8	1,008	0.404
2010	61.7	10.2	3.5	1,318	0.464
2011	62.4	10.5	3.6	1,385	0.475
2012	63.1	10.8	3.8	1,463	0.485
2013	63.6	10.8	3.8	1,488	0.488
2014	64.2	10.8	3.8	1,553	0.493
2015	64.7	10.8	3.8	1,617	0.498

Resource: Human Development Report 2016

Table 20. Utilities and its components

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
energy use	43	39	39	35	24	21	18	19	23	26	30	34	40	43	47	51	59
Renewable energy consumption	89.27	89.51	90.07	87.25	87.54	89.24	90.58	90.31	90.63	90.54	90.66	86.75					86.8
electricity prod (billion kWh)	0.13	0.11	0.10	0.10	0.17	0.10	0.09	0.13	0.13	0.12	0.12	0.16	0.24	0.28			
Electricity production (kWh)												3E+08	4E+08	4E+08	476,142,374	523,728,903	
oil (bbl/day)		0	0	0	0	0	0	0	0	0	0	0	10				
electrification-cons (billion kWh)	0.17	0.19	0.17	0.14	0.14	0.20	0.12	0.20	0.23	0.23	0.23	0.23	0.24	0.30	0.32		
domestic production (billion kWh)	0.16	0.13	0.11	0.10	0.10	0.17	0.10	0.09	0.13	0.13	0.12	0.12	0.16	0.24	0.28		
import (million kWh)	20	70	70	50	50	40	30	120	130	130	130	130	88	80	62		
Export (million kWh)	3	1	1	0	0	0	0	10	10	10	10	10	2	2	3		
energy use	43	39	39	35	24	21	18	19	23	26	30	34	40	43	47	51	59
electrification-cons (billion kWh)	0.17	0.19	0.17	0.14	0.14	0.20	0.12	0.20	0.23	0.23	0.23	0.23	0.24	0.30	0.32		
domestic production (billion kWh)	0.16	0.13	0.11	0.10	0.10	0.17	0.10	0.09	0.13	0.13	0.12	0.12	0.16	0.24	0.28		
import (million kWh)	20	70	70	50	50	40	30	120	130	130	130	130	88	80	62		
Export (million kWh)	3	1	1	0	0	0	0	10	10	10	10	10	2	2	3		

Source: National Institute of Statistics of Rwanda

Table 21. Housing and water

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
constructed houses										27,303,595	31,417,873	31,389,570	38,059,630	40,101,554	42,198,804	42,010,788	
standard (long term)										20,488,220	21,605,700			236,313	484,589	890,418	
pipe water														29	51		
clean water,	33	30	29	27	18	16	14	15	17	20	23	26	28	30	31	31	33
sewage system												221			49		
Improved water source (of pop. with access)	66.3	67	67.7	68.4	69.1	69.8	70.4	71.1	71.8	72.4	73.1	73.7	74.3	74.9	75.5	76.1	

Source: National Institute of Statistics of Rwanda

Table 22. Rwanda poverty

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
poverty line		59										45					
population below poverty rate						56.7					44.9						
Poverty headcount ratio \$3.10/day (2011 PPP)	89.65					84.05					80.66			80.6			
inequality-GNI		50.7					52.2					49.6			44.0		50.4
intensity and severity by:																	
Rwanda		0.414					0.393					0.329					
Urban		0.280					0.348					0.300					
Rural		0.420					0.397					0.331					
Kigali city		0.366					0.346					0.284					
Southern Province		0.422					0.416					0.340					
Western Province		0.396					0.395					0.340					
Northern Province		0.431					0.400					0.340					
Eastern Province		0.415					0.357					0.302					
Depth of extreme poverty		0.341					0.329					0.262			0.24		
inequality-GNI																	
Kigali city							58.6					57.7					
Southern Province							44.6					39.4					
Western Province							49.2					41.5					
Northern Province							43.1					46.4					
Eastern Province							43.6					40.1					
Depth of extreme poverty																	
Kigali city																	

Source: National Institute of Statistics of Rwanda

Table 23. Poverty line and inequality-GNI

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
poverty line		59					57					45					
inequality-GNI		50.7					52.2					49.0			44.0		50.4
population below poverty rate						56.7					44.9						

Table 24. Rwanda population characteristics

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total Population	7.7	7.9	8.1	8.3	8.6	8.8	9.0	9.2	9.5	9.7	10.0	10.2	10.5	10.7	11.0	11.3	11.5
Growth Rate	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.4	2.4	2.4	2.4
birth rate (per 1,000 people)	40.70	40.18	39.71	39.31	38.94	38.58	38.16	37.64	37.00	36.24	35.38	34.47	33.55	32.69	31.89	31.16	30.7
death rate	13.81	13.24	13.1	12.9	12.49	11.82	10.95	10.06	9.29	8.66	8.18	7.82	7.53	7.28	7.05	6.83	6.4
decomposed by gender & ages																	
female (of total)	52.04	52.08	52.13	52.20	52.26	52.3	52.31	52.31	52.30	52.28	52.25	52.23	52.20	52.18	52.15	52.11	
Ages 0 -14(of total)	45.02	44.74	44.15	43.35	42.66	42.26	42.05	42.11	42.32	42.48	42.45	42.42	42.18	41.81	41.42	41.05	
Ages 15 -64(of total)	51.76	52.12	52.83	53.75	54.55	55.03	55.27	55.22	55.01	54.86	54.88	54.91	55.13	55.47	55.84	56.16	
65 and above (of total)	3.23	3.14	3.02	2.90	2.79	2.71	2.68	2.67	2.67	2.67	2.67	2.68	2.69	2.72	2.75	2.79	

Source: National Institute of Statistics of Rwanda

Table 25. Rural-Urban population

Activity description	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total population	7,803,509	8,175,494	8,434,071	8,612,749	8,757,713	8,918,593	9,119,636	9,356,062	9,615,699
Rural	6,824,530	7,010,698	7,106,436	7,157,824	7,202,133	7,271,263	7,369,325	7,481,997	7,602,027
Urban	811,053	933,331	1,066,775	1,197,345	1,318,415	1,432,593	1,528,645	1,626,823	1,736,967
Migration (Net migration rate (migrant(s)/1,000 pop))	-2.46	-1.21	-0.32	0	0	0	0	2.41	2.29
Visitor Arrivals from different regions and purposes	119,056	84,513	75,257	75,263	63,812	100,264	92,966	80,964	72,530
Migration(Net migration rate (migrant(s)/1,000 pop))	-1.21	-0.32	0	0	0	0	2.41	2.29	2.17
Visitor Arrivals from different regions and purposes	119,056	84,513	75,257	75,263	63,812	100,264	92,966	80,964	72,530

Activity description	2009	2010	2011	2012	2013	2014	2015	2016
Total population	9,887,454	10,159,132	10,425,049	10,686,890	10,947,723	11,209,820	11,475,605	11,751,364
Rural	7,720,140	7,828,129	7,925,556	8,016,305	8,101,522	8,183,945	8,265,000	
Urban	1,861,716	1,999,086	2,148,287	2,304,454	2,465,540	2,630,873	2,801,045	2,976,573
Migration (Net migration rate (per 1,000 pop))	2.17	1.11	1.06	1.00	0.95	0.90		
Visitor Arrivals from different regions & purposes	129,109	115,524	106,833	97,373	83,937	79,411		
Migration(Net migration rate (per 1,000 pop))	1.11	1.06	1	0.95	0.9			
Visitor Arrivals from different regions & purposes	129,109	115,524	106,833	97,373	83,937	79,411		

Source: National Institute of Statistics of Rwanda

Table 26. Rwanda Labour market

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Employment to population ratio, 15+, total (modelled ILO estimate)	85.088	82.855	82.38	83.957	83.572	81.851	82.104	82.027	82.128
Employment to population ratio, 15+, male (modelled ILO estimate)	85.034	82.936	81.962	82.872	82.207	80.686	80.698	80.725	80.992
Employment to population ratio, 15+, female (modelled ILO estimate)	85.135	82.784	82.741	84.894	84.752	82.857	83.316	83.149	83.105
ages 15-24, female ()	77.2	76.6	76.0	75.6	75.1	74.8	74.6	74.5	74.5
ages 15-24, male ()	75.4	74.1	72.6	72.0	71.4	70.9	70.7	70.7	70.9
ages 15-24, total ()	76.4	75.4	74.3	73.8	73.3	72.9	72.7	72.7	72.8
15+, female ()	85.6	85.7	85.7	85.5	85.4	85.3	85.4	85.6	85.8
15+, male ()	85.1	84.3	83.5	83.3	83.1	83.1	83.2	83.4	83.8
15+, total ()	85.4	85.0	84.6	84.4	84.3	84.3	84.3	84.5	84.9
Total unemployment	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Unemployment, female (of female labour force)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Unemployment, male (of male labour force)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Total population	7,316,170	7,803,509	8,175,494	8,434,071	8,612,749	8,757,713	8,918,593	9,119,636	9,356,062
Total Labour force	3609020	3781546	3925038	4039044	4151754	4257994	4368773	4497054	4625614
Labour force female (of total labour force)	53.33	53.79	54.18	54.22	54.22	54.23	54.28	54.28	54.19
Ratio of female to male labour force participation rate (modelled ILO estimate)	100.0093	100.9477	102.1493	102.218	102.9	103.4337	103.741	103.6716	103.4185
Labour force participation rate, female (of female population ages 15+)	86.165	86.071	86.117	85.58	85.55	85.519	85.578	85.696	85.887
Labour force participation rate for ages 15-24, total () (national estimate)	76.874	75.885	74.838	74.314	73.62	73.029	72.741	72.82	73.143
Labour force participation rate for ages 15-24, male () (national estimate)	76.099	74.711	73.219	72.561	71.682	70.928	70.556	70.648	71.059
Labour force participation rate for ages 15-24, female () (national estimate)	77.585	76.956	76.32	75.932	75.428	75.011	74.822	74.902	75.154

Source: National Institute of Statistics of Rwanda

Table 26. Rwanda Labour market continued ..

Employment	2008	2009	2010	2011	2012	2013	2014	2015	2016
Employment/pop ratio, 15+, total ILO	84.247	83.256	82.976997	82.790001	82.296997	82.1930008	82.026001	82.536003	82.7310028
Employment/pop ratio, 15+, male ILO	82.727	82.156	82.028999	81.852997	81.417	81.1279984	80.5390015	81.005997	81.2630005
Employment/pop ratio, 15+, female ILO	85.552	84.199	83.789001	83.593002	83.053001	83.1100006	83.310997	83.862	84.0070038
Ages 15-24, female	74.6	74.6	74.6	74.3	74	73.6	73.3		
Ages 15-24, male	71.1	71.4	71.4	71.2	70.8	70.4	70		
Ages 15-24, total	72.9	73	73.1	72.8	72.4	72	71.7		
15+, female	86.1	86.3	86.4	86.4	86.2	86.1	85.9		
15+, male	84.3	84.6	84.9	84.9	84.8	84.6	84.4		
15+, total	85.2	85.5	85.7	85.7	85.5	85.4	85.2		
Total unemployment	0.6	0.6	0.6	0.6	0.6	0.6	0.6		
Unemployment, female (of female)	0.4	0.4	0.3	0.3	0.3	0.4	0.4		
Unemployment, male (of male force)	0.8	0.8	0.8	0.8	0.8	0.8	0.8		
Total population	9,615,699	9,887,454	10,159,132	10,425,049	10,686,890	10,947,723	11,209,820	11,475,605	11,751,364
Total Labour force	4752687	4886220	5028444	5165606	5316739	5479245	5644231	5821183	6010729
Labour force female (of total force)	54.24	54.22	54.16	54.13	54.09	54.02	53.95		
Ratio of female to male labour force participation rate (modelled ILO est.)	103.05	102.8443	102.82271	102.98865	103.30182	103.746194	104.135869	103.8609	103.591668
Labour force participation rate, female (of female pop 15+) (national estimate)	86.055	86.237	86.367996	86.459999	86.507004	86.5429993	86.5139999	86.404999	86.2669983
Labour force participation rate for ages 15-24, total (national estimate)	73.511	73.691	73.558998	73.087997	72.311996	71.3420029	70.3899994	70.235001	70.1389999
Labour force participation rate for ages 15-24, male (national estimate)	71.535	71.775	71.619003	71.033997	70.073997	68.8860016	67.7340012	67.622002	67.5749969
Labour force participation rate for ages 15-24, female (national estimate)	75.429	75.56	75.458	75.098	74.497002	73.7330017	72.9710007	72.775002	72.6340027

Source: National Institute of Statistics of Rwanda

Table 27. Rwanda trade

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
total	144	156	179	184	210	240	290	333	401	423	461	493	566	599	640	714	762
export	133	186	195	235	310	344	354	513	451	439	474	581	633	750	805	855	966
Goods (fob)	86	123	122	100	120	131	131	151	190	138	178	289	355	442	400	393	433
Export crops	11	11	8	10	12	21	61	61	63	72	77	78	92	77	100	89	103
Services	47	63	73	135	189	213	223	361	260	301	296	292	277	308	404	462	532
import	519	492	538	470	569	636	821	913	868	1,019	1,033	1,212	1,432	1,570	1,799	2,213	2,382
Goods (fob)	223	226	228	200	247	291	384	482	569	655	716	861	1,056	1,117	1,264	1,407	1,505
Trade/GDP	31.2	32.75	30.75	32	35.88	36.67	37.59	40.34	40.56	38.71	40.05	44.05	46.09	46.3	45.48		
Services	296	266	310	270	322	345	437	431	299	364	317	352	376	453	535	806	877
trade balance	-386	-306	-343	-235	-259	-292	-467	-400	-417	-579	-559	-631	-800	-820	-994	1,358	1,416
Wholesale& retail trade	39	40	39	46	52	57	59	65	81	85	88	93	97	98	100	97	97

Source: National Institute of Statistics of Rwanda

Table 28. Rwanda Expenditure on GDP

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Growth rates, in constant 2014 p																	
GDP	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Total final cons.expenditure	105	102	103	101	99	98	96	91	93	95	95	93	93	91	93	94	92
Government	19	19	20	19	18	18	17	15	13	14	14	13	14	14	15	15	15
Households and NGOs	87	83	84	82	80	80	79	75	80	81	81	80	79	78	78	80	77
Gross cap. Form.	13	14	13	14	15	16	17	19	24	23	23	23	26	27	25	27	26
Gross fixed capital formation	13	14	13	14	15	16	16	18	23	23	22	23	25	25	24	26	26
Construction	10	10	10	10	11	12	12	13	15	14	15	16	17	18	17	19	18
Other	4	4	4	4	4	4	4	5	8	8	8	6	8	7	7	7	8
Change in invent.	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1
Resource balance	-19	-16	-17	-15	-14	-14	-13	-10	-17	-18	-18	-17	-19	-18	-18	-21	-18
Exports of goods & services	6	8	7	8	11	11	12	16	13	12	12	14	13	14	15	14	15
Goods (fob)	4	6	4	3	5	5	5	5	6	4	5	7	7	8	7	6	6
Services	2	3	3	5	7	7	8	11	7	8	7	7	6	6	7	8	9
Imports of goods & services	25	24	24	24	25	25	25	25	30	30	30	31	32	32	33	35	33
Goods (fob)	13	14	13	13	13	14	14	16	19	20	21	22	24	23	23	22	21
Services	12	11	11	11	11	11	11	10	11	10	9	9	8	9	10	13	12

Table 29. Rwanda Decelerating imports growth

Year and Period	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1
Total Estimates	432.61	470.70	481.15	478.75	456.93	483.86	439.39	400.31	409.24

Table 30. Rwanda's Formal External Trade partner

	Partner	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1
Exports	WORLD	100.64	93.89	114.24	97.03	91.79	92.24	112.54	109.50	104.06
	EAC	26.83	25.73	19.65	26.13	36.45	32.16	20.45	24.09	28.79
Imports	WORLD	432.61	470.70	481.15	478.75	456.93	483.86	439.39	400.31	409.24
	EAC	109.19	116.97	125.95	121.64	106.24	111.17	113.62	109.19	97.03
Re-Exports	WORLD	38.09	46.13	46.05	39.90	41.03	50.43	51.52	60.30	61.47
	EAC	5.34	4.79	4.64	5.76	7.43	15.11	7.24	13.69	9.51
Total Trade	WORLD	571.34	610.72	641.44	615.68	589.75	626.53	603.44	570.11	574.78
	EAC	141.36	147.49	150.25	153.53	150.11	158.44	141.31	146.96	135.33
Trade Balance	WORLD	-293.87	-330.69	-320.85	-341.83	-324.10	-341.19	-275.34	-230.50	-243.70
	EAC	-77.02	-86.46	-101.65	-89.75	-62.36	-63.91	-85.93	-71.41	-58.74

Source: National Institute of Statistics of Rwanda

Table 31. Rwanda's Formal External Trade in Goods (values in US\$ million)

	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1
Exports	100.64	93.89	114.24	97.03	91.79	92.24	112.54	109.50	104.06
Imports	432.61	470.70	481.15	478.75	456.93	483.86	439.39	400.31	409.24
Re-Exports	38.09	46.13	46.05	39.90	41.03	50.43	51.52	60.30	61.47
Total Trade	571.34	610.72	641.44	615.68	589.75	626.53	603.44	570.11	574.78
Trade Balance	-293.87	-330.69	-320.85	-341.83	-324.10	-341.19	-275.34	-230.50	-243.70

Source: National Institute of Statistics of Rwanda

Table 32. Rwanda's Formal External Trade in Goods by destination (values in US\$ million)

	2013Q2	2013Q3	2013Q4	2014Q1	2014Q2	2014Q3	2014Q4	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4
CEPGL	63.53	51.57	41.64	47.51	42.35	81.26	54.95	51.68	54.31	67.03	50.66	52.88483	54.47456	62.38916	65.71708
COMESA	184.4	168.35	155.32	185.61	193.48	221.47	184.56	179.75	189.07	202.12	188.56	189.5494	190.2864	194.7815	196.0377
COMMON WEALTH	204.54	216.57	209.61	235.85	238.73	233.78	215.53	218.69	261.16	229.21	237.67	218.233	190.2864	232.6416	215.8669
ECOWAS	0.20	1.04	0.48	0.13	0.25	0.38	0.29	0.87	0.59	1.16	0.24	0.407458	0.504557	0.535723	0.57924
SADC	81.43	107.07	69.69	73.05	67.75	109.97	85.66	80.63	87.28	101.21	86.45	96.04674	94.01247	106.6926	104.2417
EU	81.89	77.38	81.94	75.98	97.55	114.3	86.36	86.87	84.57	76.01	81.09	72.20802	85.63219	68.34487	59.46225

Source: National Institute of Statistics of Rwanda

Table 33. Rwanda total export and import

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
total	144	156	179	184	210	240	290	333	401	423	461	493	566	599	640	714	762
export	133	186	195	235	310	344	354	513	451	439	474	581	633	750	805	855	966
import	519	492	538	470	569	636	821	913	868	1,019	1,033	1,212	1,432	1,570	1,799	2,213	2,382
Trade (of GDP)	31.2	32.75	30.75	32	35.88	36.67	37.59	40.34	40.56	38.71	40.05	44.05	46.09	46.3	45.48		
trade balance	-386	-306	-343	-235	-259	-292	-467	-400	-417	-579	-559	-631	-800	-820	-994	-1,358	-1,416

Source: National Institute of Statistics of Rwanda

Table 34. Rwanda's External Trade with EAC (values in US\$ million)

	2015Q1	2015Q2	2015Q3	2015Q4	2016Q1	2016Q2	2016Q3	2016Q4	2017Q1
Exports	26.83	25.73	19.65	26.13	36.45	32.16	20.45	24.09	28.79
Imports	109.19	116.97	125.95	121.64	106.24	111.17	113.62	109.19	97.03
Re-Exports	5.34	4.79	4.64	5.76	7.43	15.11	7.24	13.69	9.51
Total Trade	141.36	147.49	150.25	153.53	150.11	158.44	141.31	146.96	135.33
Trade Balance	-77.02	-86.46	-101.65	-89.75	-62.36	-63.91	-85.93	-71.41	-58.74

Source: NISR

*Note: South Sudan not yet included in the EAC trade estimates

Table 35. Rwanda financial sector

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net foreign assets (in Rwf billion)			65.5	122.5	181.3	224.9	281.8	325.6	358	414.8	564	457	634	586	609	
Foreign assets			124.3	178.3	224.7	241.2	300.6	3333.4	424	483.5	634.4	535.5	717	660.2	689.3	
Foreign liabilities			58.8	55.7	43.4	16.3	18.8	7.8	66	68.6	70.4	78.4	82.6	74.5	80.2	
Net domestic assets			-15.1	-65.3	-117	-153	-188	-210	244.7	-284	-400	-268	-421	-339	-322	
Domestic credit			15.6	-38.7	-96.9	-120	-153	-169	-204	-231	-348	-219	-339	-222	-219	
Aid (Net ODA and official received (const. 2013 USD)	5E+08	6E+08	5E+08	6E+08	7E+08	7E+08	8E+08	1E+09	1E+09	1E+09	1E+09	9E+08	1E+09	1E+09	1E+09	
saving	50	47	76	158	191	192	384	403	443	430	625	520	703	538	461	678
investment	264	284	313	350	407	496	623	821	841	902	1,001	1,212	1,311	1,382	1,630	1,767
budget deficit/surplus of GDP										-1.1	-0.9	-4.0	-3.0			-5

Source: National Institute of Statistics of Rwanda

Table 36. Rwanda Services value

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Rwanda Services value	0.87	0.85	0.81	0.85	0.9	0.99	1.29	1.39	1.81
Growth		12	7	12	7	10	12	13	12
	2008	2009	2010	2011	2012	2013	2014	2015	2016
Rwanda Services value	14	6	9	8	12	5	7	10	7
Growth	14	6	9	8	12	5	7	10	7

Source: National Institute of Statistics of Rwanda

Table 37. Rwanda tourism

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Exp. Intl tourism, (current US\$)	330000 00	2E+07 7	2.6E+0 7	3E+07	8E+07	8E+07	1E+08	1.5E+0 8	1E+08	1E+08	1.5E+0 8	1E+0 8	1E+0 8		2E+0 8
visits	113,000	494,00 0	566,00 0	507,00 0	502,00 0	504,00 0	688,00 0	815,00 0	864,00 0	926,000	908,00 9				
average stay															
hotel nights									188	220	360	375	431	436	439
Rooms									3958	4714	6500	6800	7968	8003	8,705
Visitors from:															
Africa							515,75 1	557,01 4	559,69 6	547,027	773,74 7				
Americas							23,349	31,043	28,116	33,183	37,908				
Europe							39,707	50,086	46,968	54,261	67,311				
Other							30,855	30,381	27,776	31,530	29,043				
revenues (of total exports)	18.21	25.33	21.51	21.92	27.38	39.88	41.67	32.36	37.97	35.99	32.65	33.1 7	27.3 3	24.5 2	

Source: National Institute of Statistics of Rwanda

Table 38. Rwanda Transport

	2000	2001	2002	2003	2004	2005	2006	2007
International tourism, expenditures (current US\$)	35000000	33000000	24000000	26000000	31000000	75000000	84000000	98000000
Intl tourism, passenger transport items (current US\$)	4000000	4000000				18000000	16000000	25000000
International tourism, number of arrivals	104000	113000					494000	566000
Air transport passengers carried								5,422
Air transport, freight (million ton-km)								
Aircraft Movements (c+d)(All Cargo Aircrafts)								389
land transport						2,941,430	3,630,969	6,870,628
Total of Classification of roads in (km)						4,699	-	-
National paved Roads						1,075	-	-
National and districts earth Roads (km)						3,624	-	-
District paved road Class I							-	-
Totals Vehicles					29,955	41,071	47,629	57,918
cars					8,513	10,309	11,198	13,003
Minibus					2,702	724	279	212
Coasters								
buses					56	71	87	133
passengers					2,860	33,949	179,447	234,408

Table 38. Rwanda Transport continued.

	2008	2009	2010	2011	2012	2013	2014	2015
International tourism, expenditures (current US\$)	1.46E+08	1.48E+08	1.2E+08	1.47E+08	1.33E+08	1.44E+08		2.1E+08
Intl tourism, passenger transport items (current US\$)	38000000	49000000	22000000	46000000	55000000	57000000		89000000
International tourism, number of arrivals	507000	502000	504000	688000	815000	864000	926000	987000
Air transport passengers carried	7,719	10,041	188,221	268,377	593,198	610,996	626,925	544541
Air transport, freight (million ton-km)			3.269194	6.436402	17.45429	19.99901	20.69627	
Aircraft Movements (c+d)(All Cargo Aircrafts)	347		489	260	284	514	528	
land transport	7,687,795	5,598,668						
Total of Classification of roads in (km)	4,699	-	4,707	4,700	4698	6655	6655	
National paved Roads	1,141	-	1205	1205.28	1224	1211	1291	
National and districts earth Roads (km)	3,558	-	3493	3493	3474	5386	5289	
District paved road Class I		-				58	75	
Totals Vehicles	71,306	80,019	88,621	105,324	125,001	140,149	152,085	161,925
cars	14,925	16,292	17,220	19,177	22,772	25,47	1 27,312	29,519
Minibus	657	193	4,853	5,021	5,503	6,223	6,118	5,952
Coasters				323	747	801	939	
buses	224	250	397	469	531	597	794	1,020
passengers	276,115	266,946						

Source: National Institute of Statistics of Rwanda

Table 39. Rwanda Airline passengers

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Rwanda Airline passengers	0.01	0.01	0.01	0.01								
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Rwanda Airline passengers							0.19	0.27	0.59	0.61	0.63	0.54

Table 40. Rwanda Health care

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Health exp/cap, PPP (const. 2011 intl \$)	26.75	29.71	31.85	49.2	52.37	61.99	99.83	91.02	90.51	88.62	103	107.7	115.9	120.4	125.1	
public (of total health exp)	39.17	48.83	52.27	52.74	46.05	46.82	49.72	44.52	36.94	33.35	37.02	36.46	36.94	38.05	38.10	
private (of GDP)	2.57	2.24	1.99	3.00	3.37	3.63	5.04	4.71	4.83	4.80	4.98	4.90	4.84	4.76	4.66	
Exp.total? GDP	4.22	4.38	4.18	6.34	6.24	6.83	10.02	8.49	7.66	7.20	7.91	7.71	7.68	7.69	7.53	
doctors									562	579	604	625	683	684	709	742
nurses									6,543	7200	8046	8,273	8,779	8,985	8,898	8,751
hospitals									45	45	45	45	47	48	48	48
Clinique's													174	245	242	193

Source: National Institute of Statistics of Rwanda

Table 41. Rwanda education sector

	2000	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Education	33	49	58	69	74	84	90	104	113	134	143	149	154	157	160
Gov. exp on educ total (of GDP)	4.096					4.2861	3.78633		4.94519	4.7156	4.7461	5.0223		3.79746	3.61734
primary exp. on education	48.18					46.267	45.59538		36.7372	31.846	36.249	30.11		32.665	34.61112
Exp on sec.edu (of gov exp on edu)	16.68					19.759	24.98727		30.6812	37.65	36.485	41.714		42.6248	52.82524
Exp tertiary educ (of gov exp on edu)	34.65					25.412	25.40973		22.7497	18.435	13.269	14.022		20.8579	
students															
Primary students	1E+06	2E+06	2E+06	2E+06	2E+06	2E+06	2190270	2264672	2299326	2E+06	2E+06	2E+06	2E+06	2450705	2,546,263
secondary				218,517	239,629	266,518	288,036	346,518	425,587	486,437	534,712	566,370	565,312	543,936	553,739
tertiary	15.04	13.28	12.08	12.108					16.2248			16.867	19.156	19.5898	17.34653
teachers															
primary	26499	27319	28254	26944	30637	31037	32338	33158	35583	40299	40397	40159	41193	42005	40,921
secondary	5557	7058	7750	7610	7818	12103		15329		20522	23335	25532	27116	29558	
tertiary														4,049	3,281
total schools															
primary				2,295	2,323	2,370	2,432	2,469	2,510	2,543	2,594	2,650	2,711	2,752	2,842
secondary				553	579	643	689	686	1,399	1,362	1,466	1,502	1,521	1,543	1,575

Source: National Institute of Statistics of Rwanda

Map 1. Rwanda's Map



Part Two. Economic Growth

Chapter 3. Alemayehu Geda and Addis Yimer, “An Applied Macroeconometric Model for Rwanda”.

Chapter 4. Jean-Baptiste Habyarimana and Bertrand Dushimayezu, “Good Governance, Economic Growth and Development: Insight from a 22 Years Econometric Analysis”.

Chapter Three

An Applied Macro-econometric Model for Rwanda

Alemayehu GEDA
Department of Economics
Addis Ababa University
Po Box 1176, Addis Ababa, Ethiopia
Email: ag112526@gmail.com

Addis YIMER
Department of Economics
Addis Ababa University
Po Box 1176, Addis Ababa, Ethiopia
Email: addisyimer@gmail.com

Abstract

This study develops a macro-econometric model for a typical supply constrained African economy aimed at developing a theoretical and empirical template for such policy tools that are increasingly being demanded by African ministries of finance and central banks. We concretize it by building a macro-econometric model for Rwanda. The Rwanda macro-econometric model has 107 equations of which 72 are endogenous. In addition, we also build a supplementary ARIMA based model with 33 equations for the exogenous variable to make the model useful for forecasting. We disaggregate the fiscal, balance of payments and money supply blocks of the model to offer an adequate picture of the macro-economy. We also do an econometric estimation of the core behavioral equations of the model using the error correction modeling approach for the period 1960-2009. The model can be easily extended further to the support budgeting, forecasting and macroeconomic policy analyses in the relevant ministries and central banks in Africa. We successfully solve the model and reproduce historical values from 1999 to 2009 and forecast major macro-variables for 2010 to 2015. We also use the model to conduct a policy and external shock related simulation exercise that is important for policymakers.

Keywords: Macro-econometric model, macroeconomic policy, simulation, Rwanda, Africa.

JEL Classification Codes: C51; C52; C53; E60.

1. Introduction

Macroeconomic policymaking in Africa is increasingly being informed by medium to long-term plans such as the Poverty Reduction Strategy Paper (PRSP). This is closely linked to a widely used budgeting approach called the Medium-Term Expenditure Framework (MTEF). Both the realization of a strategy such as PRSP and the use of MTEF require an overall macroeconomic framework that ensures consistency in defining the aggregate resource envelop of a country, how it is going to be spent and for forecasting major macro-aggregates three to four years ahead. A macro-econometric model is an invaluable instrument in achieving this since both the preparation of the budget and forecasting of key macro-variables are done using a consistent framework and hence this does not allow the budget's components to be changed in a discretionary manner. In addition, such forecasts can be used for monitoring the economy with reference to the government's current economic strategy and to suggest modifications either in its substance or tactics.

Another important justification for having macro-modeling in many African countries is its capability to help policymakers take informed decisions by conducting policy analyses using policy simulation. This is crucial for policymakers because it will help them assess the implications of proposed policy packages before their actual implementation. Policy analyses conducted with the aid of such models avoid a partial analysis and hence a partial understanding of issues of national significance. It has the advantage of taking all possible inter-linkages in the economy that are not easily tractable by the human mind. In addition, macro-models are also instrumental in carrying out macroeconomic research by allowing macro-policy research institutions to organize their research across the major components (block) of the macro-model and carrying out an in-depth analysis of major issues in each block such as inflation or fiscal deficit. This in turn improves the model and hence policy formulation (Huizinga and Geda, 2004; see Huizinga et al., 2001).

Despite such important uses of macro-models, their use in Africa is limited. Recently, however, many countries are showing an interest in such models. Thus, there is a need to come up with a template for a macro-model for a majority of the countries on the continent by ensuring that such a model is grounded in African reality and is applicable and built based on a rigorous analysis. Our building of the Rwandan macro-econometric model is primarily motivated to develop such a template. This is done by: (a) developing a macro-econometric model well-grounded in theory and a rigorous econometric analysis; and (b) illustrating the use of such a model using actual macroeconomic policy issues in Rwanda and combining it with expert opinion. Our experience in building and using such models in Kenya and Ethiopia shows that notwithstanding the weakness of macro-models in forecasting, in practice things are not as bad as they look at first because a model's outcome is not meant to be used by itself, but jointly with expert opinion for additional information. This information may be based on events that have just happened but which will affect the immediate future. Also, expert opinions from different segments of the government may be incorporated into the macro-model's forecast and examples of this include specialists in government expenditure and revenue and specialists in different sectors of the economy. These specialists also benefit from this exchange since they get a better picture of the overall economy. Adding such outside information significantly reduces the forecast's uncertainty (see Geda and Yimer, 2013; Huizinga and Geda, 2004; Huizinga et al., 2001).

Generally, a translation of shocks or policy proposals has to be done before they can be used as actual inputs for the model as the model is not tailor-made to the often complex shocks and policy proposals. This requires a thorough understanding of how the model works. Even then some simplifications and additional assumptions are needed to make a proper analysis. It is often necessary to use expert opinion to do this properly. Thus, the practical use of a model of the type developed in our study requires institution building in relevant ministries such as the Ministry of Finance and central banks. Such institutionalization is important not only for an appropriate use of the model but also for its sustainability.

2. The Theoretical Framework of the Model

Our model is built along the lines of the aggregate demand-aggregate supply (AD-AS) framework by emphasizing the supply constrained nature of the economy in question.¹ Unlike in typical demand-driven Keynesian models this is done by explicitly modeling the supply side of the economy. The supply side contains three main components: the formal sector, the informal sector and the agricultural sector. Agriculture is sub-divided into cash crops (exports) (traded sector) and food production for the domestic market (non-traded sector). If the need arises this could readily be sub-divided further by major types of agricultural products. The informal sector consists mainly of small-scale industries and handicrafts, informal trade such as street vendors and informal restaurant services. The formal sector consists mainly of the government and the formal (modern) private sectors of industry and services. The latter include large and medium scale manufacturing, formal trade, hotels and restaurants, transport and communications, banking, insurance and real estate.

Thus, the modeling of the real sector incorporates basic linkages within and between the three sectors (Figure 1). Once we have this prototype, the model can be expanded up to the full scale of the short-run model using the AD-AS framework. The formal and informal sectors both have constant elasticity-of-substitution (CES) production functions. However, the shares of inputs are different. The level of capital used in the formal sector is far greater than it is in the informal sector. As a result, the employment response to demand fluctuations is far greater in the informal sector than it is in the formal sector. The formal private sector is modeled along neoclassical lines based on the theory of profit maximization described in detail in Huizinga and Geda (2004) and given briefly in Appendix 1. Keeping in view monopolistically competitive firms, we set the prices as a mark-up over costs, which consist of labor costs and the cost of intermediate goods and raw materials. Demand for labor and capital follows from a CES production function which allows us to model wages and capital formation/investment.

Formal sector output is demand driven in the short-run. In the long-run it has a supply component as investments may be used to increase capacity. The degree to which this happens depends to a large extent on factors outside a firm's control such as the quality of infrastructure and an overall stable economic and political climate. This is especially

¹This section is based on Huizinga and Geda (2004; also see Geda, 2011) and it heavily draws from that. Readers are advised to consult Huizinga and Geda (2004) for a full and detailed picture of the theoretical framework. To save space we give just the gist of the theoretical framework with a summary of the algebra given in Appendix 1. A demand-driven version of this model's theoretical framework is given in Geda et al., (2002) and this heavily influenced the theoretical formulation of a recent model of the Central Bank of Kenya (see Were et al., 2013).

true if overseas physical and financial investments are to play a major role. Therefore, investments in the formal sector have both a cyclical component following GDP and a structural component following infrastructure and overall macroeconomic stability.

Demand for labor in the formal sector exhibits a large degree of labor hoarding, especially during bad agricultural seasons when a reduction in domestic demand is mostly absorbed by a reduction in profits and also relatively little by lay-offs. This is partly based on the high search costs for a relatively highly skilled and hence scarce labor force and partly based on implicit contract considerations. Therefore, skilled labor is relatively insulated from the cyclical variations in economic growth both in terms of income and employment. Thus, wages in the formal sector are based on a mixture of bargaining and efficiency considerations as well as structural productivity. Wages of the unskilled workers are purely based on efficiency considerations, as there is an excess supply of unskilled labor. This means that in the short-run wages are a mark-up over subsistence levels without much regard for economic activity (see, Huizinga and Geda, 2004; Huizinga et al., 2001).

The agricultural sector, on the other hand, is mostly supply driven. Output is determined by land, the quality of seeds and fertilizers, labor, some capital and most importantly rainfall. Thus, the modeling starts with the agricultural sector as shown in Figure 1. It has a production function based on land, capital, labor, rainfall and technology. Labor consists mostly of family labor which is exogenously determined by population growth. There are strong decreasing returns to scale with respect to labor reflecting the current excess labor supply. Since all elements of the agricultural production function are exogenous so is total agricultural output.

Normally a part of the labor force in agriculture moves to urban areas to find jobs in formal and informal sectors. Because of their low skill levels these workers start out in the informal sector. The wage rate in the informal sector is a mark-up over the subsistence level in the agricultural sector because of efficiency wage considerations among other things. As a result, there are always agricultural workers, especially young ones, who prefer to work in the informal sector and move there if job conditions improve. Because of the constant excess supply of labor in the informal market, the wages are constant in the short-run. Similarly, the wages in the formal sector is a mark-up over that in the informal sector; this is also based on efficiency wage considerations. Workers in the informal sector prefer jobs in the formal sector and, therefore, there is also always excess supply in the formal sector. We may assume that the wages in the formal sector are constant in the short-run as there is an excess supply of labor in the Lewisian sense (see, Lewis, 1954). This is not visible in the form of unemployment in rural areas because of the family nature of farm production (that is, there is disguised unemployment). Young people in general may leave the farms because they cannot get their own land (even if they manage to get land it is very small in size due to population pressures) and they look for employment in the urban informal sector thus maintaining the excess labor supply in the non-agricultural sector (Huizinga and Geda, 2004).

The short-run aspects of the macro-economy relate to modeling output volatility. In particular, this is assumed to prevail in the agricultural sector. The most important determinant of cyclical variations in output is rainfall. If there is an adverse external shock such as a bad agricultural season, food supply to the market reduces sharply. As a result, the prices of food items increase. As food is a major component of CPI in many African countries, rainfall has a major effect on CPI. As nominal wages are not indexed, real wages

of urban workers drop sharply when there is a shortage of food. This reduces domestic demand for industrial products in both formal and informal sectors. In the informal sector, reduced demand leads to reduced employment, which further reduces demand. In the formal sector, the effects are less dramatic. One reason is that part of the demand in the formal sector comes from abroad. Export demand is not directly affected by a bad agricultural season. Another reason is that the formal sector is able to absorb a temporary reduction in demand better through a reduction in profits (in the case of the private sector) or a deficit (in the case of the government sector). The informal sector bears the brunt of cyclical variations in economic growth. Unlike the formal sector, it cannot afford to keep employment intact during a cyclical downturn or a drought. So, a reduction in demand reduces output, employment and investments immediately. The flip side is that it is relatively easy to reactivate economic activity if demand picks up again as labor is readily available and the capital stock is not a major input. Hence, the informal sector is completely demand-driven with constant excess supply and a production function based mostly on low skilled labor (see, Huizinga and Geda, 2004).

In modeling long-term growth it is reasonable to assume that the output of the agricultural sector can be increased substantially through a combination of better seeds, use of fertilizers and better infrastructure. Other things remaining intact this leads to a drop in food prices and a rise in urban workers' real wages. The increase in disposable incomes leads to a rise in consumption demand in the formal and informal sectors. In the formal sector, this leads to increased profits, investments and eventually employment. In the informal sector, it leads to increased employment and eventually increased investments and profits. The key issue in terms of poverty reduction is that the demand for labor in the formal and informal sectors continuously grows faster than population growth which adds to the excess supply of labor, assuming that the food sector will not constrain this growth through inflation in a familiar Kaleckian fashion (see, Geda and Tafere, 2011).

In sum, the overall model for the short-run consists of two blocks that form the aggregate supply side of the model: the agricultural sector whose output is determined by exogenous, but widely fluctuating supply conditions; and the formal and informal sectors, which are mostly demand-determined in the short-run. The link between the two components is the price of food, which is set such that the demand for food in the formal and informal sectors equals the exogenous supply of food. This real sector modeling is briefly summarized in Figure 1. In real sector modeling, the aggregate demand (consumption, investments, government spending and exports) determine the level of imports and total value-added. This value-added is disaggregated into agricultural, formal and informal sectors. Given the data problem on this sector in many African countries the value-added in the informal sector is assumed to be the residual. With this, an injection from aggregate demand, which in turn creates demand for value-added, is assumed to generate demand for factor inputs (capital, labor and imports). It is assumed that the choice of these factor inputs follows from an optimization problem of agents in each sector using a CES production function as given in Appendix 1.

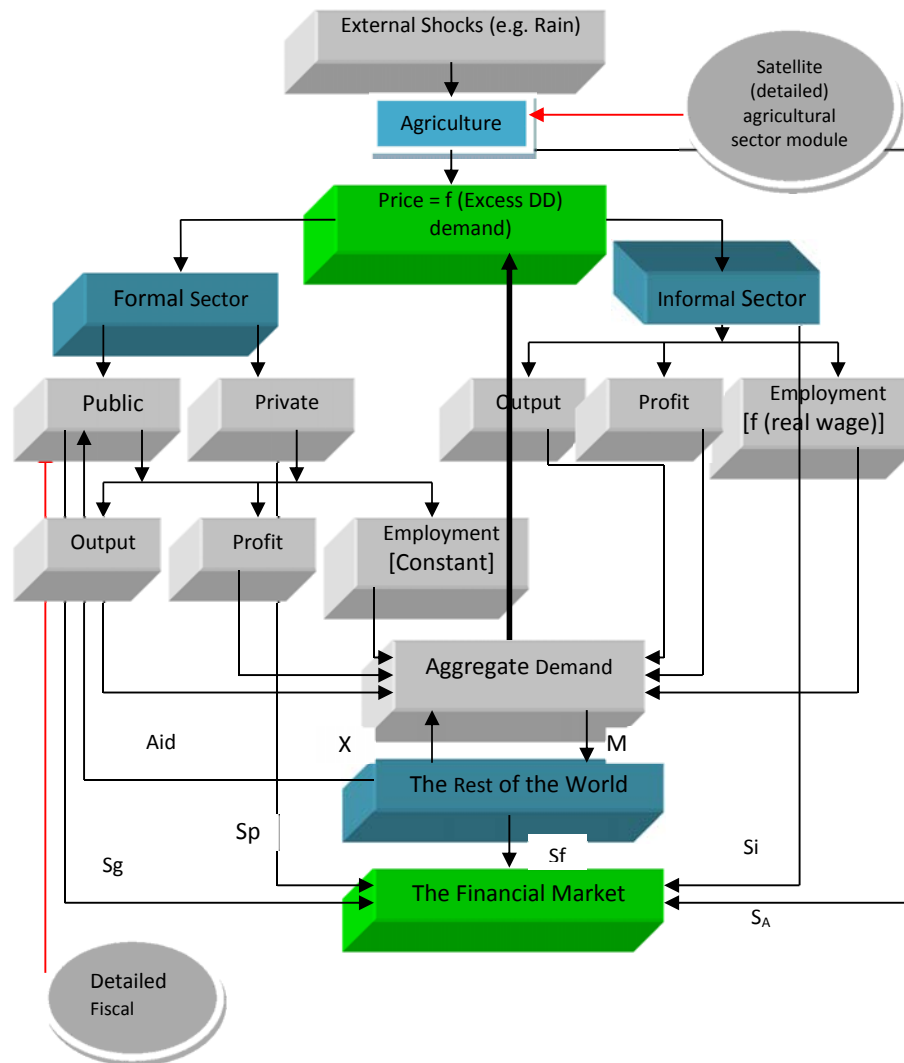


Figure 1: A Flow Chart for Rwandan Macro-Model - The Real Sector
Source: Huizinga and Geda (2004).

Our model is designed in such a way that it tends to return to equilibrium with ‘normal’ capacity utilization and unemployment rates in the medium and long-run. The main feedback mechanisms in the real economy work through the wage-price spiral, the interest rate and the real exchange rate which are modeling as a nominal sector of the model and depicted in Figure 2. The mechanisms in the model can be illustrated by considering a supply shock, like favorable rainfall that increases output in the agricultural sector.

The increased supply of food leads to lower prices and an increase in real wages. This leads to an increase in consumption demand in the informal and formal sectors. Both sectors increase their output. The formal sector also increases investments which are in part financed by increased profits. Employment in the formal sector is much less responsive in the short-run. The informal sector is far more employment-based and does not feature labor hoarding and therefore immediately increases employment. In addition, increased demand and profits lead to more investments, but this may be less important numerically. Increase in investments

and employment further increase demand in the informal and formal sectors and also demand for food from the agricultural sector. The model converges because of leakages in the form of increased savings, increased imports and increased prices in the formal sector leading to erosion in competitiveness (Figures 1 and 2) (Huizinga and Geda, 2004).

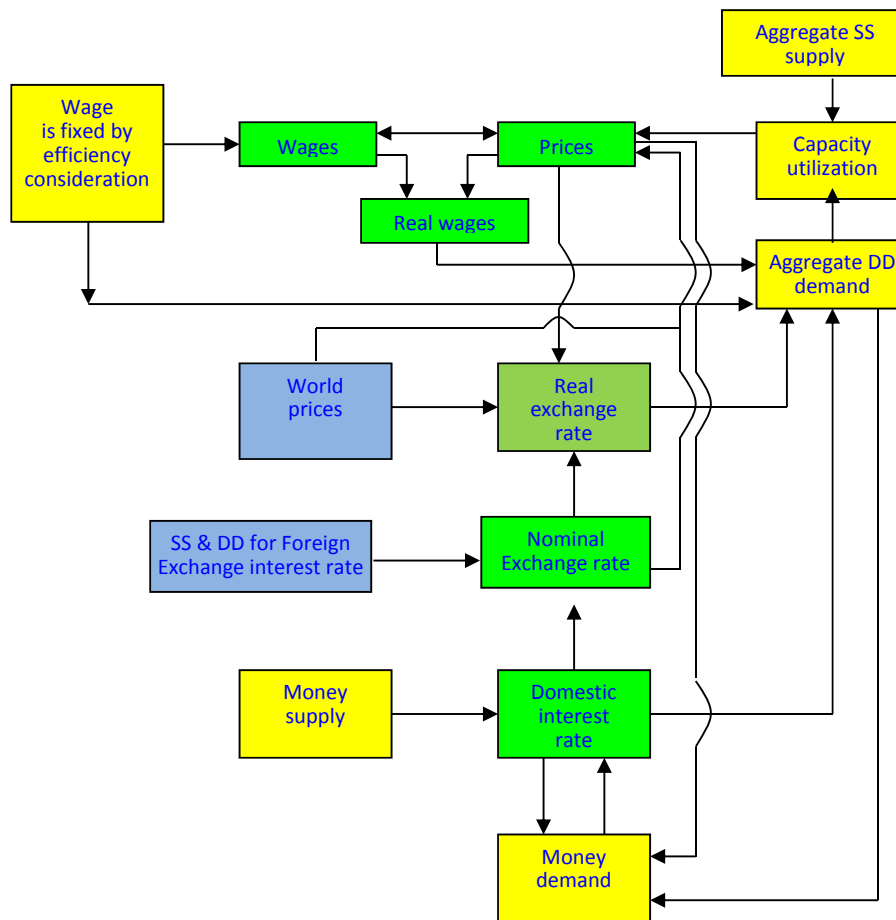


Figure 2: A Flow Chart for Rwandan Macro-Model - The Nominal Side
Source: Huizinga and Geda (2004).

Figure 2 gives an overview of the nominal side of the economy. The light shaded boxes denote demand and supply in the labor, goods and services and money markets. The white (green) boxes denote endogenous prices and the dark (light blue) ones denote exogenous variables. The arrows indicate the direction of causation or determination. Six prices are determined endogenously in the model (the prices of goods and services; the nominal and real wage; the nominal and real exchange rates; and the domestic nominal interest rate (Huizinga and Geda, 2004)).

Wages and prices are determined in the labor and product markets. Wages and prices also depend on each other as indicated by the double arrow so there is a wage-price spiral in the model. The exchange rate and the interest rate are determined in the financial market. The financial market is sub-divided into markets for domestic money, domestic bonds and foreign assets. By Walras' law we only have two models of these markets; and if these are

in equilibrium, so is the third. The markets for domestic money and for foreign assets are modeling leaving the market for domestic bonds implicit. The exchange rate is floating (or managed floating) so that money supply is available as an exogenous policy instrument. Money demand is determined by aggregate demand, price level and interest rates. The interest rate moves to clear the money market so that it is a function of money supply, real demand and prices. The exchange rate clears the market for foreign assets. A rise in the domestic interest rate relative to the foreign interest rate makes domestic assets relatively more attractive and thus causes an appreciation. By definition, the real exchange rate follows from the nominal exchange rate, the domestic price level and the foreign price level (see Figure 2) (Huizinga and Geda, 2004).

3. Applied Macro-econometric Models in Eastern and Southern Africa:² A Review of Literature

Following the economic events of the 1970s and early 1980s, a large number of macroeconomic models have been constructed for many African countries.³ In the heated debate of the 1970s and early 1980s on the role of additional external resources and domestic adjustment measures in economic recovery in Africa, Horton and McLaren (1989) used a supply constrained macro-econometric model of the Tanzanian economy to examine the effects of several alternative strategies. Their results highlight the problems of either a strategy of devaluation or of more external aid alone.

Elliott et al., (1986) give macroeconomic model of the Kenyan economy as a small and open developing economy that is vulnerable to conditions in world commodity and credit markets. They describe the theoretical structure of the model, which consists of markets for domestic output, labor, money and the balance of payments. They provide a complete listing of the model equations with numerical results of the estimated equation and use the model for forecasting and policy simulations of alternative policies. Similarly, Musila and Rao (2002) developed a demand-oriented macro-econometric model of the Kenyan economy, whose equations are estimated using the cointegration technique. They use this model to perform various policy simulation experiments to determine the sensitivity of key macroeconomic variables to changes in exchange rate, net government current expenditure and nominal interest rate. Their results show that exchange rates and fiscal policies were relatively more effective than monetary policy in influencing the level of economic activity.

Notwithstanding Elliott et al., (1986) and Musila and Rao's (2002) models, which are academic-based works, two applied macro-econometric models are currently in use in Kenya: the CBKMM (see, Were et al., 2013), and the KIPPRA-Treasury Macro Model (KTMM) (see, Huizinga et al., 2001). The theoretical basis of both the models is the Keynesian demand-driven model that is set up in a typical aggregate demand (AD)-aggregate supply (AS) framework. Their fundamental difference lies in the fact that KTMM consolidates the monetary aspect of the model while having a detailed government (fiscal) sector. This is because it was designed to meet government needs in the national budgetary and planning process. On the other hand, the CBK model has a more detailed monetary sector tailored to

² The survey in this section focuses on applied macro-models in Eastern and Southern African countries.

³ A survey of modeling efforts in Africa in the past by Harris (1985) showed that there were about 184 macroeconomic models on various African economies, 33 of which were on Nigeria.

the needs of the monetary policy process while consolidating the fiscal block of the model. Both models are currently used for forecasting, policy analyses and budget preparation.

Kidane (1991) developed a detailed economic-demographic model for Ethiopia and studied the interaction between the two considering various demographic variables as being endogenous. His model aimed, *inter-alia*, to assess the effect of changes in these demographic indicators on some economic parameters. He developed the economic-demographic interactions in a schematic form by identifying the direction of variable associations and then recording the various structural equations and identities. He estimated the parameters of the model using time-series data and then presented alternative simulation outcomes of the model under different assumptions.

Musila (2002) estimated a small open-economy macroeconomic model for Malawi in which the structure of the model consists of production, expenditure, government, monetary and employment sectors and prices. The short-run version of the model was estimated using the cointegration estimation technique. The model is used for policy analyses. For instance, the dynamic simulation results indicate that a sustained devaluation of the Malawi kwacha improved the real trade balance, but led to higher inflation and reduced real GDP growth. A bond-financed increase in government consumption expenditures was less inflationary and led to higher real GDP growth but worsened the real trade balance position.

Tjipe et al., (2004) developed a macro-econometric model for the Namibian economy. Based on experience and their understanding of the functioning of the different sectors of the economy, this model was informed by a theoretical framework that incorporated all essential features of the economy. The model equations were estimated using an error correction modeling approach and their forecasting performance was assessed. The authors constructed the model and carried out a policy analysis and stimulations of external shocks to examine different scenarios to give further insights into the future path of the main economic variables of the model.

Huizinga and Geda (2004) developed a supply-constrained macro-econometric model for Ethiopia for use by the Ministry of Finance and Economic Development. They estimated the core behavioral equations of the model using an error-correction modeling approach. Like that of KTMM in Kenya, fiscal, balance of payments and money supply blocks of their model were fairly disaggregated to offer an adequate picture of the macro-economy. The Ethiopian treasury has used the model for forecasting and budget preparation.

Finally, the Bank of Uganda (2010) built a small-scale macroeconomic model for Uganda. The model consists of five equations: a price equation, an aggregate demand equation (IS curve), a money demand equation (LM), an exchange rate equation and a policy rule. These equations are estimated using quarterly data for the period 1999-2009. The model is used for conducting policy simulation experiments to analyze the effect of different external shocks on inflation, output, exchange rate and interest rate. The simulation results suggest that government expenditure (fiscal policy) is quite effective in raising aggregate demand, while money supply (monetary policy) has little impact on inflation and interest rates and no effect on output.

Despite the importance of such applied macro-econometric models in many Africa countries which is an encouraging trend there are a number of problems associated with these models and their use. The first important one relates to the limited emphasis that most

applied macro-models have on the supply constrained nature of African economies and the importance of the informal sector in such countries and hence their modeling. Another problem that is widespread in most African macro-econometric models relates to the macroeconomic modeling tradition that is largely framed without a consistent analytical framework but is used for either policy analyses or model-based forecasting exercises. As Harris (1985) argues, equation specifications have also been an exercise in the search of those models that can give better explanatory powers, rather than being rooted in any framework of economic behavior. The models' emphasis is on 'tracking history' and they largely ignore the long-run sustainability of policy actions. Thus, inter-temporal budget constraints are not observed and these models are not robust for analyzing the consequences of major policy shifts (Harris, 1985).

In addition, although a large number of macroeconomic models have been constructed for Africa, most of the models on individual African countries (see, for example, Elliott et al., 1986; Horton and McLaren, 1989; Musila, 2002; Musila and Rao, 2002) are either the products of doctoral theses, represent one-shot research efforts to write journal articles or they are built to analyze specific issues and not maintained thereafter. This shows the challenge of moving from academic modeling towards applied macro-modeling for policy analyses and its institutionalization.

4. Estimation Method and Results

4.1 Estimation Method

The modeling and estimating strategy in our study involves an application of the Johansen (1988, 1991) approach. We estimate individual behavioral equations in a cointegration framework using the single equation error correction modeling (ECM) approach, where short-run and long-run dynamics are modeled simultaneously.

Following Johansen (1988, 1991) we may consider a VAR model given by:

$$(1a) \quad Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_n Y_{t-n} + \mu_t$$

where, Y represents a vector of variables with n lags.

Generally, economic time series exhibit a non-stationary process and hence VAR systems like Equation 1a can be expressed as Equation 1b through repeated parameterization to tackle this problem (Geda et al., 2012):

$$(1b) \quad \Delta Y_t = -\sum_{i=1}^n (I - A_i) Y_{t-i} - \sum_{j=2}^n A_j \Delta Y_{t-j} - \sum_{j=3}^n A_j \Delta Y_{t-j} - \sum_{j=i}^n A_j \Delta Y_{t-n-1} + \phi D + \phi \mu_i, \text{ where, } D \text{ is a vector of exogenous variables}$$

or

$$\Delta Y_t = \Pi Y_{t-1} \sum_{j=i+1}^{n-1} \Phi_i \Delta Y_{t-n+1} + \phi D + \phi \mu_i$$

With

$$\Pi = \left(I - \sum_{i=1}^n A_i \right) \quad \text{and} \quad \Phi_i = \left(I - \sum_{j=i+1}^n A_j \right) = -A * (L)$$

The model that we estimate is based on the VECM formulation given as Equation 1b, which is a traditional first difference VAR model except for the term ΠX_{t-1} . The Johansen procedure is based on an examination of matrix Π , which contains information about long-run relationships. The analysis of a long-run relationship in the model is based on examining the rank of this matrix. The most interesting possibility is when $0 < \text{rank } \Pi = r < p$, which implies there are $p \times r$ matrices α (the adjustment vector) and β (the long-run cointegration vector) such that $\Pi = \alpha\beta'$. The cointegration vector β has the property that $\beta'X_t$ is stationary even though X_t itself is non-stationary. The Johansen procedure helps determine and identify this/these cointegrating vector(s). The empirical part of our study uses this approach to identify such cointegrating vector(s).

Equation 1b is estimated based on the autoregressive distribution lag model (ADL) formulation of the VAR given as Equation 1a, which is re-parameterized to offer Equation 1b. In general, in ADL formulation, a long-run (equilibrium) relationship between two variables, Y and X , can be given by Equation 2:

$$(2) \quad Y_t = KX_t^\gamma = \gamma_1 + \gamma_2 X_t$$

where, K, γ_1 and γ_2 are constants and $\gamma_1 = \log K$.

As this equilibrium relationship cannot be observed, the observable disequilibrium formulation of this long-run (equilibrium) relationship between Y and X , in a simplified form, can be given by Equation 3 which is simple *ADL* (m, n, p) where m is the number of lags and n and p are the number of endogenous and exogenous variables respectively, *ADL* (1,1,1). Formulation of Equation 2:

$$(3) \quad Y = \beta_0 + \beta_1 X_t + \beta_2 X_{t-1} + \alpha Y_{t-1} + u_t, \quad 0 < \alpha < 1$$

With some re-parametrization,⁴ the ECM representation of Equation 3, which is the estimable version of Equation 1, can be given by Equation 4 (Geda, 2002; Hendry, 1995; Morales and Raci, 2013; Thomas, 1993):

$$(4) \quad \Delta Y = \beta_1 \Delta X_t - (1 - \alpha)[Y_{t-1} - \gamma_1 - \gamma_2 X_{t-1}] + u_t$$

where, $\gamma_1 = \frac{\beta_0}{1-\alpha}$; $\gamma_2 = \frac{\beta_1 + \beta_2}{1-\alpha}$; and $\{-(1 - \alpha)\}$ = the ECM term that should be negative.

This formulation can be generalized for a general ADL of the form:

$$(5) \quad Y_t = \beta_0 + \sum_{i=1}^{m+1} \beta_i X_{t-i+1} + \sum_{i=1}^{m+1} \alpha_i Y_{t-i} + u_t$$

The estimable ECM formulation of Equation 5 can be derived in a similar way as:

$$(6) \quad \Delta Y_t = \gamma_0 + (1 - \sum_{i=1}^m \alpha_i)[Y_{t-m} - \gamma_0 - \sum_{i=1}^m \gamma_i X_{t-m}] + \sum_{i=1}^m \beta_i \Delta X_{t-m+i}$$

where, $\gamma_0 = \frac{\beta_0}{1 - \sum_{i=1}^m \alpha_i}$ is the constant; and the long-run coefficients are given by $\gamma_i = \frac{\sum_{i=1}^{m+1} \beta_i}{1 - \sum_{i=1}^m \alpha_i}$

⁴Subtracting Y_{t-1} from either side of Equation 3 or adding and subtracting X_{t-1} in the right-hand side of the resulting equation gives Equation 4.

4.2 Estimated Results

Before estimating the model, we carried out a test for stationarity of the variables in the model and found all the variables to be integrated of order one, I (1). In addition, the Johanson test for cointegration proved the presence of a long run relationship among the variables in each of the behavioral estimates. Table 1 presents the short-run and long estimated coefficients for each of the behavioral equations from their ECM formulation. We generally found the theoretical expected sign in the estimated equations. The number of lags used in the LM and Ramsey RESET test is given in Table 2.

Table 1: Estimated Equations of the Model

1	Private Consumption
	$\Delta(\ln RPC) = -3.18 + 0.52\Delta(\ln RGDI) - 0.02\Delta(\ln DIR) - 0.26ECM_{t-1} + 0.37\ln RGDI_{t-1}$ (-2.24) (11.93) (-0.58) (-2.70) (5.37) $-0.06\ln DIR_{t-1}$ (-2.03)
2	Private Investment
	$\Delta(\ln RPRINV) = -6.59 - 0.51\Delta(\ln RPUINV) + 2.13\Delta(\ln RGDP) - 1.70\Delta(\ln GDPDEF)$ (-1.39) (-4.60) (4.46) (-2.74) $-0.22\Delta(\ln INVP) - 0.98ECM_{t-1} - 0.22\ln RPUINV_{t-1} + 1.06\ln RGDP_{t-1}$ (-0.40) (-34.75) (-1.15) (2.77) $-1.28\ln GDPDEF_{t-1} - 0.97\ln INVP_{t-1} + 0.19@trend$ (-2.58) (-6.13) (3.85)
3	Food Demand
	$\Delta(\ln FC) = -7.72 + 0.12\Delta(\ln CPI) + 1.75\Delta(\ln RGDI) - 0.42ECM_{t-1} + 0.93\ln CPI_{t-1}$ (-2.33) (0.36) (13.36) (-2.70) (3.07) $-0.65\ln CPI_{t-2} + 1.01\ln RGDI_{t-1} + 0.44DUM_{90}$ (-2.04) (2.96) (3.65)
4	Agricultural Production
	$\Delta(\ln RAGVA) = -15.49 + 2.38\Delta(\ln AGLF) + 1.01\Delta(\ln CS) - 0.42ECM_{t-1} + 0.37\ln AGLF_{t-1}$ (-1.75) (11.08) (4.03) (-2.27) (2.01) $+0.55\ln CS_{t-1} + 0.05@trend$ (4.85) (3.49)
5	Non-Agricultural Production
	$\Delta(\ln RNAGVA) = -10.42 + 3.08\Delta(\ln NAGLF) + 0.79\Delta(\ln CS) - 0.24ECM_{t-1}$ (-4.56) (9.41) (3.06) (-2.59) $+0.97\ln NAGLF_{t-1} + 0.24\ln CS_{t-1} + 0.07@trend$ (2.81) (3.76) (8.37)
6	Export Demand
	$\Delta(\ln RX) = 3.05 + 0.20\Delta(\ln RER) + 0.48\Delta(\ln INV GDP) + 0.43\Delta(\ln INCTRAD)$ (3.84) (1.20) (2.45) (3.71) $-0.53ECM_{t-1} + 0.03\ln RER_{t-1} + 0.56\ln INV GDP_{t-1} + 0.33\ln INCTRAD_{t-1} - 0.82DUM_{94}$ (-11.24) (0.27) (9.35) (4.5) (-8.79)
7	Import Demand
	$\Delta(\ln RM) = -16.64 - 0.50\Delta(\ln RER) + 1.29\Delta(\ln AID) + 0.58\Delta(\ln RGDP) - 0.45ECM_{t-1}$ (-1.92) (-1.87) (0.77) (1.47) (-2.11) (0.42) $+0.08\ln RER_{t-1} + 0.14\ln AID_{t-1} + 0.91\ln RGDP_{t-1} + 1.33DUM_1 - 0.05@trend$ (0.42) (1.44) (1.98) (2.24) (-1.95)
8	Exchange Rate
	$\Delta(\ln NER) = -0.52 + 1.20\Delta(\ln M) - 0.14\Delta(\ln XA\_DS) - 0.13ECM_{t-1} + 0.28\ln M_{t-1}$ (-1.69) (8.56) (-6.68) (-2.72) (8.91)

	$+0.25LnXA\_DS_{t-1}$ (-13.95)
9 Wage Rate	
	$\Delta(LnNWR) = -4.14 + 0.42 \Delta(LnCPI) - 0.46\Delta(LnUNEMPTRATE) + 0.15 \Delta(LnLABPRO)$ (-2.79) (1.46) (-0.10) (0.46)
	$-0.95ECM_{t-1} + 0.37LnCPI_{t-1} - 1.46LnUNEMPTRATE_{t-1} + 0.71LnLABPOR_{t-1}$ (-6.76) (1.40) (-1.99) (4.76)
	$+0.05@trend$ (1.08)
10 Money Demand	
	$\Delta(LnM2) = -1.07 + 0.75 \Delta(LnCPI) - 0.10\Delta(LnIRD) + 0.51 \Delta(LnRGDP)$ (-0.60) (3.50) (-1.86) (9.47)
	$-0.06ECM_{t-1} + 0.11LnCPI_{t-1} - 0.10LnIRD_{t-1} + 2.17DUM_{06} + 0.20DUM_{07}$ (-2.12) (2.35) (-1.99) (6.56) (4.45)
11 Consumer Price	
	$\Delta(LnCPI) = 17.09 + 0.39 \Delta(LnCUR) + 0.03\Delta(LnM2) - 0.27 \Delta(LnFC) + 0.51 \Delta(LnLIR)$ (9.93) (3.67) (1.87) (-5.19) (4.63)
	$+0.06 \Delta(LnMP) - 0.47ECM_{t-1} + 0.49LnCUR_{t-1} + 0.59LnLIR_{t-1} + 0.02LnMP_{t-1}$ (0.70) (-4.99) (6.06) (4.90) (0.17)
	$+0.06LnM2_{t-1} - 0.41LFC_{t-1} + 0.05DUM_{94} + 0.14DUM_{96} + 0.04@trend$ (2.05) (-8.68) (1.86) (-3.58) (5.59)
12 Export Price	
	$\Delta(LnXP) = -6.61 + 1.92 \Delta(LnPUC) + 0.51\Delta(LnCUR) + 0.13 \Delta(LnRIR) + 0.33 \Delta(LnMP)$ (-5.08) (2.55) (2.90) (1.41) (3.52)
	$-0.92ECM_{t-1} + 2.34LnPUC_{t-1} + 0.41LnCUR_{t-1} + 0.25LnRIR_{t-1} + 0.05LnMP_{t-1}$ (-5.06) (5.08) (1.79) (2.00) (0.31)
13 Investment Price	
	$\Delta(LnINVP) = 0.04 - 0.53 \Delta(LnCUR) + 0.01\Delta(LnCUP) + 0.61 \Delta(LnMP) + 0.12 \Delta(LnRIR)$ (0.07) (-3.15) (-0.01) (2.67) (2.45)
	$-0.36ECM_{t-1} + 0.13LnCUR_{t-1} + 0.28LnPUC_{t-1} + 0.49LnMP_{t-1}$ (-3.16) (1.21) 1.06) (2.49)
	$+0.11LnRIR_{t-1} + 0.46DUM_{91} + 0.03@trend$ (1.07) (0.46) (-4.17)

Note: ECM_{t-1} is the Error Correction Term; t-values are in parenthesis.

As can be seen from the Adjust R^2 in Table 2 the estimated individual behavioral equations have a good fit. In addition, the estimated individual equations passed all post-estimation diagnostic tests reported for each of the estimated equations. Such tests included normality test, heteroskedasticity test, test for serial correlation, model specification and stability test (Table 2).

Table 2: Diagnostic Tests of the Estimated Behavioral Equations

Equation	Adjusted R^2	F-Statistic	LM Serial Correlation test	White Heteroskedasticity test	Normality test(JB)	Ramsey RESET test
Private Consumption	0.90	46.03 (0.00)	0.24 (0.62)	20.08 (0.34)	2.55 (0.28)	1.18 (0.29)
Private Investment	0.69	44.00 (0.00)	4.09 (0.13)	17.95 (0.10)	1.87 (0.37)	10.92 (0.01)
Food Demand	0.90	37.67 (0.00)	0.03 (0.86)	9.21 (0.24)	2.45 (0.29)	3.78 (0.07)

Agricultural Production	0.29	2.87 (0.03)	0.66 (0.79)	28.37 (0.25)	8.59 (0.01)	0.10 (0.75)
Non-Agricultural Production	0.61	7.90 (0.00)	0.52 (0.77)	27.35 (0.24)	0.53 (0.77)	0.10 (0.75)
Export Demand	0.80	14.08 (0.00)	2.07 (0.15)	4.31 (0.89)	0.79 (0.67)	0.10 (0.75)
Import Demand	0.48	3.35 (0.02)	0.17 (0.68)	7.59 (0.58)	0.10 (0.95)	0.04 (0.84)
Exchange Rate	0.46	5.04 (0.00)	1.29 (0.26)	12.95 (0.84)	0.53 (0.77)	12.16 (0.00)
Wage Rate	0.98	107.35 (0.00)	1.02 (0.31)	6.84 (0.55)	0.08 (0.96)	0.44 (0.54)
Money Demand	0.97	128.61 (0.00)	0.12 (0.73)	8.48 (0.49)	0.48 (0.79)	1.32 (0.26)
Consumer Price	0.75	6.80 (0.00)	2.36 (0.13)	12.99 (0.53)	0.97 (0.62)	6.87 (0.02)
Export Price	0.61	5.10 (0.00)	1.61 (0.21)	4.60 (0.87)	1.96 (0.38)	2.78 (0.12)
Investment Price	0.53	3.43 (0.02)	0.67 (0.41)	9.20 (0.60)	0.13 (0.94)	1.90 (0.19)

Note: P-values in parenthesis.

With these estimated equations and a consistent macro database we developed the model in the Eviews platform. A solution to the fully-fledged model requires incorporating identities and bridging equations. The list of these bridging equations is given in Appendix 1b. The model was used after calibrating it and by running it repeatedly to see its stability, its capacity to reproduce historical values of the macro-economy and the sensibility of its forecast values. The model was found to reproduce historical values and offers reasonable forecast values. It was also found to be stable.

5. The Use of the Model: A Policy Simulation Experiment for Rwanda

In this section we report some policy simulations related to the Rwandan government's plan which is contained in the 'Budget Framework Paper 2012/13-2014/15'. The aim of this is showing the use of the model both for forecasting and policy analysis. The Government of Rwanda noted that its budget could have macroeconomic risks that may result from its proposed policy and possible external shocks (Box 1).

However, these probable macroeconomic risks are not quantified in the budget because of the lack of a macroeconomic model in Rwanda. Thus, our task here is to show the use of the model by focusing on macroeconomic risks and if there are any then the planned budget has no macroeconomic stability. Apart from showing the short-term forecasting ability of the model built in the context of our study, we also demonstrate the use of such models to tackle real-world policy problems.

Box 1: External and Policy Shocks Examined in the Simulation Exercise Government Policy 1

- 1) Government expenditure stipulated in the budget framework contains (see Table B1):
 - (a) Change in the total government expenditure in line with the proposed budget (an annual growth of 10 per cent during the budget period)
 - (b) Change in composition of this expenditure: Annual growth of 13 and 5 per cent for current and capital expenditure respectively.

Table B1: Level and Growth of Government Expenditure in the Budget Framework

	July 2011- June 2012	2012-13	2013-14	2014-15	
Model Years	2011	2012	2013	2014	Average
Current Expenditure (in billion Rwf)	596.3	670	782	8.57	726.3
Annual Growth		12.4	16.7	9.6	12.9
Capital Expenditure (in billion Rwf)	508.6	651.6	715	6.25	624.9
Annual Growth		28	9.8	-12.6	8.4
Total Government Expenditure	1104.9	1321.1	1497	1482	1351.3
Annual Growth		19.6	13.3	-1	10.6

Government Policy 2

- 2) The new Wage Pay and Retention Policy: Rwf 46.7 billion which is about 8 per cent of the current expenditure or 4 per cent of the total government expenditure.
- 3) Proposed Efficiency Saving: This is assumed to bring a 4.2 per cent cut in the allocation of each of the budget lines outlined in the budget to generate the Rwf 1.1 billion proposed (which is 0.1 per cent of the budget) for the airport project.

The External Sector Risk Stipulated in the Budget

- 4) The probable slowdown in the world economy: Impact of the global economy on the planned budget. This takes two forms:
 - (a) Change in foreign price (import price increase) 5 to 10 per cent which is a record in the last 5 years. We simulated the relatively optimistic scenario of a 5 per cent rise in import price.
 - (b) A decline in exports (say due to the global economic slowdown - Rwanda's trading partners' economies). The last 5 years show a decline in exports that varies from 2.6 to 8.4 per cent. We took the average value of 5 per cent.

Financing Risk

- 5) Financing risk: A shortfall in external resources is proposed to be addressed by a possible delay in non-priority spending in the budget document. For this we simulated a decline in net-external borrowing of 10 per cent.

Source: Compiled from Republic of Rwanda, Ministry of Finance and Economic Planning (2012).

The simulation exercise in relation to the scenarios noted in Box 1 is focused on some major macroeconomic outcomes (see Box 2) that need to be examined to see what their likely direction may be, and hence the implied macroeconomic stability of the country during the realization of the proposed budget. This in turn is fundamental for sustainable growth, poverty reduction and social and political stability. Thus, we carried out a simulation exercise for the shocks outlined in Box 1.

Box 2: Macroeconomic Outcome Indicators Selected to Gauge the Trend of the Macro-Economy

1. GDP and GDP Growth	7. External Sector/Balance of Payment
2. Investment (Private and Total)	7.1 <i>Export of Goods and Non-factor Services</i>
3. Private Consumption	7.2 <i>Import of Good and Non-factor Services</i>
4. Inflation (CPI)	7.3 <i>Current/Overall Balance of Payment</i>
5. Exchange rate (Nominal and Real)	
6. Fiscal Issues	
6.1 <i>Government Revenue (before and after grants)</i>	
6.2 <i>Government Expenditure</i>	
6.3 <i>Government Surplus/Deficit</i>	

5.1. The Base run values and Forecast

We start our policy analysis by producing what is called a base run value of the model. The current version of the model could be solved from 1999 to 2009 and can fairly reproduce actual/historical figures. Given the evolution of the exogenous variables that are forecast using the supplementary ARIMA model with 33 endogenous equations built for this purpose we also used it to forecast major macro-variables for 2010-15.

There are two advantages of the base run. First, it gives us the evolution of the economy without policy interventions and external shocks. We use this as the benchmark to measure the effect of the government's planned activities, as outlined in Box 1. Second, it also shows the potential of the model for making macroeconomic forecasts which are important for policymakers. Some of the major values of the base run and forecast values are reported in Table 3 and Figure 3.

Table 3: Base run and Forecast Values of Major Macroeconomic Outcomes Forecast

Year	Growth	Real GDP	Real Private Investment	Real Private Consumption	Real Exports	Real Imports	Total Government Expenditure	Total Revenue after grants
2009	5.6	1366.8	104.3	1545.6	94.8	1093.3	780.4	738.0
2010	5.7	1444.8	118.2	1659.0	93.5	1134.1	909.6	897.7
2011	8.9	1574.1	135.5	1837.3	90.7	1199.3	1044.0	1063.1
2012	6.4	1675.0	145.5	2024.1	86.6	1285.3	1168.5	1219.0
2013	7.7	1803.9	162.3	2237.1	82.5	1377.9	1299.8	1382.8
2014	7.0	1930.6	175.8	2463.6	78.9	1482.5	1435.3	1552.4
Year	Government Fiscal Surplus after grants (as per cent GDP)		Government Fiscal Surplus before grants (as per cent of GDP)		Current Account deficit (as per cent of GDP)		BOP Overall (as per cent of GDP)	
2009	-0.5		-17.8		-12.0		-6.8	
2010	-0.1		-15.5		-9.9		-5.3	
2011	0.1		-13.9		-8.7		-4.6	
2012	0.3		-13.4		-8.5		-4.6	
2013	0.5		-13.0		-8.4		-4.6	
2014	0.6		-12.9		-8.4		-4.8	

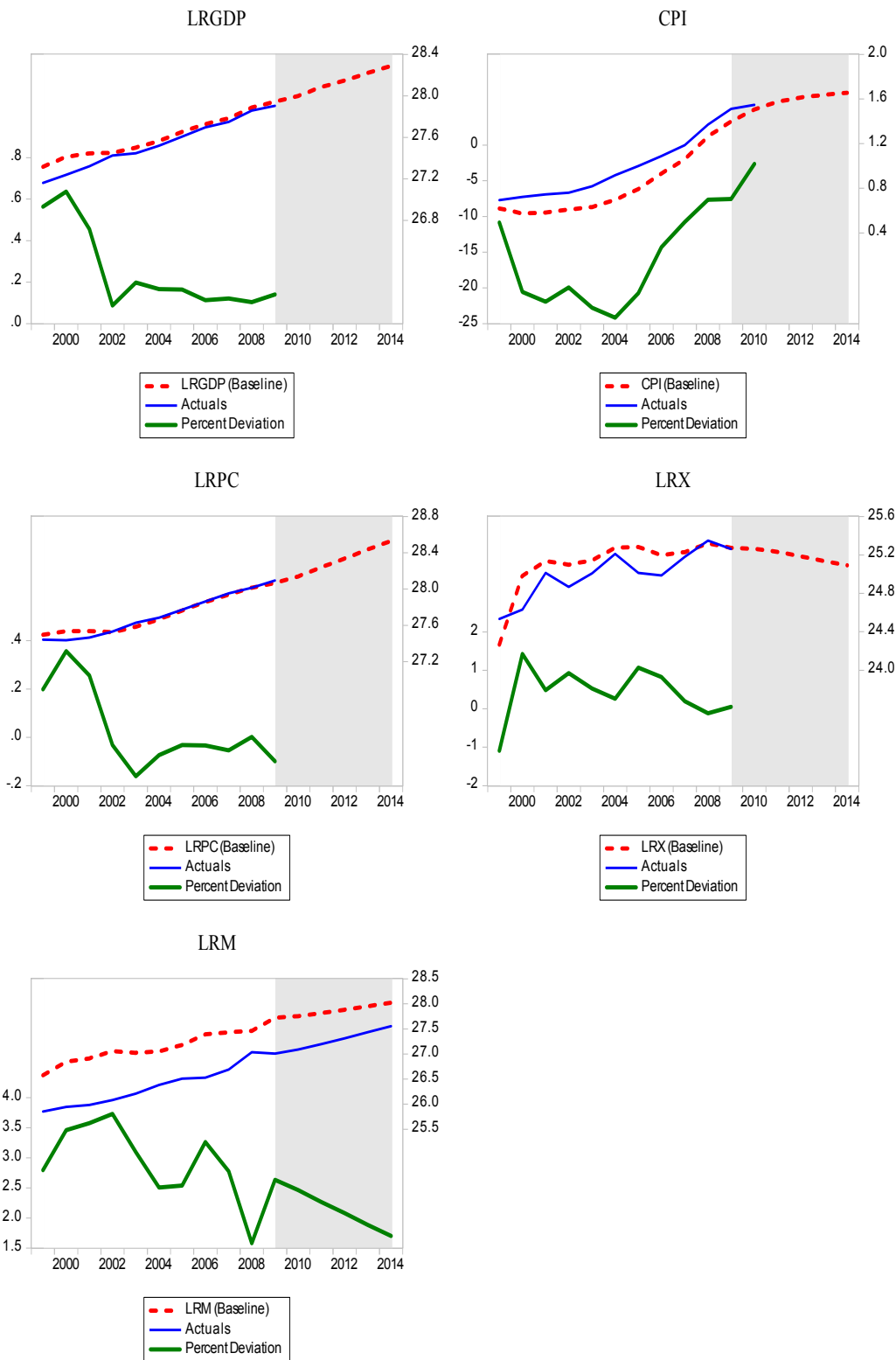


Figure 3: Base run and Forecast Values of the Major Macroeconomic Variables
Forecast

5.2 Policy Simulation Outcomes

5.2.1 The Effect of Government Policy 1: Planned Government Spending

In this simulation, we raised the level of total public spending from its base run value generated using the forecasting ability of the model to the level stipulated in the new budget which is a growth rate of about 10 per cent per annum from 2009 to 2014. The results of this simulation are given in Figure 4 (and Table A2(a) in Appendix 2).

The results show that the proposed spending during the fiscal period will generally be compatible with a stable macroeconomic environment (see Figure 4). The effect on real GDP is almost nil and hence the GDP growth rate will remain as that of the base run forecast. The effect on inflation, nominal as well as real exchange rate is also negligible as the deviation from the base run is in the range of 0.01 per cent to 0.05 per cent with this policy.

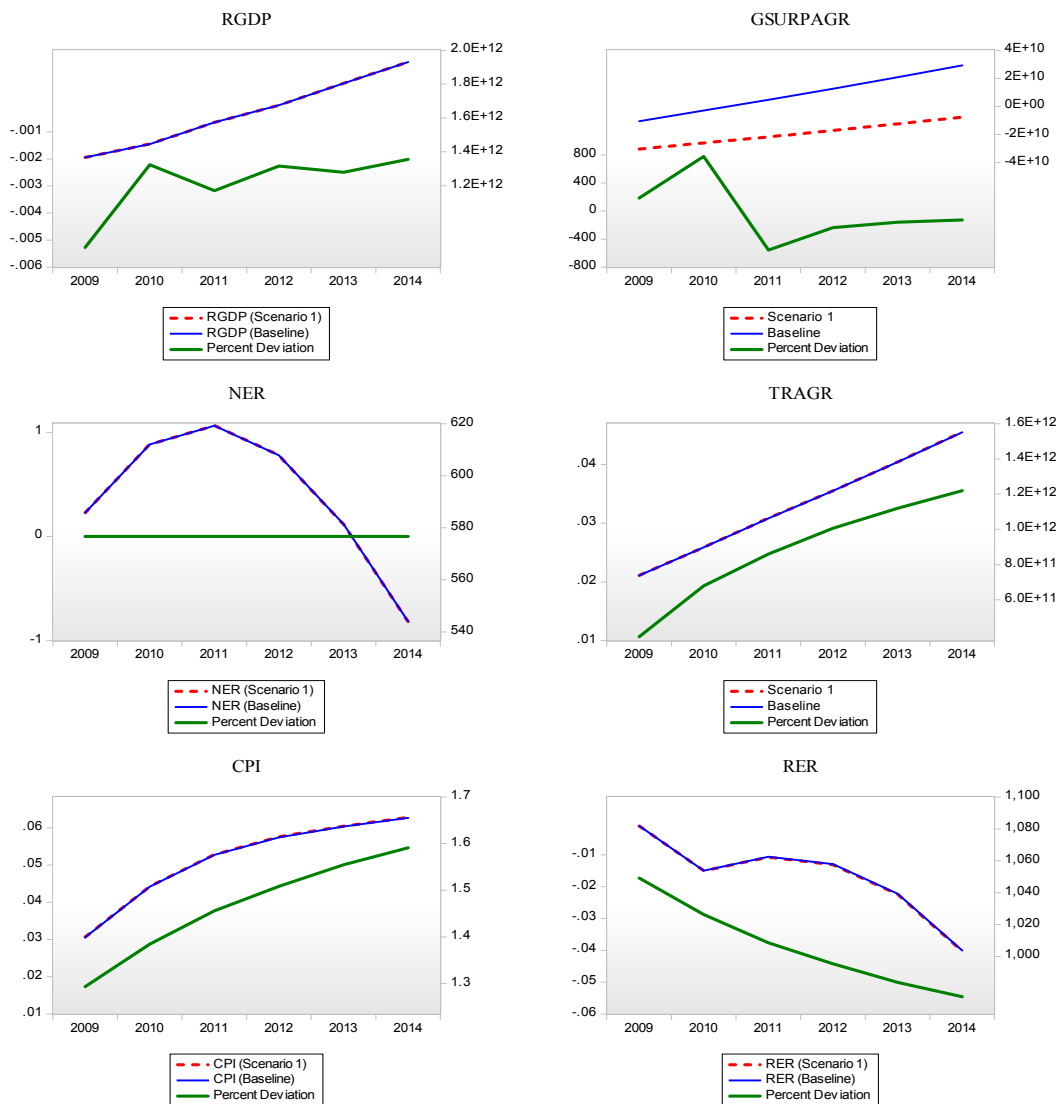


Figure 4: The Effect of the Proposed Government Spending (Deviation from Base Run, in Per cent)

Notwithstanding the effect of this total spending simulation, the model shows that the composition of this spending does matter in terms of its macroeconomic effect although it is not extremely significant in terms of magnitude (see Figure 5 and Table A2(b) in Appendix 2). As noted in Box 1 we varied the current expenditure by 13 per cent per annum and the capital expenditure by 5 per cent as stipulated in the budget framework paper (the combined effect of this is to vary the total spending by 10 per cent).

As can be seen from Figure 5 (and Table A2(b) in Appendix 2) the effect on GDP is very similar; thus, the GDP growth rate will remain as that of the base run forecast. The effect on nominal and real exchange rate also remains fundamentally unchanged. CPI (inflation), GDP and total revenue after grants have the same effect in terms of direction. However, the effect becomes stronger in this scenario. The overall magnitude of the effect is a variation of the base run value of 0.2 to 0.55 with the policy in all cases and hence it is not significant. The policy will also result in an increase in money supply of 2 to 7 per cent compared to the base run.

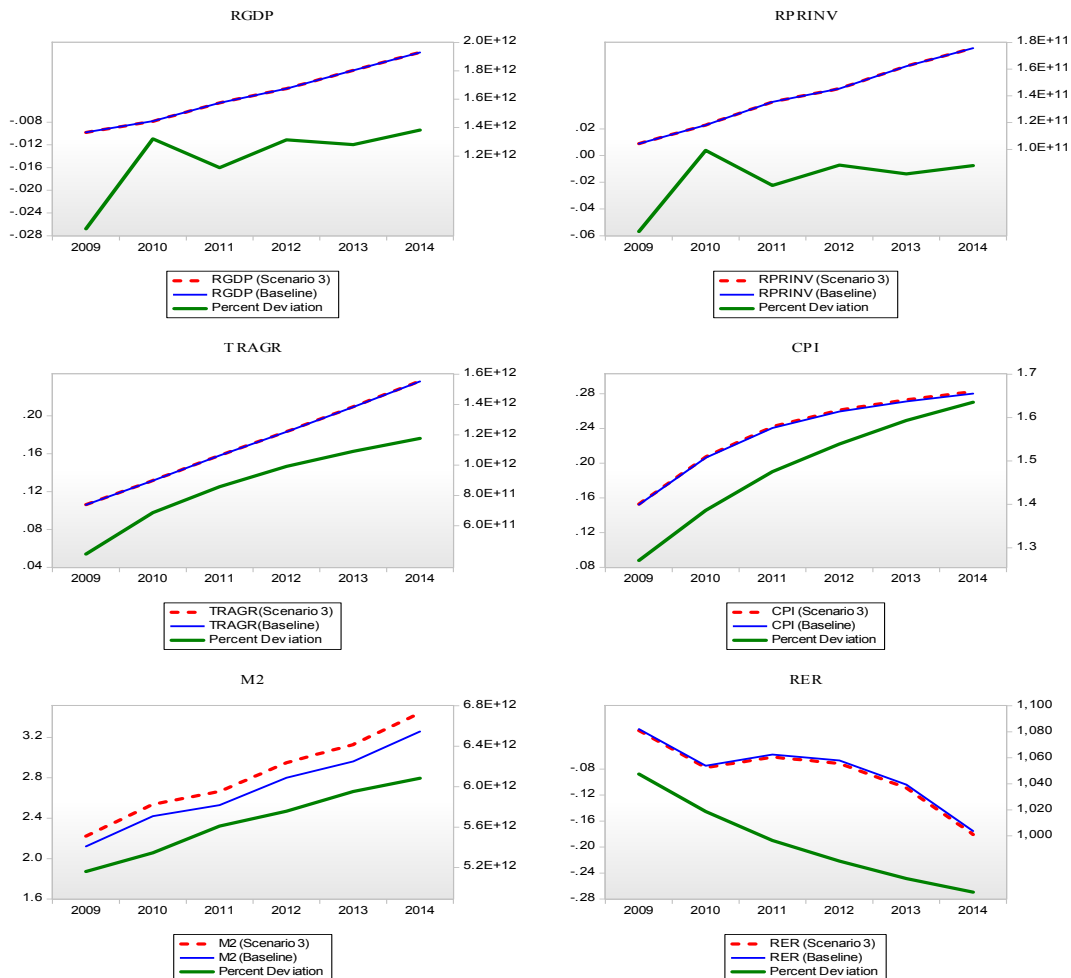


Figure 5: The Effect of the Composition of Government Proposed Spending (Deviation from Base Run, in Per cent)

5.2.2 The Effect of Government Policy 2: The Effect of the New Wage Pay and Retention Policy

The effect of the new wage pay and retention policy is to raise government spending (8 per cent of current expenditure or 4 per cent of total). Hence, its effect is similar to the simulation done earlier but less potent owing to its relative magnitude. As can be seen from Figure 6 and the associated Table A2(c) in Appendix 2, its effect is to reduce GDP, private investments and the real exchange rate. However, the magnitude is very small. In fact, the growth rate of the economy is hardly affected compared to the base run. On the other hand, it leads to an increase in total current expenditure, inflation and the money supply as expected. Again the magnitude of this is not that strong and hence the stability of the macroeconomic environment will not be affected. It will have an effect of raising the fiscal deficit after grants from about -0.5 per cent of the GDP to -3 to -5 per cent of the GDP during the planned period.

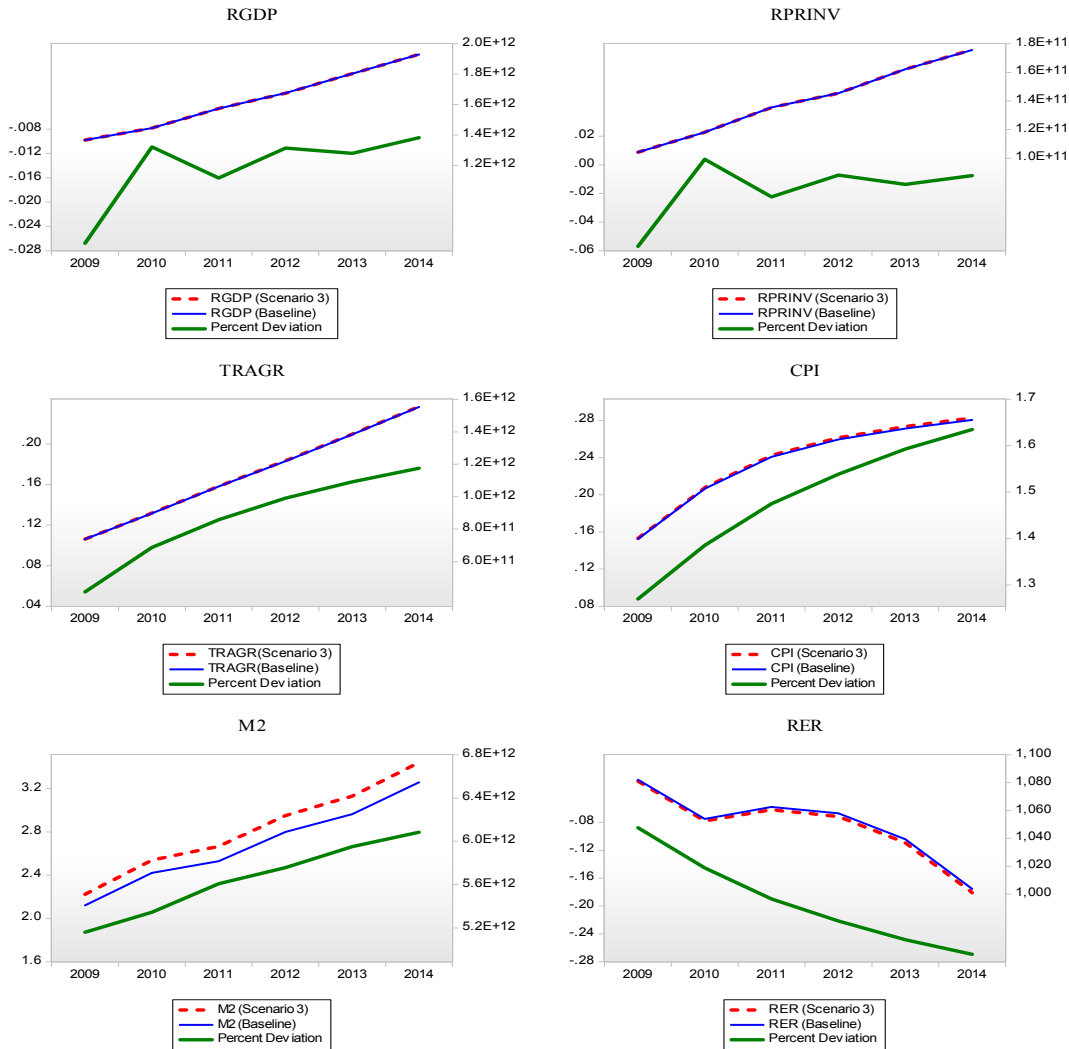


Figure 6: The Effect of the Wage and Pay and Retention Policy (Deviation from Base Run, in Per cent)

5.2.3 The Effect of the External Economy (Possible External Shock)

The effect of this probable adverse external shock is reducing GDP (-1.3 per cent), private investments (-5 per cent), exports (about -4.5 per cent) and imports (about -1 per cent) sharply in the first period (see Figure 7 and Table A2(d) in Appendix 2). This will lead to a sharp increase in fiscal deficit although the balance of payments is not affected that much in this period. However, this sharp decline will moderate over the course of the planned period accompanied by a decline in imports and recovery in exports. As a result, the balance of payments and government deficit will show a recovery. This simulation generally shows the significant macroeconomic risk implications of such an external shock and the need to be cautious in taking appropriate policy responses if such an event does occur.

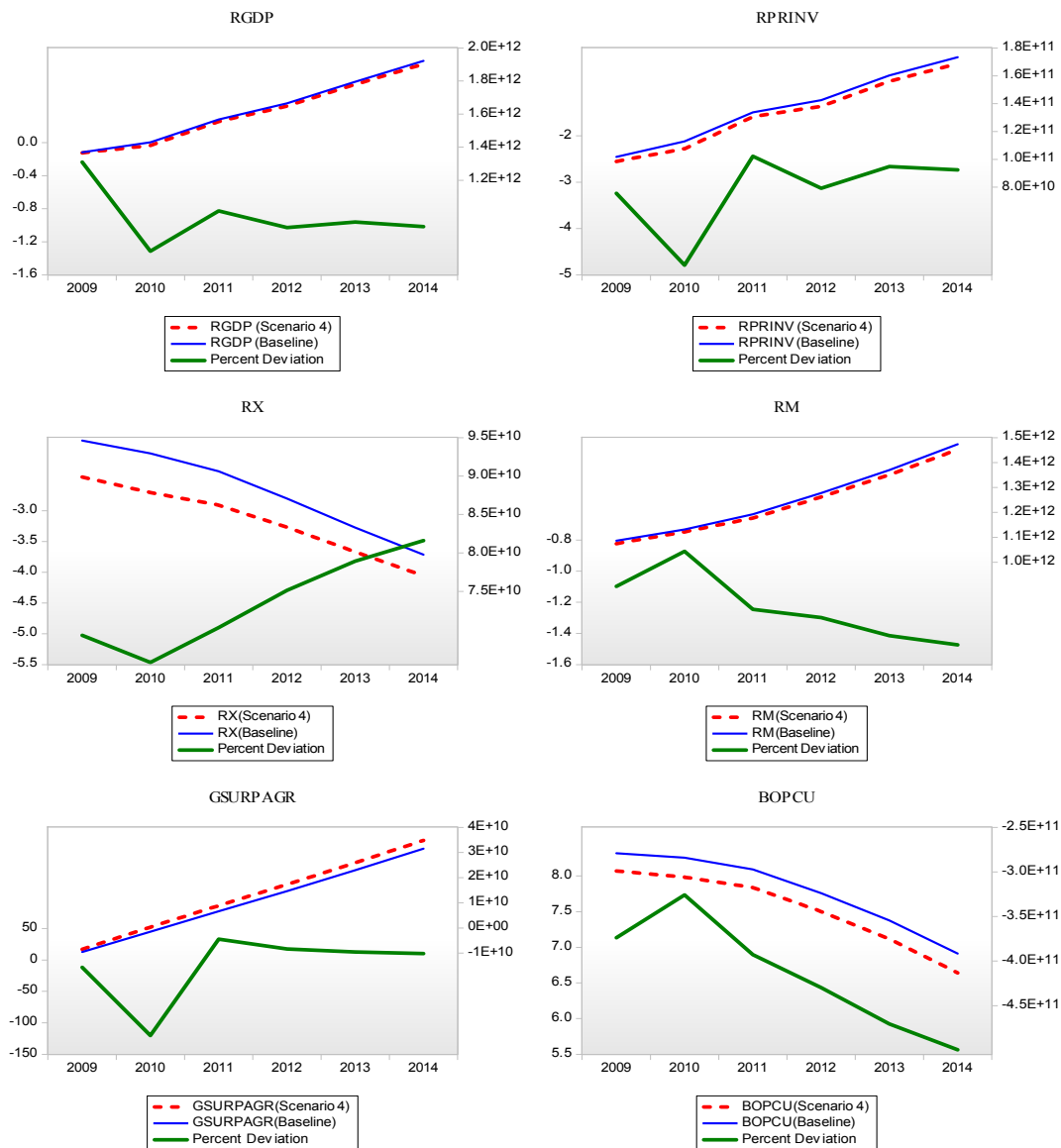


Figure 7: The Effect of a Possible Slowdown in the World Economy (Deviation from Base Run, in Per cent)

5.2.4. The Effect of a Shortfall in External Financing

This is a probable financing risk envisaged in the budget planning process (see Box 1). As Figure 8 and the associated Table A2(e) in Appendix 2 show, we can generalize that the effect of this probable risk is negligible, in particular in real GDP growth and government total expenditure terms. However, its effect on government fiscal deficit as well as total government revenue (including grants) is relatively important in percentage terms (a deterioration of 6 to 25 per cent from the base run in the first two periods). In actual terms this is not significant as it shows a deterioration of the government fiscal deficit (after grants) from -0.48 per cent of GDP in the base run to -0.51 per cent of GDP with the shock in the first year; and a similar deterioration from -0.11 per cent to -0.14 per cent of GDP in the second year. In summary, this macroeconomic risk is not significant. However, the government's strategy of 'delaying of spending' plan in such an event is an excellent cautious policy to deter any probable effect of this financing risk on the macro-economy.

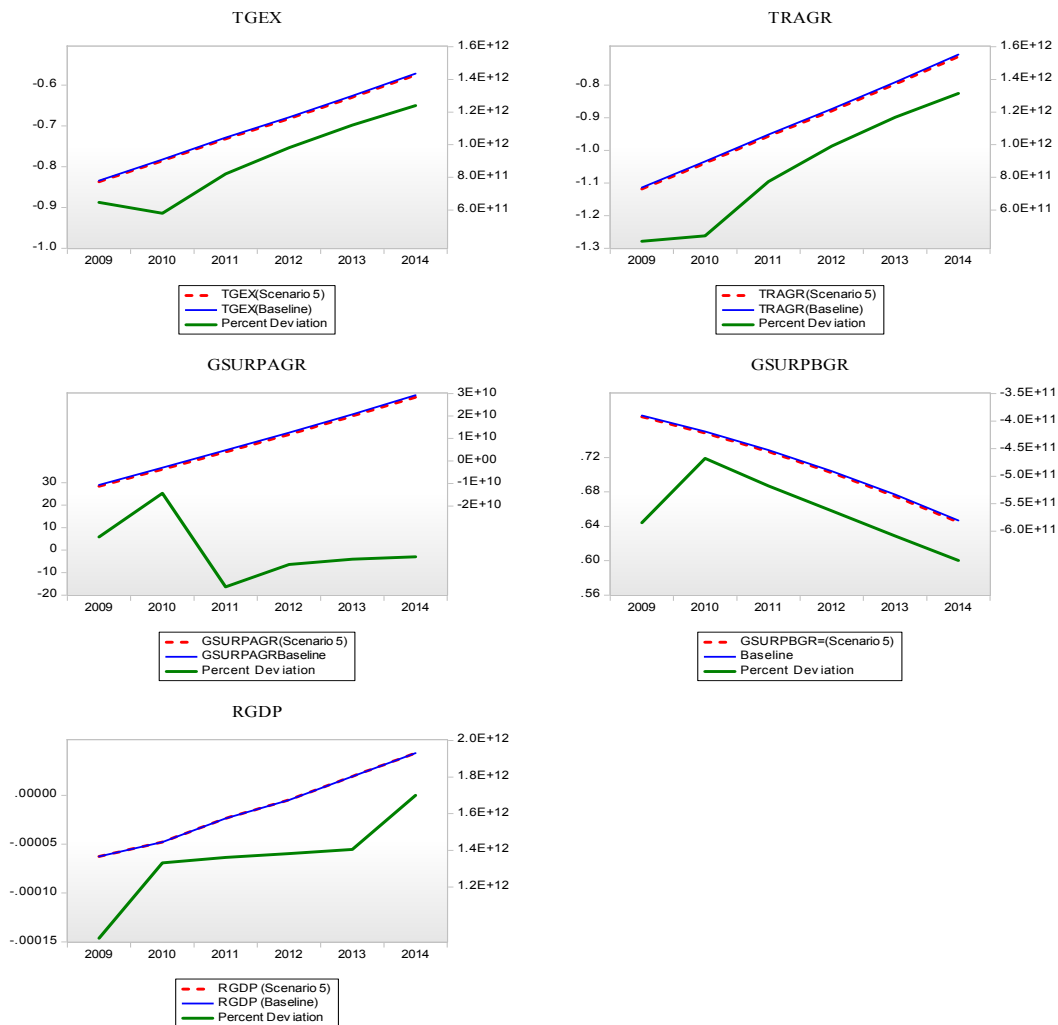


Figure 8: The Effect of a Shortfall in External Financing (Deviation from Base Run, in per cent)

6. Conclusion

We developed an applied macro-econometric model for a typical supply constrained African economy aimed at developing a template for such policy tools that are increasingly being demanded in Africa. The Rwanda macro-econometric model built along these lines had 107 equations of which 72 were endogenous. In addition, we also built a supplementary ARIMA based model of 33 equations, which is necessary for forecasting the exogenous variables needed for the overall forecasting ability of the model. The fiscal (including financing), balance of payments and money supply blocks of the models were fairly disaggregated to offer an adequate picture of the macro-economy. We used a single equation error correction modeling framework for estimating the core behavioral equations of the model. The model is similar to other successfully applied macro-models in the region such as the KIPPRA-treasury model and the Central Bank of Kenya's recent model. Our model can be further extended easily to support budgeting, forecasting and macroeconomic policy analyses in relevant ministries such as the Ministry of Finance of Rwanda. We successfully solved the model from 1999 to 2009 and forecast major macro-variables till 2015. The use of the model was illustrated by a real-world policy analysis of the Rwandan economy through a simulation exercise.

In the simulation exercise we discussed the implications of the Government of Rwanda's budget related policy as contained in its 2012/13-2014/15 Budget Framework Paper. The analysis focused on identifying major macroeconomic outcomes in the planning period that could arise from the government's proposed policy and probable external shocks. The following conclusions regarding the macroeconomic aspects of the economy (both prospects and risks) that might be encountered in the planning period can be read from the policy simulation exercise:

First, the forecast macroeconomic outcome of the model in the planning period (2012/13-2014/15) is compatible with the Ministry of Finance's forecast. This underscores the importance of this macro-model for the ministry's works in the future.

Second, our simulation exercise revealed that the planned spending was compatible with a stable macroeconomic environment. Thus, there seems to be no macroeconomic risk as it stands.

Third, the Rwandan economy may face a limited macroeconomic risk if the world economy slows down and prices of imports (in particular fuel price) increase in the planning period. This will require a policy response such as a flexible exchange rate policy and encouraging tourism to contain the probable macroeconomic risks.

Fourth, in terms of fiscal policy, given the level and forecast of inflation, there seems to be limited room for pro-poor fiscal expansion. This fiscal expansion is, however, conditional on an expansion of food supply and hence growth in the agricultural sector. If the latter is feasible, the financing strategy proposed by the Government of Rwanda (shying away from domestic debt) and delaying spending in the face of shortages of external resources, is a good strategy that needs to be pursued. In relation to this, the government deficit after grants is generally good. However, grants are above 10 per cent of GDP, and may lead to vulnerability if that level fails for some reason. Thus, the government needs to be cautious about this.

Finally, we note the potential use of this model in policymaking circles in Rwanda. It is a good macroeconomic policy tool for policy analyses and forecasting if it is accompanied by

expert opinion in Rwanda. The model will be more effective if it is further extended and institutionalized in relevant ministries such as the Rwandan Ministry of Finance or the country's central bank.

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Appendix 1: The Theoretical Model

Appendix 1a: Core Behavioral Equations of the Theoretical Model

The theoretical model is the basis for the empirical model developed and reported in the main text of this study. This theoretical framework draws from the theoretical framework developed in detail by Geda and Huizinga (2004; also in Geda, 2011) and is offered here briefly.

I. The Real Side

5.1 Production Functions

$$(1) \quad Y_A = A[\beta_L L_A^{-\lambda} + \beta_K K_A^{-\lambda} + \beta_R R_A^{-\lambda}]^{-1/\lambda}$$

$$(2) \quad Y_F = A[\beta_L L_F^{-\lambda} + \beta_K K_F^{-\lambda} + \beta_Z Z_F^{-\lambda}]^{-1/\lambda}$$

$$(3) \quad Y_I = Y - [Y_A + Y_F] = AL_I^\beta$$

where, Y, Y_A , and Y_F are total, agriculture and the formal (modern sector) respectively. L_A, L_i , and L_F is agricultural, informal and formal sector labor respectively, K_A and K_F is capital in the agricultural and formal sectors. R is rainfall and Z is intermediate imports.

1.2 Demands for Factor Inputs

5.1.1 Employment in the Formal Sector

$$(4) \quad L_F = (\beta_L)^\delta (Y_F) \left(\frac{w}{p_y} \right)^{-\sigma} \text{ where } \sigma = \frac{1}{1+\lambda}$$

In terms of percentage changes we have:

$$(5) \quad \hat{L}_f = \hat{Y}_f - \sigma(\hat{w} - \hat{p}_y)$$

where, w is the wage rate in the formal sector. p_y is the aggregate price level.

5.1.2 Investment

$$(6) \quad K = (\beta_k)^\sigma Y \left(\frac{p_k}{p_y} \right)^{-\sigma},$$

where, K is the optimal macro-capital stock and p_k is capital stock price, π is profit, q is capacity utilization rate and I_g is public investment. From this we get:

$$(6a) \quad \frac{\Delta K}{K-1} = \hat{Y} - \sigma(\hat{p}_k - \hat{p}_y) \text{ or}$$

$$(6b) \quad \frac{i}{K-1} = \hat{Y} - \sigma(\hat{p}_k - \hat{p}_y) + \delta \frac{i}{K-1} = \hat{Y} - \sigma(\hat{p}_k - \hat{p}_y) + \delta + \lambda \left(\frac{\pi}{K} \right)_{t-1} + \mu(q-1) + \eta \hat{I}_g$$

$$(6c) = \hat{Y} - \sigma(\hat{p}_k - \hat{p}_y) - \sigma \frac{dr}{r+\delta+r} + \delta + \lambda \left(\frac{\pi}{K} \right)_{t-1} + \mu(q-1) + \eta \hat{I}_g$$

Investment relationship with the incremental capital output ratio (ICOR) which is widely used in growth analyses in Africa can be specified as:

(6d) $\Delta K = ICOR(\Delta Y)$, where $\Delta K = I - d*Y_{t-1}$ and "d" is the depreciation rate,

$$I_{gross} = ICOR*\Delta Y + d*K_{t-1}, I_{gross} = ICOR*\Delta Y + d*ICOR*Y_{t-1}$$

1.2.3 Demand for Imports

This is the percentage change in imports due to output effects, assuming constant import shares, that is, constant relative prices. To add the effect of relative prices we have:

$$(7a) \hat{m} = \hat{z}_m - \sigma(\hat{p}_m - \hat{p}_y),$$

where, p_m denotes price of imports in the local currency.

Note that, by implication, z_m is proportional to a geometric average of the components of gross output z (or GDP).

$$(7b) Z_m \propto C^{\frac{m_c}{M}} I^{\frac{m_i}{M}} G^{\frac{m_g}{M}} X^{\frac{m_x}{M}}$$

The price of imports equals the (exogenous) price of imports in foreign currency, p_m (\$). times the exchange rate (e). times 1 plus the import tariff rate (t_m).

$$(7c) \hat{p}_m = \hat{p}_m(\$) + \hat{e} + \frac{\Delta t_m}{1+t_{m-1}}$$

1.2.4 Labor Supply and Unemployment

Labor supply is modeled exogenously as the product of the population within working age times the labor activity ratio plus employment in the non-working age. The equation for labor supply is:

$$(8a) l^s = \varphi \text{ population}_{\text{working age}} + \text{employment}_{\text{non-working age}},$$

where, φ is the exogenous labor activity ratio.

Total unemployment (u) which is given as the economically active population (l^{econ}) minus employment (l) can be specified as:

$$(8b) u = l^{econ} - l$$

The unemployment rate (ur) is given by the number of unemployed divided by the labor supply (l^s):

$$(8c) ur = \frac{u}{l^s}$$

1.3 Final Demand for Goods

1.3.1 Consumption

Real consumption (c) is determined by a model of intertemporal optimization (simplified to two periods here):

$$\arg \max(c_1, c_2): \log c_1 + \frac{1}{1+\delta} \log c_2$$

Subject to:

$$(9a) \quad c_1 + \frac{1}{1+r} c_2 = y_1^d + \frac{1}{1+r} y_2^{d,e} + \log c_2 + \text{wealth}_0,$$

where, y_i^d is real disposable income and e denotes the expected value.

$$(9b) \quad c_1 = \left(1 + \frac{g}{2+r}\right) y_1^d + \left(\frac{\text{wealth}_0}{2+r}\right)$$

where, r is the real interest rate.

$$(9c) \quad c = y^d - r$$

Disaggregation by Sector

$$(9d) \quad Y_d^* = Y_d - p_a \bar{c}_a,$$

where, Y_d^* is remaining nominal disposable income and $\bar{c}_a$ is minimum level of food consumption.

In nominal terms consumption of food is given as:

$$(9e) \quad p_a c_a = a_a Y_d^* + p_a \bar{c}_a$$

An increase in disposable income also raises food consumption but reduces the relative share of agricultural consumption. Consumption of non-food (c_{na}) items is a function of disposable income after expenditure on necessities. This can be given by:

$$(9f) \quad p_{cna} c_{na} = a_{na} Y_d^*$$

where, P_{cna} is price of non-food consumption. c_{na} is non-food consumption.

1.3.2 Exports

$$(10a) \quad X = Y_N^{\beta_1} \left(\frac{ep_x}{p_d}\right)^{\beta_2} \left(\frac{i}{y}\right)^\phi$$

where, X is exports, Y_n is income of trading partners, i is investment. In logarithmic form (10a) can be written as:

$$(10b) \quad \hat{X} = \beta_1 \hat{Y}_N + \beta_2 (\hat{p}_x + \hat{e} - \hat{p}_d) + \phi \left(\frac{i}{y}\right)_{-1}$$

1.3.3 Government Spending and Revenue

Government spending (G) and revenue (T) in the model are formulated using a number of semi-behavioral equations (see Appendix 1b) which took the following generic form:

$$(11) \quad G = \sum G_i = \sum (\alpha_i + \beta_i Z_i)$$

$$(12) \quad T = \sum T_i = \sum (\alpha_i^* + \beta_i^* Z_i)$$

where, G_i and T_i denote the vectors of different spending and revenue categories respectively and Z_i is a vector of determinants of G_i . and T_i , α and β (α^* and β^*) are parameters.

2. The Nominal Side

2.1 Price Determination in the Agricultural Sector

$$(13a) \quad p_a c_a = a_a Y_d^* + p_a \bar{c}_a$$

Supply equals:

$$(13b) \quad p_a^* y_a + e p_f m_{ca}$$

where, m_{ca} is the real import of consumption of agricultural goods (imported food). e is the nominal exchange rate and p_f is the price of imports (foreign price). Equating supply and demand gives:

$$(13c) \quad p_a (y_a - \bar{c}_a) + (e p_f m_{ca}) = a_a Y_d^*$$

$$(13d) \quad p_a = \frac{a_a Y_d^* - (e p_f m_{ca})}{y_a - \bar{c}_a}$$

2.2 Price and Wage Determination in the Formal Sector

We assume that output prices are set by firms which operate in a market structure of monopolistic competition. That is, we assume that for each good, there exists an inverse demand curve $p^f = p^f(z)$, with p^f denoting the price at factor cost and z denoting gross output. The price at factor cost is exclusive of indirect taxes and subsidies, and thus equals the price the firm actually receives for its product. We also assume that there exists a well-behaved cost function $c = c(z)$. Profit maximization then leads to:

$$(14a) \quad \text{argmax}(z): (1 - t_\pi)[p^f(z)z - c(z)], \text{ where: } t_\pi \text{ the profit tax.}$$

Profits are maximized by setting the price p^f equal to:

$$(14b) \quad p^f = \left(1 - \frac{1}{\varepsilon}\right)^{-1}$$

where, ε is the price elasticity of demand and mc denotes marginal cost. This optimization, including the effect of competitive price can lead to the following final form for general price (see Huizinga and Geda, 2004 for detail) $mc = dc/dz$. Note that profit tax has no influence on the price, since both marginal revenue and marginal cost are reduced by the same amount. The market price, denoted p_y , is related to the factor cost price p^f by:

$$(14c) \quad p_y = p^f (1 + t_z - s_z)$$

$$(14d) \quad \hat{p}_y^{m,s} = (1 - \gamma) \left(\alpha_w (\hat{w} - \hat{h}) + \alpha_k \hat{p}_k + \alpha_m \hat{p}_m + \beta_1 \Delta q + \beta_2 (q - 1) + \frac{\Delta t_z + \Delta s_z}{1 + t_z - s_z} \right) + \gamma p_{comp}$$

where, t_z and s_z are the indirect tax and subsidy rates.

The relation of the market price is therefore given in terms of the price of aggregate goods in the formal sector, $\hat{p}^{ag}$ as:

$$(14e) \quad \hat{p}^{ag} = (1 - \lambda)\hat{p}_y^{m,s} + \lambda\hat{p}^p$$

where, the superscript p denotes policy-determined.

2.3. Price and Wage Determination in the Informal Sector

$$(15) \quad w_I = w_A(1 + g_A)$$

$$(16) \quad P_I = w_I(1 + g_I)$$

Thus, the level of general prices should be a weighted average of the price in the formal and informal sectors and that in the agricultural sector:

$$(17) \quad P^{GDP} = \beta_1 P^{agr} + \beta_2 P^{formal} + \beta_3 P^{informal} \text{ where } \beta_1 + \beta_2 + \beta_3 = 1$$

2.4 The Money Market and Exchange Rate

2.4.1 Money Demand and Supply and the Domestic Nominal Interest Rate

$$(18a) \quad M^d = \alpha Y + \beta P - \gamma_i$$

where, M^d denotes nominal demand for money, Y stands for GDP and i the nominal interest rate on bonds (the rest of the symbols being parameters).

$$(18b) \quad i = \frac{1}{\gamma}(\alpha Y + \beta P - MS^*)$$

With the inflation targeting monetary policy the rule is given by:

$$(18c) \quad \Delta MS^* = \alpha \Delta Y + \beta \Delta P^* + \beta_1 [\Delta P - \Delta P^*], \text{ where } \beta_1 < \beta,$$

where, P^* is the target level of inflation.

2.4.2 Exchange rate

$$(19) \quad e = \beta_0 + \beta_1 M - \beta_2 [X + A - FX_g^{dd}]$$

where, M , money, X is export, A is aid and FX_g^{dd} , demand for foreign exchange for its international obligations such as debt servicing.

The real exchange (RER) is derived by definition as:

$$(20) \quad RER = e + p_f - p_d$$

Appendix 1b

Table A1b: Identities and Bridging Equations

1) General $NGDI = NGDP - TXR$ $RC = RPC + RGC$ $RGDI = NGDI / GDPDEF$ $RPRINV = NPRINV / INVP$ $RINV = RPRINV + RPUINV$ $PF = 0.5 * (XP + MP)$ $RER = NER * (PF / CPI)$ $RGDP = RPC + RINV + RGC + RX - RM$ $RTVA = RAGVA + RNAGVA$ $GDPDEF * RGDP = RPC * CPI + RINV * GDPDEF + RGC * CPI + RX * XP - RM * MP$ $NGDP = GDPDEF * RGDP$	3) The Balance of Payment Block $BOPCU = (X - M + NDINROW + NCUTR)$ $BOPOVERALL = BOPCU + BOPCA$
2) The Fiscal Block A) Government Revenue $TRBGR = TXR + NONTXR + CAPREV$ $TXR = DTX + IDTX + FTRTX$ $DTX = DTX(-1) * (NGDP / NGDP(-1)) + \text{Discrepancy}$ $IDTX = IDTX(-1) * (FCONEX / FCONEX(-1)) + \text{Discrepancy}$ $FCONEX = RPC * CPI + RGC * CPI$ $FTRTX = IMPORTAX + EXPORTAX$ $X = RX * XP$ $M = RM * MP$ $IMPORTAX = IMPORTAX(-1) * (M / M(-1)) + \text{Discrepancy}$ $EXPORTAX = EXPORTAX(-1) * (X / X(-1)) + \text{Discrepancy}$ $TRAGR = TRBGR + GR$ $CAPREV = NETBORROWING\_EXT + OTHCAPIREV$ B) Government Expenditure, Fiscal Balance and Debt $TGEX = GCUREX + GCAPEX$ $GCUREX = WS + TINTEXPE + AMORT\_EXT + OTHCUREXP + \text{Discrepancy}$ $WS = (WS(-1)) * (EMPT / EMPT(-1)) * (WRATE / WRATE(-1))$ $DEBT\_DOM = DEBT\_DOM(-1) + NETBORROWING\_DOM + \text{Discrepancy}$ $EXTDEBT = EXTDEBT(-1) + NETBORROWING\_EXT$ $TINTEXPE = INTPAYDOMDEBT + INTPAYEXTDEBT$ $OTHCUREXP = OTHCUREXP(-1) * (NGDP / NGDP(-1)) + \text{Discrepancy}$ $GCAPEX = GCAPEX(-1) * ((NETBORROWING\_EXT + GR) / (NETBORROWING\_EXT(-1) + GR(-1))) + \text{Discrepancy}$ $GSURPAGR = (TRAGR - TGEX)$ $GSURPBGR = TRAGR - TGEX - GR$	4) The Monetary Block $GOVSUGRLessEA = GSURPAGR - NETBORROWING\_EXT - AMORT\_EXT$ $TOTAL\_FINANCING = -1 * (GOVSUGRLessEA)$ $NETBORROWING\_DOM = TOTAL\_FINANCING - NETBORROWING\_EXT$ $NETBORROWING\_EXT = GROSSBORROWING\_EXT - AMORT\_EXT$ $OFICALEXCHANGERESERVES = OFICALEXCHANGERESERVES(-1) + CHANGEINRESERVES(-1)$ $CHANGEINRESERVES = BOPOVERALL - STATDESCREANCY1$ $M2 = OFICALEXCHANGERESERVES + (DOM\_CREDIT\_CALIMSONGOVT(-1) + NETBORROWING\_DOM) + DOMCRED\_CLAIMS\_OTHERS + STATDESCREANCY2$

Appendix 1c

Table A1c: List of Variables used in the Estimated Model

Name	Label
AID	Net Official Development Assistance and Official Aid Received
AGLF	Agriculture Labor Force, Absolute Value
AMORT_EXT	External Loan Amortization ,Nominal
BOPCA	Balance of Payment, Capital, Nominal
BOPCU	Balance of Payment, Current, Nominal
BOPOVERALL	Balance of Payment, Overall ,Nominal
CAPREV	Capital Revenue, Nominal
CHANGEINRESERVES	Changes in net reserves ,Nominal
CPI	Consumer Price Index
CS	Total Capital Stock, Real
CURN	Capacity Utilization Rate ,Nominal
CURR	Capacity Utilization Rate, Real
DUM ₁	Period dummy,(1991-2009=1) and 0 otherwise
DUM ₉₀	Impulse Saturation Dummy,1990=1 and 0 otherwise
DUM ₉₁	Impulse Saturation Dummy,1991=1 and 0 otherwise
DUM ₉₄	Impulse Saturation Dummy,1994=1 and 0 otherwise
DUM ₉₅	Impulse Saturation Dummy,1995=1 and 0 otherwise
DUM ₉₆	Impulse Saturation Dummy,1996=1 and 0 otherwise
DUM ₀₆	Impulse Saturation Dummy,2006=1 and 0 otherwise
DUM ₀₇	Impulse Saturation Dummy,2007=1 and 0 otherwise
DIR	Deposit Interest Rate, Nominal
DOM_CREDIT_CALIMSONGOVT	Claims on Central Government ,Nominal
DEBT_DOM	Domestic Debt, Nominal
DOMCRED_CLAIMS_OTHERS	Claims on Others, Nominal
DTX	Direct Tax, Nominal
EMPT	Total Employment, Absolute Value
EXCESDDFOOD	Excess Food Demand
EXPORTAX	Export Tax, Nominal
EXTDEBT	External Debt Stock, Nominal
FCONEX	Final Consumption Expenditure, Nominal Total
FTRTX	Foreign Trade Tax, Nominal
GCAPEX	Government Capital Expenditure, Nominal
GCUREX	Government Current Expenditure, Nominal
GDPDEF	GDP Deflator, Period Average
GR	Grant, Nominal
GROSSBORROWING_EXT	Gross External Borrowing, Nominal
IDTX	Indirect Tax, Nominal
IMPORTAX	Import Tax, Nominal
INCTRAD	Income of Trading Partners, Real
INF	Inflation(Change in CPI)
INTPAYDOMDEBT	Interest Payment on Domestic Debt, Nominal
INTPAYEXTDEBT	Interest Payment on External Debt, Nominal
INVGDP	Investment to GDP Ratio, Real
INVP	Investment Price
LnAGLF	The Natural Log of Agriculture Labor Force, Absolute Value
LnABPRO	Labor Productivity, Real
LnAID	The Natural Log of Net Official Development Assistance and Official Aid Received
LnCPI	The Natural Log of Consumer Price Index
LnCS	The Natural Log of Total Capital Stock ,Real
LnCURN	The Natural Log of Capacity Utilization Rate, Nominal
LnCURR	The Natural Log of Capacity Utilization Rate, Real
LnDIR	The Natural Log of Deposit Interest Rate, nominal
LnDTX	The Natural Log of Direct Tax, Nominal
LnEMPT	The Natural Log of Total Employment, Absolute Value
LnFC	The Natural Log of Real Food Consumption

LnGDPDEF	The Natural Log of GDP Deflator, Period Average
LnINCTRAD	The Natural Log of Income of Trading Partners, Real
LnINVGD	The Natural Log of Investment to GDP Ratio, Real
LnINV	The Natural Log of Investment Price
LnIR	Lending Interest Rate
LnLABPRO	The Natural Log of Labor Productivity
LnM	The Natural Log of Import of Goods and Services, Nominal
LnM2	The Natural Log of Money Supply(M2)
LnMD	The Natural Log of Money Demand
LnMP	The Natural Log of Import Price
LnNAGLF	The Natural Log of Non-Agricultural Labor Force
LnNER	The Natural Log of Nominal Exchange Rate, Period Average
LnNGDP	The Natural Log of Nominal GDP
LnNPRINV	The Natural Log of Nominal Private Investment
LnNPUINV	The Natural Log of Nominal Public Investment
LnNWR	The Natural Log Nominal Wage Rate
LnPUC	The Natural Log of Per Unit Cost of Out Put
LnRAGVA	The Natural Log of Real Agricultural Value Added
LnRER	The Natural Log of Real Exchange Rate
LnRES	The Natural Log of Reserves, Nominal
LnRGC	The Natural Log of Real Government Consumption
LnRGDI	The Natural Log of Real Disposable Domestic Income
LnRGDP	The Natural Log of Real GDP
LnRIR	The Natural Log of Real Interest Rate
LnRM	The Natural Log of Real Import of Goods and Services
LnRNAGVA	The Natural Log of Real Non-Agricultural Value Added
LnRPC	The Natural Log of Real Private Consumption
LnRPRINV	The Natural Log of Real Private Investment
LnRPUINV	The Natural Log of Real Public Investment
LnRX	The Natural Log of Real Export of Goods and Services
LnUNEMPTRATE	The Natural Log of Unemployment Rate
LnXP	The Natural Log of Export Price
M	Imports of goods and Services, (BoP, nominal)
M2	Money Supply (M2)
MD	Money Demand, Nominal
MP	Import Price
NAGLF	Non-Agricultural Labor Force, Absolute Value
NAGVA	Nominal Agricultural Value Added
NCUTR	Net current transfers (Bop, Nominal)
NDINROW	Net Direct Income(ROW, BoP, Nominal)
NER	Nominal Exchange Rate, Period Average
NETBORROWING_DOM	Net Domestic Borrowing, Nominal
NETBORROWING_EXT	Net External Borrowing, Nominal
NGDI	Nominal Domestic Disposable Income
NGDP	Nominal GDP
NGDPP	Nominal GDP Potential
NNAGVA	Nominal Non-Agricultural Value Added
NONTXR	Non-Tax Revenue, Nominal
NPRINV	Nominal Private Investment
NPUINV	Nominal Public Investment
NWR	Nominal Wage Rate
OFICALEXCHANGERESERVES	Official Exchange Reserve, Nominal
OTHCAPIREV	Other Capital Revenue
OTHCUREXP	Other Current Expenditure
PC	Nominal Private Consumption
PF	Foreign price
PUC	Per Unit Cost of Output
RAGVA	Real Agricultural Value Added
RER	Real Exchange Rate
RGC	Real Government Consumption

RGDI	Real Disposable Domestic Income
RGDP	Real Gross Domestic Product
RGDP_BELGIUM	Real GDP of Belgium
RGDP_KENYA	Real GDP of Kenya
RGDP_SWITZERLAND	Real GDP of Switzerland
RGDPP	Real GDP Potential
RINV	Real Total Investment
RIR	Real Interest Rate
RM	Real Import of Goods and Services
RNAGVA	Real Non-Agricultural Value Added
RPC	Real Private Consumption
RPRINV	Real Private Investment
RPUINV	Real Public Investment
XP	Export Price
X	Export of goods and services,(BoP, Nominal)
WS	Wages and Salaries, Nominal
WRATE	Wage Rate, Nominal
TGEX	Total Government Expenditure
TXR	Total Tax Revenue, Nominal
TRBGR	Total Revenue Before Grant, Nominal
TRAGR	Total Revenue After Grant, Nominal
TOTALDEBT	Total Government Debt, Nominal
TINTEXPE	Total Interest Expense, Nominal
STATDESCREPANCY 1	Statistical Discrepancies 1
STATDESCREPANCY 2	Statistical Discrepancies 2
RX	Real Export of Goods and Services
RTVA	Real Total Value Added

Appendix 2

Simulation Results using the Rwanda Macro-econometric Model

TableA2 (a): The Effect of the proposed government spending (Deviation from Base Run, in Percentage)

Year	Growth	Gov't Fiscal Surplus After Grants (as per cent of GDP)	Gov't Fiscal Surplus Before Grants (as per cent of GDP)
2009	-0.1	-2.2	-34.3
2010	0.1	-1.8	-35.4
2011	0.0	-1.4	-35.5
2012	0.0	-1.0	-36.4
2013	0.0	-0.7	-37.0
2014	0.0	-0.4	-37.7

Table A2 (b): The Effect of the Composition of Government Proposed Spending (Deviation from Base Run, in Percentage)

Year	Growth	Real GDP	Real Private Investment	Total Government Expenditure	Total Revenue After Grants	Total Revenue Before Grants	Real Exchange Rate	M2 (Money Supply)	MD (Money Demand)
2009	-0.26	-0.01	-0.01	10.14	0.01	0.02	-0.02	0.37	0.02
2010	-0.05	0.00	0.00	10.16	0.02	0.04	-0.03	0.40	0.03
2011	-0.11	0.00	0.00	10.19	0.02	0.04	-0.04	0.46	0.04
2012	-0.10	0.00	0.00	10.24	0.03	0.05	-0.04	0.49	0.05
2013	-0.14	0.00	0.00	10.29	0.03	0.06	-0.05	0.53	0.05
2014	-0.11	0.00	0.00	10.34	0.04	0.06	-0.05	0.56	0.06

Table A2 (c): The Effect of the Wage and Pay and Retention Policy (Deviation from Base Run, in Percentage)

Year	Growth	Real GDP	Real Private Investment	Total Revenue After Grants	Total Revenue Before Grants	Current Account Deficit	BoP (Overall)	CPI (Inflation)	Real Exchange Rate	M2 (Money Supply)
2009	-0.50	-0.03	-0.06	0.05	0.10	0.02	0.03	0.09	-0.09	1.87
2010	0.29	0.01	0.00	0.10	0.18	0.00	0.00	0.15	-0.15	2.06
2011	-0.06	0.02	-0.02	0.13	0.23	0.00	-0.01	0.19	-0.19	2.32
2012	0.08	0.01	-0.01	0.15	0.26	-0.01	-0.02	0.22	-0.22	2.47
2013	-0.01	0.01	-0.01	0.16	0.29	-0.01	-0.01	0.25	-0.25	2.66
2014	0.04	0.01	-0.01	0.18	0.32	-0.01	-0.01	0.27	-0.27	2.80

Table A2 (d): The Effect of a Possible Slow Down in the World Economy (Deviation from Base Run, in Percentage)

Year	Growth	Real GDP	Real Private Investment	Real Investment (Total)	Real Private Consumption	Real Exports	Real Imports	Total Government Expenditure	Total Revenue After Grants	Total Revenue Before Grants
2009	-4.30	-0.24	-3.24	-0.46	-0.46	-5.02	-1.10	-1.16	-0.60	-1.14
2010	-25.65	-1.31	-4.79	-0.76	-1.10	-5.46	-0.87	-0.29	0.48	0.87
2011	5.58	-0.83	-2.44	-0.44	-1.10	-4.90	-1.25	0.68	1.48	2.62
2012	-3.47	-1.03	-3.13	-0.58	-1.27	-4.29	-1.30	1.08	1.86	3.30
2013	0.91	-0.96	-2.66	-0.53	-1.31	-3.82	-1.41	1.39	2.13	3.78
2014	-0.87	-1.02	-2.74	-0.57	-1.38	-3.48	-1.47	1.54	2.24	4.01

Year	Government Fiscal Surplus After Grants as per cent of GDP)	Government Fiscal Surplus Before Grants (as per cent of GDP)	Current Account Deficit	Bopca_0	BoP (Overall)	CPI (Inflation)	Real Exchange Rate	M2 (Money Supply)
2009	-11.80	-1.18	7.13	0.00	12.04	1.13	1.77	0.35
2010	-120.24	-1.69	7.73	0.00	13.69	3.02	-0.31	0.70
2011	33.18	-1.97	6.90	0.00	12.51	4.12	-1.42	1.03
2012	17.53	-2.13	6.43	0.00	11.54	4.76	-2.07	1.31
2013	12.71	-2.22	5.92	0.00	10.43	5.13	-2.45	1.60
2014	10.31	-2.28	5.56	0.00	9.54	5.36	-2.70	1.85

Table A2(e): The Effect of A Shortfall in External Financing (Deviation from Base Run, in Percentage)

Year	Growth	Total Government Expenditure	Total Revenue After Grants	Total Revenue Before Grants	Government Fiscal Surplus After Grants (as Per cent of GDP)	Government Fiscal Surplus Before Grants (as Per cent of GDP)	Current Account Deficit
2009	-0.003	-0.89	-1.28	-2.42	5.92	0.64	0.00
2010	0.00	-0.91	-1.26	-2.31	25.33	0.72	0.00
2011	0.00	-0.82	-1.10	-1.97	-16.28	0.69	0.00
2012	0.00	-0.75	-0.99	-1.78	-6.39	0.66	0.00
2013	0.00	-0.70	-0.90	-1.62	-4.04	0.63	0.00
2014	0.00	-0.65	-0.83	-1.50	-2.98	0.60	0.00

Chapter Four

Good Governance, Economic Growth and Development: Insights from a 22-Year Econometric Analysis in Rwanda

Jean-Baptiste Habyarimana¹ and Bertrand Dushimayezu²

¹Corresponding author:
Department of Economics
University of Rwanda, Kigali, Rwanda,
E-mail: kradrimn@gmail.com

²University of Nairobi, Nairobi, Kenya
E-mail: bertrand.dushimayezu@gmail.com

Abstract

This paper uses two techniques -- scatter and line plots and ordinary least squares -- to investigate how governance is related to economic growth and development. It simulates Benhabib and Spiegel's (1994) alternative model for growth and calibrates it with the estimated shock in human capital development to investigate the spillover effects of lack of good governance on economic growth and development. This paper demonstrates the existence of a pro-cyclic relationship between governance and economic growth and development. It uncovers the existence of a counter-cyclic relationship between a shock in human capital development and growth. It suggests that, *ceteris paribus*, the level of economic development and growth not only depends on fixed capital formation and the labour force, but also on good governance. Thus, this paper demonstrates that significantly good economic performance, further economic growth and development in Rwanda will be driven by good governance in the country. It argues that the most important pre-requisites for sustainable growth and development are strong politico-socio-economic policies and strategies to develop appropriate 'home grown solutions' and channelizing them. It also suggests that taking lessons from Rwanda's good governance system and replicating it in other African countries can lead to political stability and sustainable growth and development elsewhere on the continent, which is the most pressing issue in Africa.

Keywords: Governance, economic growth and development, econometric analysis, Rwanda.

JEL Classification Codes: C32; E24; G38; H11; O11; O47;

1. Introduction

Rwanda has progressively experienced improvements in a durable security apparatus and sustainable economic performance since 2000. This is related to the good governance practices that have been implemented since then (the National Institute of Statistics of Rwanda [NISR] 2015; Rwanda Governance Board [RGB], 2016a, 2016b, 2016c). The period 1994-2000 was characterized by reconstruction, during which time the country was highly dependent on humanitarian aid to provide assistance to people in need and for restoring internal security, strengthening the justice system and repatriating and resettling refugees and displaced persons (International Monetary Fund [IMF], 2000; United Nations [UN], 2004). However, since 2000 the country's vision has changed and it now wants to become a self-sustained and middle-income country by 2020. Good governance and a capable state are the first pillars of this vision (Ministry of Finance and Economic Planning [MINECOFIN], 2012, 2013). To position good governance at the centre of economic growth and development, the institutionalization of the ombudsman has helped in strengthening the national justice system and in the creation of different institutions including the Rwanda Development Board and Rwanda Government Board. These institutions have helped in developing and evaluating solutions appropriate for achieving economic growth and development in the country and have led to many achievements across all economic sectors 'that among others include agriculture and livestock, education, health, local administration, hygiene and sanitation, social protection, justice, respect of governance principles and trust in governance institutions, security and citizen participation' (RGB, 2016a, 2016b).

Some studies have been done to investigate Rwanda's economic performance. Although the results of these works vary, their general conclusion seems to be similar. They all demonstrate that after the genocide against the Tutsi in 1994 and the period of reconstruction in 2000, Rwanda's economy has grown consistently. From 1994 to 2016, Rwanda demonstrated that a good governance approach was an apt approach for creating a capable and efficient state with an enabling environment for curbing unemployment, reducing poverty, improving health conditions and ensuring households' food security for durable economic growth and development (RGB, 2016b; Ministry of Agriculture and Animal Resources [MINAGRI] et al., 2016; NISR, 2015). Even though the period 1994 to 2000 was dominated by humanitarian aid offered by different international institutions and characterized by the country reconstruction's (IMF, 2000; UN, 2004), consistent growth started in early 2003, three years after the implementation of vision 2020 (NISR, 2002, 2006, 2012, 2015).

In addition, since 2004 the country has progressively become self-sufficient in terms of food availability; both health status and social welfare too have improved remarkably which has resulted in independence from humanitarian aid (MINAGRI et al., 2016). Even though previous studies do not provide a clear empirical link between good governance and economic growth and development, the growth and development attained in Rwanda is linked to aspects of good governance and national security (NISR, 2015; RGB, 2016a, 2016b, 2016c). Rwanda's GDP (current US\$) increased from US\$ 1.8 billion in 2003 to US\$ 8.1 billion in 2015. GDP per capita (current US\$) grew from US\$ 210 in 2003 to about US\$ 700 in 2014 or nearly 3.3 times that of 2003 and about 4.6 times that of 1994 (World Bank [WB], 2016). The poverty rate decreased from 58.9 per cent in 2000 to 39.1 per cent in 2014 and extreme poverty declined from 40.0 per cent to 16.3 per cent (NISR, 2015). The unemployment rate was curbed significantly

and it shrunk from 2.2 per cent in 2010 to 2.0 per cent in 2014 (NISR, 2015). These figures show that Rwanda's growth accelerated during 2003-2014, which corresponds to the enforcement of good governance and the establishment of different institutions to promote good governance practices, decentralization and ensuring national security. Therefore, aspects of good governance are critical and strategically important factors for economic growth and development.

Hence, it becomes important to examine the impact of 22 years of good governance on economic growth and development in Rwanda. This paper uses six worldwide governance indicators (WGIs) -- control of corruption; government effectiveness; political stability and absence of violence/terrorism; regulatory quality; rule of law; and voice and accountability to find out how trends in these indicators affected growth and development. It also finds out how these indicators can influence growth and development through shocks in human capital development as a result of lack of good governance.

2. Governance, human capital development, economic growth and development

The process by which governments are selected, monitored and replaced, the capacity of the government to effectively formulate and implement sound policies and earn the respect of the citizens and the state for the institutions that govern economic and social interactions among them is referred to as governance (Kaufmann et al., 2009). From this definition, Kaufmann et al., (2009) differentiate six WGIs: (i) Control of corruption which captures perceptions of the extent to which public power is exercised for private gains including both petty and grand forms of corruption and the 'capture' of the state by elites and private interests. It also measures the strength and effectiveness of a country's policy and institutional framework to prevent and combat corruption. (ii) Government effectiveness which captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulations and implementation and the credibility of the government's commitment to such policies. (iii) Regulatory quality which captures perceptions about the government's ability to formulate and implement sound policies and regulations that permit and promote the development of the private sector. (iv) Rule of law which measures the extent to which individuals and firms have confidence in and abide by the rules of society. In particular, it measures the functioning and independence of the judiciary, including the police, the protection of property rights, the quality of contract enforcement and the likelihood of crime and violence. (v) Voice and accountability which captures perceptions about the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association and a free media. (vi) Political stability and absence of violence/terrorism which measures perceptions about the likelihood of political instability and/or politically motivated violence including terrorism.

Literature shows the importance of measuring these indicators by relating them to growth and socio well-being. First, corruption impedes growth and development by increasing costs, lowering productivity, discouraging investments, reducing confidence in public institutions, limiting the development of small and medium-sized enterprises, weakening systems of public financial management and undermining investments in health and education (Fisman and Svensson, 2007; Olken, 2006). Second, countries with more

effective governments tend to achieve higher levels of economic growth by obtaining better credit ratings and attracting more investments, offering higher quality public services and encouraging higher levels of human capital accumulation. They also succeed in putting foreign aid resources to better use, accelerating technological innovations, increasing the productivity of government spending, improving health and education and curbing environmental degradation and repressing corruption (Easterly et al., 2006; Lewis, 2006; WB, 2006a). Third, improved regulatory quality can promote economic growth by creating effective and efficient incentives for the private sector and also by helping the poor by creating opportunities for entrepreneurship. Improved regulatory quality can also help in reducing opportunities for corruption, increasing the quality of public services and improving the functioning of the housing, service and labour markets on which they rely (Djankov et al., 2006; Dollar et al., 2006; Jalilian et al., 2007; Loayza et al., 2006; WB, 2006b). Fourth, by the rule of law judicial independence promotes a stable investment environment that leads to higher levels of investment and growth and thus helps in reducing poverty through efficient legal systems (Easterly et al., 2006; WB, 2006b).

3. Methodology and data

3.1. Modelling relationship between governance and economic growth/development

To observe trends in WGIs, this paper used a line plot (Figure 1), in which the vertical axis gives the estimates of the six selected governance indicators and the horizontal axis gives the timeline covering the period 1996-2015. Our paper used scatter plots to investigate the evolution of growth and development in Rwanda as a function of the level of good governance and a shock in human capital development. In the scatter plots in Figures 2 and 3, the horizontal axes are estimates of the six selected good governance indicators and the vertical axes are the log of GDP and log of GDP per capita respectively. In the scatter plots in Figures 4 and 5, the horizontal axes are the arithmetic mean of the six WGIs and the vertical axes are the log of GDP and log of GDP per capita respectively. We used the log GDP and log GDP per capita as they allow characterization of the pattern of each selected governance indicator and the pattern of shock in human capital development with growth and development. In the scatter plot in Figure 7, the horizontal axis gives estimates of the six selected good governance indicators and the vertical axis gives the log of the estimated shock in human capital development. In the scatter plots in Figures 8 and 9, the horizontal axes are the log of the estimated shocks in human capital development and the vertical axes are the log of GDP and log of GDP per capita respectively.

Insert Figure 1 about here

Insert Figure 2 about here

Insert Figure 3 about here

Insert Figure 4 about here

Insert Figure 5 about here

In the line plot in Figure 6, the vertical axis is the log of the estimated shock in human capital development and the horizontal axis is the timeline covering the period 1996-2015.

Insert Figure 6 about here

3.2. Modelling shock in human capital development and growth/development

The model used in our paper is based on Benhabib and Spiegel's (1994) 'alternative model for growth accounting.' To specify this model, Benhabib and Spiegel departed from the standard Cobb-Douglas (1928) technology in which per capita income, Y , is function of labour L , physical capital K and human capital H . It is from the relationship in Equation 1 that, in Equation 2, Benhabib and Spiegel take log differences to express the relationship for long-term growth:

$$(1) \quad Y_t = A_t K_t^\alpha L_t^\beta H_t^\gamma$$

$$(2) \quad (\log Y_T - \log Y_0) = (\log A_T - \log A_0) + \alpha(\log K_T - \log K_0) + \beta(\log L_T - \log L_0) + \gamma(\log H_T - \log H_0) + (\log \varepsilon_T - \log \varepsilon_0)$$

However, from Equation 2, Benhabib and Spiegel (1994) show that it can result in biased estimates because physical and human capital are accumulated factors, they are correlated with the error term, ε . Because of the accumulation effect they also show that α and γ estimates are likely to be upward biased coefficients while the β estimate is likely to be a downward biased coefficient. It was because of these criticisms that they developed an 'alternative model for growth accounting':

$$(3) \quad (\log I_T - \log I_0) = (\log A_T - \log A_0) + \alpha(\log K_T - \log K_0) + \beta(\log L_T - \log L_0) + \gamma(1/T \sum_0^T \log H_t) + (\log \varepsilon_T - \log \varepsilon_0)$$

However, as our paper uses yearly data and H is proxied by government expenditure on education, we found that using $1/T \sum_0^T \log H_t$ as in Equation 3 by Benhabib and Spiegel (1994) can result in biasing estimates α , β and γ for a number of reasons. First, using this formula will result in forcing H to be constant over the sample period, $t = 1$ to $t = n$, where n is the total number of years covered by this study. Second, as the formula is an arithmetic mean in its nature, growth in recent years is attributed to technological progress in these recent years and also to that in earlier years and vice-versa. To handle this issue, we estimated the cumulated H noted as H^c , and considering shock in human capital development we also estimated growth in H^c as in Equation 4 where we estimate shock in human capital development noted by H_t^{c*} as:

$$(4) \quad H_t^{c*} = \frac{1}{\log H_{(t)}^c - \log H_{(t-1)}^c}$$

Therefore, we modified the model in Benhabib and Spiegel (1994) and specify the models for economic growth and development respectively as:

$$(5) \quad (\log Y_{(t)} - \log Y_{(t-1)}) = (\log A_{(t)} - \log A_{(t-1)}) + \alpha(\log K_{(t)} - \log K_{(t-1)}) + \beta(\log L_{(t)} - \log L_{(t-1)}) + \gamma \left(\frac{1}{\log H_{(t)}^c - \log H_{(t-1)}^c} \right) + (\log \varepsilon_{(t)} - \log \varepsilon_{(t-1)})$$

$$(6) \quad (\log I_{(t)} - \log I_{(t-1)}) = (\log A_{(t)} - \log A_{(t-1)}) + \alpha(\log K_{(t)} - \log K_{(t-1)}) + \beta(\log L_{(t)} - \log L_{(t-1)}) + \gamma \left(\frac{1}{\log H_{(t)}^c - \log H_{(t-1)}^c} \right) + (\log \varepsilon_{(t)} - \log \varepsilon_{(t-1)})$$

We use growth, Y , proxied by GDP growth; development, I , proxied by income per capita growth; physical capital, K , proxied by gross fixed capital formation; labour force, L ; and a shock in human capital development, H_t^c , proxied by inverse of growth in cumulated government expenditure on education.

4. Empirical findings and discussion

4.1. Trends in selected good governance indicators

Estimates of WGIs over 1996-2015 show that there were successful and consistent improvements in governance in Rwanda. The most successful achievements were in controlling corruption, followed by regulatory quality, rule of law, government effectiveness and political stability and absence of violence/terrorism. The least successful achievements were in voice and accountability. These achievements created an enabling environment for promoting the private sector and a business environment, increasing domestic productivity, ensuring economic efficiency and welfare and developing small and medium-sized enterprises and cross-border trade promotion (RGB, 2016a). Moreover, good governance is one of the most important tools for increasing the viability of public and private institutions and promoting safety net programs for reducing poverty and ensuring food security in the country (RGB, 2016b; NISR, 2015; MINECOFIN, 2012; MINAGRI et al., 2016). Although these successful attempts might tempt one to conclude that good governance is an important determinant of economic growth and development and human capital development, we do not want to jump too quickly to this general conclusion for Rwanda because there is a need of an empirical analysis.

4.2. The pro-cyclic relation between good governance and growth/development

The results of this sub-section show that both the level of growth and the level of development showed an increasing trend with improvements in governance indicators. Therefore, Figures 2 and 3 demonstrate that there exists a positive correlation between growth and development and all the selected governance indicators. This predicts that deterioration in governance indicators will lead to a decline in growth and development. Among the six selected governance indicators, control of corruption had the most pro-cyclic relationship with growth and development, followed by government effectiveness, regulatory quality, rule of law and political stability and absence of violence/terrorism. The indicator with the least pro-cyclic relation with growth and development was voice and accountability. In Figures 4 and 5, trends of growth and development plotted against governance, measured as the arithmetic mean of the six WGIs, verify the existence of a strong pro-cyclic relationship between governance and economic growth and development in Rwanda. Figure 4 also reveals that economic growth increases the level of improvement in governance when contrasted with economic development in Figure 5.

The observed trends highlight that significant economic performance, further economic growth and economic development in Rwanda will primarily be driven by good governance in the country.

Because of the strong and positive relationship that exists between governance and the level of growth ($R^2 = 0.93$) and level of economic development ($R^2=0.86$), good governance is one of the most important pillars in different strategic documents developed in Rwanda to attain sustainable economic growth and development. The improvements in governance that occurred during 1996-2015 show that Rwanda's economic growth and development was based on creating effective and efficient incentives for the private sector, helping the poor by creating opportunities for entrepreneurship, reducing opportunities for corruption, increasing the quality of public services and service delivery and increasing opportunities for job creation (NISR, 2015; RGB, 2016a). In addition to this, good governance brings a stable environment for investments, an enabling environment for undertaking research for creativity and innovations and improvements in developing, adopting and/or imitating new technologies to increase domestic productivity (Republic of Rwanda, 2006). Further, improvements in all these were led by the development of a number of 'home grown solutions' appropriate for solving different problems that Rwandans faced after the genocide against the Tutsi in 1994 and the period of the country's reconstruction in 2000 in a sustained manner. Among others, the home grown solutions have helped Rwanda offer higher quality public services and encouraged higher levels of human capital development and accumulation, appropriate use of foreign aid resources, accelerated technological innovations, increased the productivity of government spending, increased social safety net programs and social protection mechanisms, improved health and education, curbed environmental degradation and repressed corruption.

All this led Rwanda to achieve high levels of economic growth and development. Hence, the home grown solutions have strengthened systems of public financial management leading to efficient use of public investments in health and education, efficient allocation of public investments to productive projects and widening the development of small and medium-sized enterprises. Different home grown solutions which have contributed to these achievements are grouped into four clusters: Umwiherero, Umushyikirano, Governance Month, National Forum Political Parties, Itorero and Imihigo grouped in the governance cluster; Girinka, Ubudehe, Vision Umurenge Program, Universal Health Insurance Scheme and 9 & 12 Years Basic Education grouped under the social cluster; Umuganda, Agaciro Development Fund and Land Use Consolidation grouped under the economic cluster; and Gacaca, Abunzi and Maisond'Accès à la Justice grouped under the justice cluster (RGB, 2016d).

The predictions in Figures 1, 4 and 5 suggest that in the long-term and very long-term the sustainability of Rwanda's economic performance will be based on good governance. Given the positive impact of the home grown solutions on good governance, the most important pre-requisite for sustainable economic performance will be political stability and strong politico-economic policies and strategies for developing appropriate home grown solutions and channelizing them for better implementation.

4.3. Trend of the estimated shock in human capital development

In this sub-section we analyse the trend in shocks in human capital development, estimated using Equation 4. To understand the trend of an estimated shock in human capital development, let us start by explaining its association with economic growth and development. Figure 6 shows that a period of maximum shocks in human capital development corresponds with a period of minimum growth and development and a period of minimum shocks in human capital development corresponds with a period of maximum growth and development. In Figure 6, we observe two critical points, one in 1994 and the other in 2000. The 1994 situation is explained by a dramatic decline in education, health and human capital development and accumulation resulting from the 1994 genocide against the Tutsi. Therefore, the observed situation in 1994 was highly associated with a period of lack of good governance in Rwanda. However, as 2000 corresponds to the period during which the vision of the country changed to becoming a self-sustained and middle-income country, the observed situation may be explained by the fact that during the period of policy reforms, indicators of economic performance were subjected to measurable variations. These can be attributed to sequencing implementation problems and intermittent economic adjustments. As our focus is on governance and not on variations in the indicators of economic performance as a result of economic reforms, we conclude that lack of good governance is the most important factor leading to a significant shock in human capital development and accumulation.

4.4. Counter-cyclic relation between good governance and shock in human capital development

This sub-section demonstrates that the estimated shock in human capital development declines with improvements in governance indicators. This reflects a counter-cyclic relation that exists between a shock in human capital development and good governance. Figure 7 suggests that improvements in good governance go with improvements in human capital development, whereas lack of good governance leads to a high shock in human capital development. Taking two governance indicators, political stability and absence of violence/terrorism and voice and accountability, which are the most and least significant governance indicators negatively related to the estimated shock in human capital development, *ceteris paribus*, a decline in the estimated shock in human capital development is explained by improvements in political stability and absence of violence/terrorism by 46 per cent and by voice and accountability by 25 per cent. When the arithmetic mean of the six WGs used in our paper is plotted against the estimated shock in human capital development, Figure 7 demonstrates that a decline in the estimated shock in human capital development is explained by good governance by 42 per cent. Different factors explain why the lack of good governance can negatively affect human capital development and accumulation. Lack of good governance incapacitates the government economically by rendering public and private institutions ineffective, undermining investments in health and education leading to inefficient allocation of government budgets, weakening government revenues and tax collection systems and enfeebling the saving and investment system. It further leads to increasing labour market inefficiencies, rendering the business environment vulnerable and inappropriate and hindering public and private willingness to develop safety net programs and social protection mechanisms. All these factors lead to lower levels of human capital

development and accumulation which may result in a drop in researches for creativity and innovations and decline in developing, adopting and/ or imitating the capacity for new technologies, thus creating economic inefficiencies and lowering production capacity.

Insert Figure 7 about here

Figures 8 and 9 demonstrate that, *ceteris paribus*, there exists a moderate counter-cyclic relationship between a shock in human capital development and economic growth and development. The negative impact of a shock in human capital development is higher on economic growth than on economic development. A shock in human capital development negatively affects economic growth through productivity deficiency and economic inefficiencies while it affects economic development through lack of functioning public and private institutions and lack of public systems to promote welfare and create safety net program channels. On the one hand, productivity deficiency and economic inefficiencies arise from the fact that lack of good governance leads to a decline in absorption capacity, which is accompanied by a fall in researches for creativity and innovations, a decline in the capacity to develop, adopt and/ or imitate new technologies and high domestic market inefficiencies resulting from corruption and political instability distorting the labour market, the goods and services market and the financial market. On the other hand, lack of functioning public and private institutions and lack of public systems to promote welfare and create safety net programs arises from the fact that lack of good governance makes the implementation of inclusive development where people take part in formulating policies relevant to the socioeconomic problems that they are facing complex. However, improvements in good governance and ‘home growth solutions’ have proved that they can be efficient remedies for all these challenges. They can curb shocks in human capital development and create an enabling environment for higher human capital development and accumulation whilst increasing domestic productivity, ensuring economic efficiency and welfare, ensuring the viability of public and private institutions and promoting safety net programs for poverty reduction and food security (RGB, 2016a, 2016b, 2016c, RGB, 2016; NISR, 2015; MINAGRI et al., 2016; MINECOFIN, 2012).

Insert Figure 8 about here

Insert Figure 9 about here

4.5. Effect of a shock in human capital development on economic growth and development

Although the analysis so far shows a negative relationship between growth/development and a shock in human capital development, it does not show if that relationship is still negative and significant enough to negatively affect growth and development in Rwanda when calibrated in the production function. This sub-section discusses the spillover effect of lack of good governance on economic growth and development. We assume a shock in human capital development to be one of the channels through which lack of good governance negatively affects economic performance.

The results in Table 1 show that all the series are stationary at their log and differenced levels. As the estimated F statistics for the Breusch-Godfrey LM test in Models 1 and 2 are not statistically significant and the estimated Durbin-Watson d-statistics in these two

models are approaching 2, these results strongly accept the null hypothesis of ‘no serial correlation.’ In addition to this, the estimated statistics, Adjusted R-square, root MSE, TSS and TMS, for model-fit demonstrate that the used variables fit the two mobilized models well. *Ceteris paribus*, the Adjusted R-square in Model 1 demonstrates that 98 per cent growth in Rwanda is likely explained by gross fixed capital formation, labour force and shock in human capital development, whereas in Model 2, development in Rwanda is likely explained by 92 per cent by these three variables.

The results in Table 1 agree with the results obtained in section 4.4, which show that there is a negative relationship between a shock in human capital development and growth and development. More importantly, this section demonstrates that this negative relationship is statistically significant at the 5 per cent and 10 per cent levels in Model 1 and Model 2 respectively. Our empirical findings suggest that a 1 per cent increase in a shock in human capital development will result in decreasing growth and development by 0.28 per cent and 0.31 per cent respectively. Our findings also show that the uncovered negative effect of a shock in human capital development reverberates more in economic development as compared to economic growth. This is explained by the fact that the estimated elasticity of a shock in human capital development on development in Model 2 is greater than the estimated growth in Model 1. This reminds us how home grown solutions have contributed significantly to reducing poverty, curbing the unemployment rate, reducing households’ vulnerability and exposure to natural hazards, ensuring national security, increasing productivity and ensuring food security, among others (RGB, 2016a, 2016b, 2016c, 2016d; NISR, 2015; MINAGRI et al., 2016; MINECOFIN, 2012). Therefore, the positive impact that good governance has on improving human capital development and accumulation leading to an improvement in growth and development, reveals that the level of development and growth in Rwanda not only depends on fixed capital formation and labour force but also on improvements in controlling corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law and voice and accountability. These are the indicators of governance used in our paper. Therefore, it can be concluded that good governance is one of the key factors determining the success of economic reforms for attaining economic growth and development.

Indicators of good governance also provide important insights to investors to decide on where, when and how to invest as an improvement in good governance increases inclusive development and leads not only investors in general but also risk averse investors to be more confident about the future and potentially invest more as their investments are safe and secure with expectations of positive returns. Inclusive development and an increase in investments depend on the economy's capacity to absorb human capital to increase productivity and ensure economic efficiency. Moreover, human capital development is a determining factor in an economy's capacity to invent new technologies and adopt or imitate technologies developed in other economies that may include world leaders in terms of technological progress (Başak and Sevinç, 2013; Bilas et al., 2016; Coe and Helpman, 1995; Guellec and Van, 2001; Lai et al., 2006). In contrast, a shock in human capital development slows down technological progress, catch-up and technological diffusion. On the one hand, the more an economy's human capital development gets better the more its ability to adopt and imitate new technology from abroad. As a result the economy steps towards high and efficient production capacity which in turn stimulates growth and development. On the other hand, the more

an economy's human capital development shrinks, the more its production capacity gets worse thus hampering growth and development.

Insert Table 1 about here

5. Conclusion and policy implications

We used two techniques, scatter and line plots and OLS, to investigate how governance is related to economic growth and development. In OLS, we simulated Benhabib and Spiegel's (1994) alternative model for growth accounting and calibrated it with the estimated shock in human capital development to investigate the spillover effects of lack of good governance on growth and development. Our paper shows that there exists a pro-cyclic relationship between governance and economic growth and development. It also shows that the spillover effect of lack of good governance on economic growth and development is a counter-cyclic relation between a shock in human capital development and growth and development. It suggests that this may be a result of the fact that lack of governance leads to a decline in absorption capacity; slows down technological progress, catch-up and technological diffusion; leads to high domestic market inefficiencies; and makes the implementation of inclusive development more complex. It also demonstrates that the uncovered negative effects of a shock in human capital development reverberate in development when compared to growth. Finally, it reveals that the level of development and growth in Rwanda not only depends on fixed capital formation and labour force, but also on good governance. It suggests that 'home growth solutions' have been efficient remedies in curbing shocks in human capital development and creating an enabling environment for higher human capital development and accumulation whilst increasing domestic productivity, ensuring economic efficiency and welfare, ensuring the viability of public and private institutions and promoting safety net programs and social protection mechanisms for poverty reduction.

A significant economic performance, further economic growth and economic development in Rwanda will be driven by good governance in the country. Given the positive impact of the home grown solutions on good governance, the most important pre-requisite for sustainable economic performance is political stability and strong politicoeconomic policies and strategies to develop more such home grown solutions and channelizing them so that they are better implemented.

Finally, given the results of our study which demonstrates how good governance has been a key driving factor in growth and development and which show how a shock in human capital development emanating from lack of good governance can significantly impede both growth and development, our paper suggests that there is still room for improvement in growth and development in all other African countries through good governance. Our study suggests that drawing lessons from Rwanda's good governance system and replicating it in other countries in Africa will lead to political stability and sustainable economic growth and development which are the most pressing issues on the continent.

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Figure 1: Trends in selected governance indicators (1996-2015)

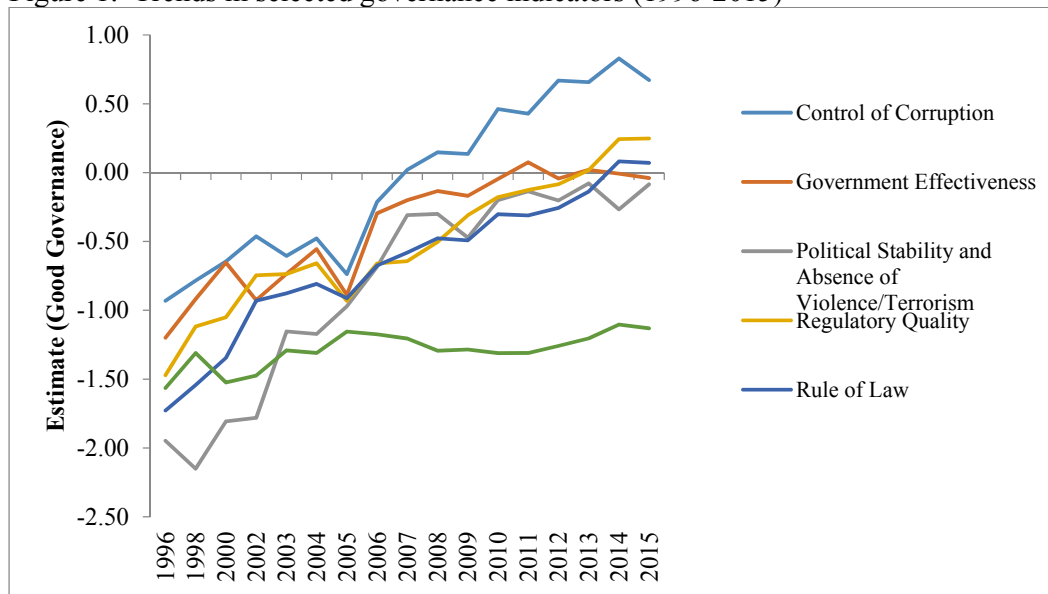
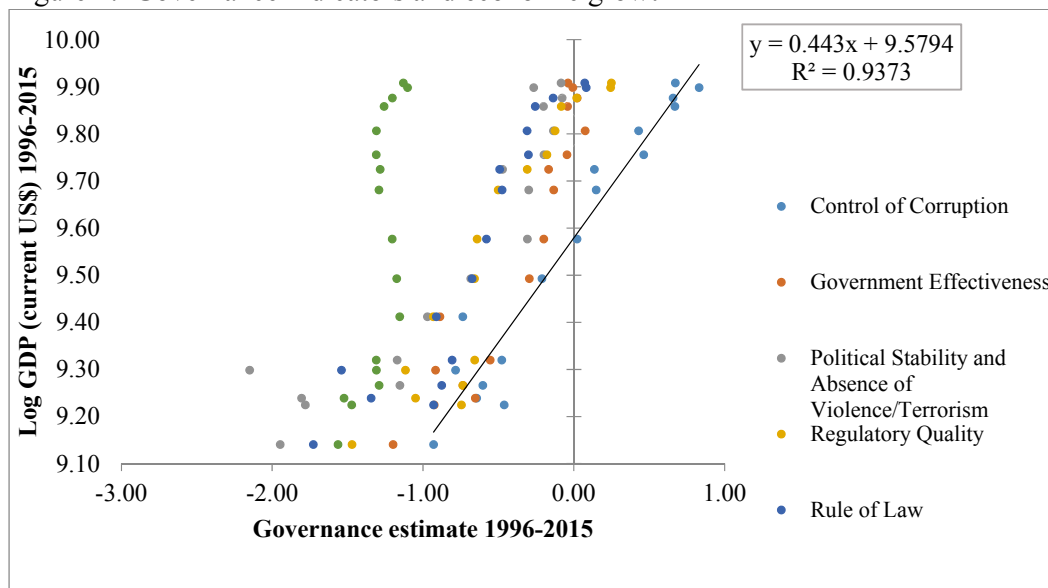
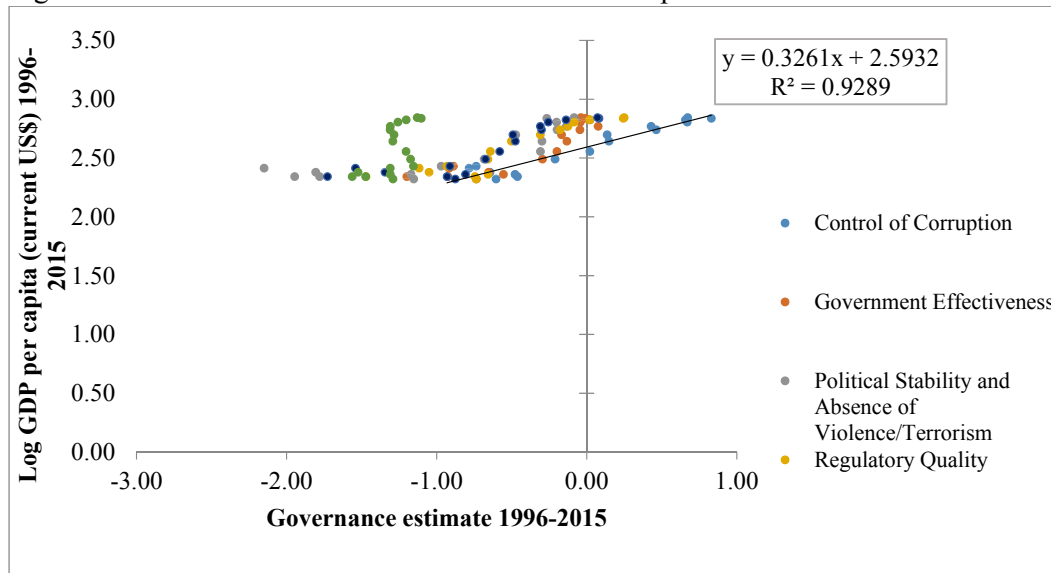


Figure 2: Governance indicators and economic growth



Note: Ceteris paribus, the estimated coefficient of determination demonstrates that improvements in economic growth can be explained by control of corruption (94%), government effectiveness (87%), government effectiveness (87%), regulatory quality (86.7%), rule of law (85%), political stability and absence of violence/terrorism (85%) and voice and accountability (45%).

Figure 3: Governance indicators and economic development



Note: Ceteris paribus, the estimated coefficient of determination demonstrates that changes in economic growth can be explained by control of corruption (93%), government effectiveness (81%), regulatory quality (82%), rule of law (76%), political stability and absence of violence/terrorism (75%) and voice and accountability (33%).

Figure 4: Good governance and development

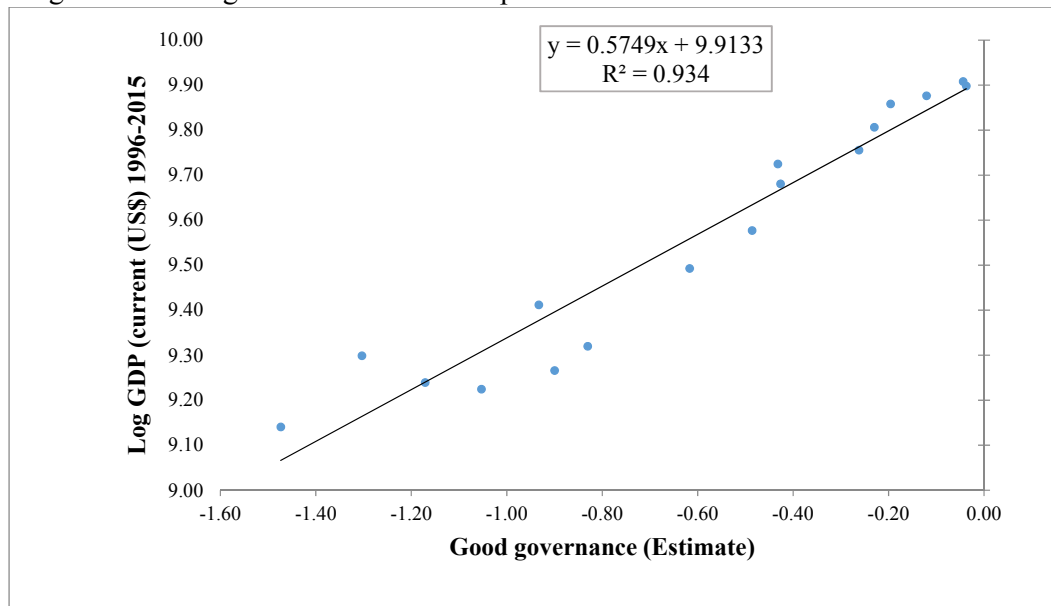


Figure 5: Good governance and development

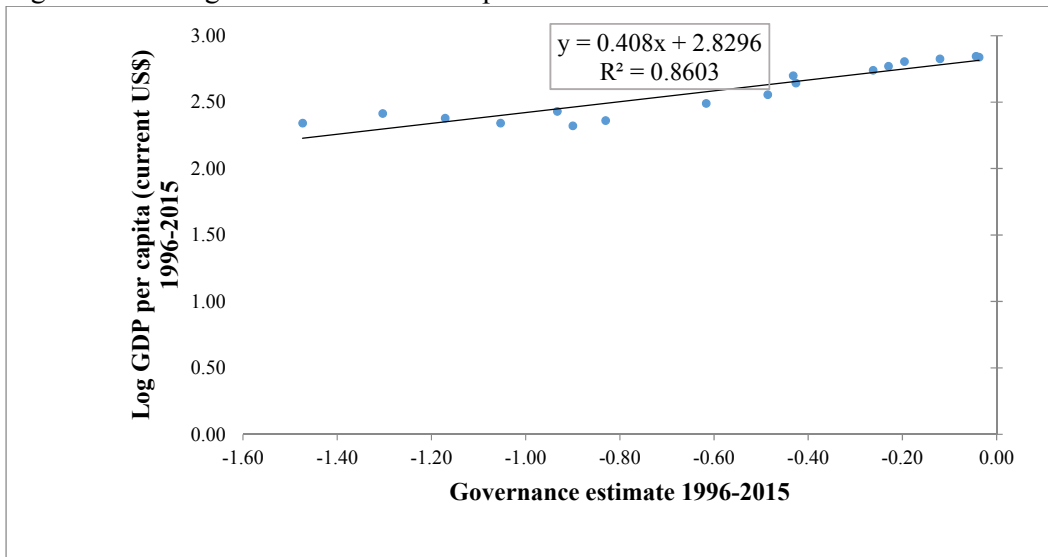


Figure 6. Log of estimated shock in human capital development

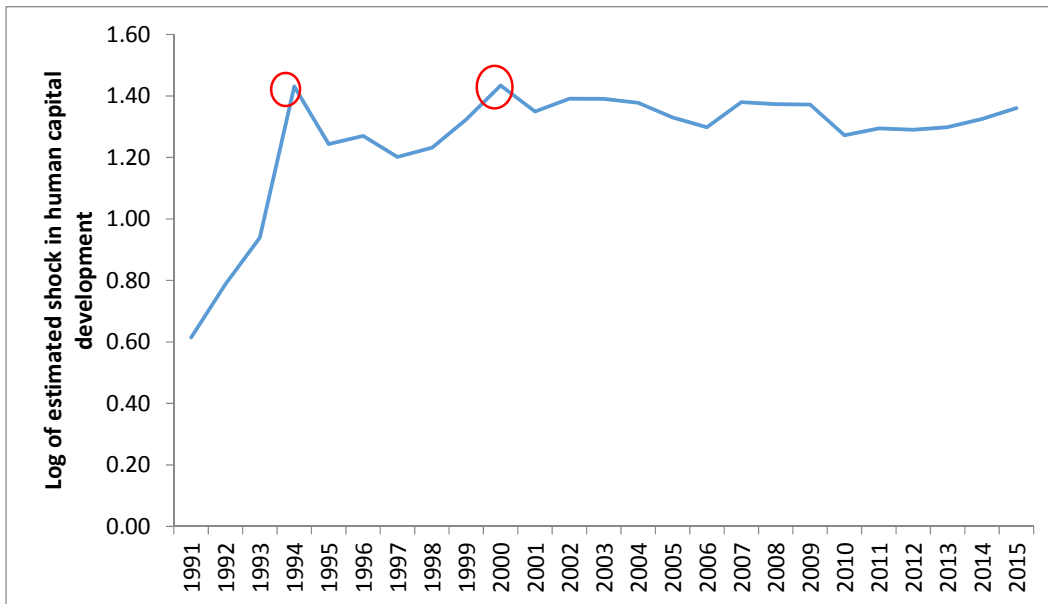
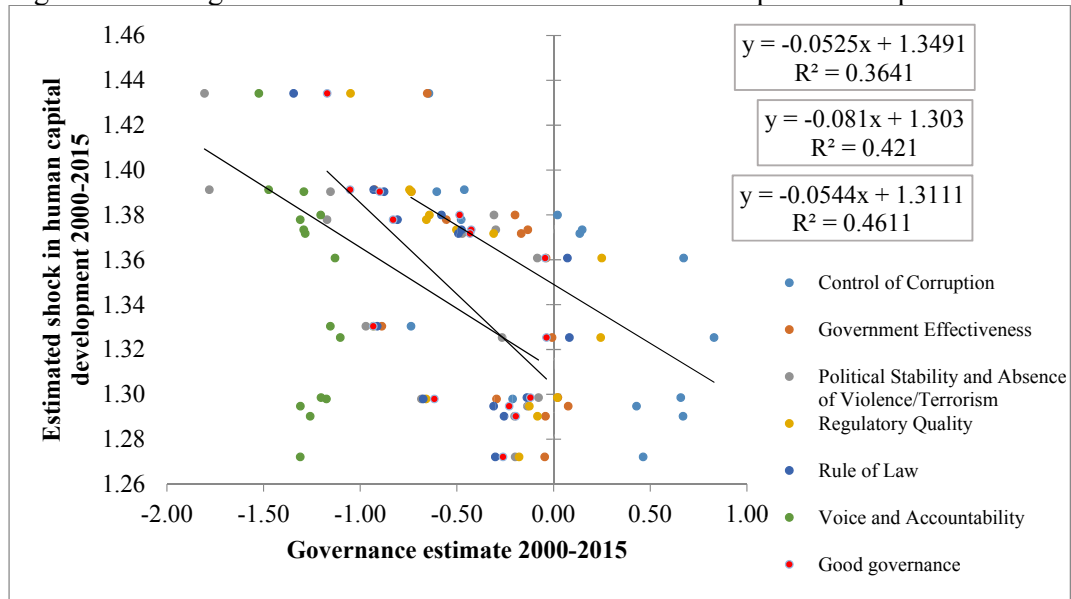


Figure 7: Good governance indicators and shock in human capital development



Note: Ceteris paribus, the estimated coefficient of determination demonstrates that decline in a shock in human capital development can be explained by improvement in governance (average six WGIs) by 42%, political stability and absence of violence/terrorism by 46%, rule of law by 38%, control of corruption by 36%, government efficiency by 34%, regulatory quality by 32%, and voice and accountability by 25%.

Figure 8. Human capital shock and growth

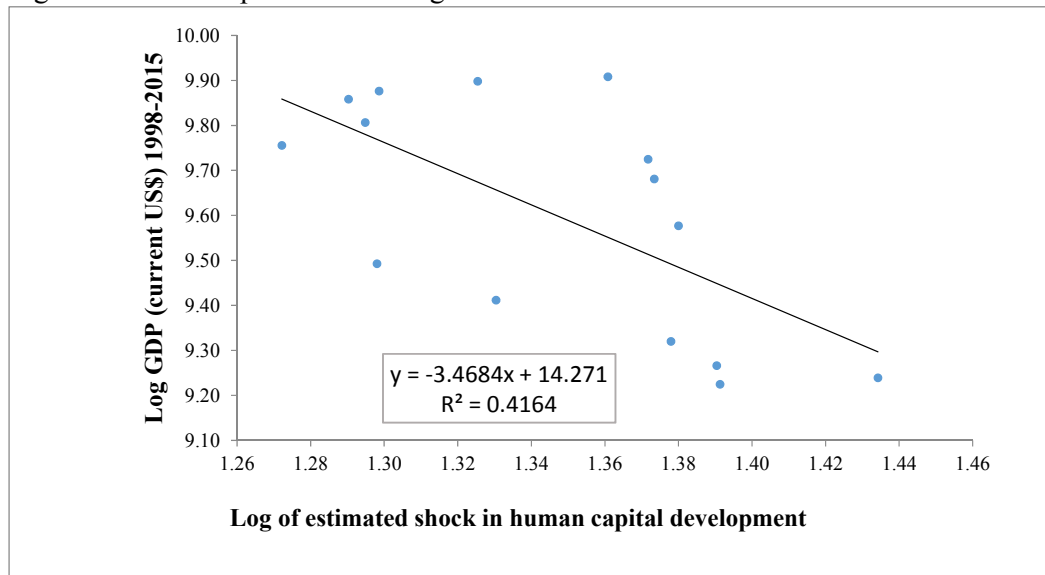


Figure 9. Human capital shock and economic development

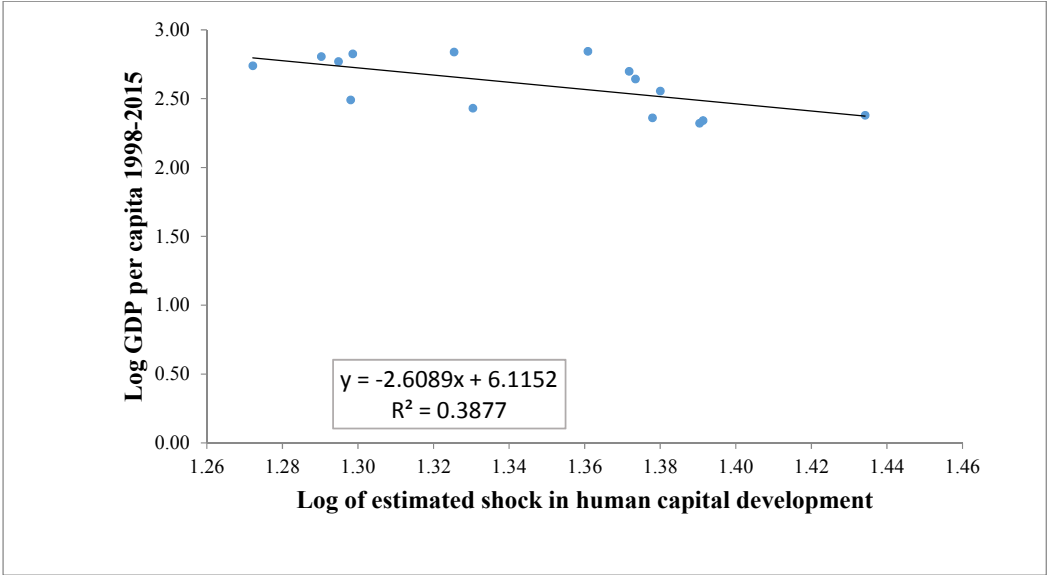


Table 1: OLS summary results

	DF Unit-root test Test Statistic	Model1		Model2	
		Coef.	Std.Err	Coef.	Std.Err
GDP (Log, 1 st Δ)	-5.548***				
GDP per capita (Log, 1 st Δ)	-4.797***				
Capital (Log, 1 st Δ)	-5.875***	0.581*** [0.022]***	(0.031)	0.398*** [0.014]***	(0.044)
Labor Force (Log, 1 st Δ)	-2.837*	0.574** [0.006]**	(0.227)	0.323 [0.004]	(0.331)
Shock in HCD (Log, 1 st Δ)	-4.999***	-0.090** [-0.0028]**	(0.039)	-0.100* [-0.0031]*	(0.057)
Obs.		24		24	
F(3, 21)		363.73***		87.93***	
Adj R-square		0.978		0.916	
Root MSE		0.016		0.024	
TSS		0.297		0.161	
TMS		0.012		0.007	
Breusch-Godfrey LM test (1, 20)		1.763	[0.199]	0.035	[0.854]
Durbin-Watson d-statistic(3, 24)		2.503		2.040	

Note: ***, **, * denote statistical significance at 1%, 5% and 10%. Figures in parenthesis are standard errors. Figures in [] are elasticities. Model 1: GDP is taken as the dependent variable; Model 2: GDP per capital is taken as the dependent variable. Coef and Std.Err. stand for coefficient and standard error respectively. MSE, TSS and TMS stand for mean square error, total sum square and total mean square. (Log, 1stΔ) denotes logged and first differenced time series. Shock in HCD stands for estimated shock in human capital development. DF stands for Dickey-Fuller.

Part Three. Development Goals

Chapter 5. Ewa Cieslik, “Assessing Economic Potential of Rwanda from the International Perspective”.

Chapter 6. Theogene Rizinde, Ferdinand Nkikabahizi, Leonidas Babamwana and Josephine Umutesi, “Achieving the Sustainable Development Goals in Rwanda: The Role of administrative data inclusion”.

Chapter 7. Pereez Nimusima, Nathan Karuhanga and Dative Mukarutesi, “Evaluation of Rwanda Vision 2020 Achievements”.

Chapter Five

Assessing Rwanda's Economic Potential from an International Perspective

Ewa Cieslik

Faculty of International Business and Economics
Poznan University of Economics and Business, Poznan, Poland,
E-mail: ewa.cieslik@ue.poznan.pl

Abstract

This study focuses on the multidimensional characteristics of Rwanda's business climate and potential in terms of foreign economic relations. This country has created macroeconomic stability and increasingly attractive investment conditions for foreign investors, trading partners, business start-ups, entrepreneurs and other private sector actors. The study has the following objectives: (i) assessing Rwanda's economic potential in the background of the East African states using the taxonomic methods (three different types of standardizations were used in the study: classical standardization, standardization by average and standardization by range); (ii) evaluating the potential of Rwandan exports; and (iii) formulating policy recommendations for developing Rwandan international economic relations. The paper also classifies conditions for doing business with non-model methods. The analysis covers almost all East African states. Moreover, an evaluation of Rwandan export potential is based on the index of indicative trade potential. The study takes into account Rwanda's most important export partners: the Common Market for Eastern and Southern Africa, the East African Community, the Democratic Republic of the Congo and Kenya. The analysis spans the period 2001-15. In some cases the research period was extended to 2016.

Keywords: Rwanda, economic potential, foreign trade, indicative trade potential, taxonomic methods, East Africa.

JEL Classification Codes: C1; F14; F17; O1;

1. Introduction

The last decades of the 20th century brought a significant acceleration to the processes of globalization, exemplified by an increase in global interactions, diminishing of geographical barriers in the flow of goods, capital, services, technology, information, and the development of mass culture and increasingly intense bilateral and multilateral trade relations. At that time most of the East African countries¹ played a relatively small part in these processes. The first decade of the 21st century, however, brought about fundamental qualitative changes in East African countries, indicating their potential and developmental possibilities (Cargill, 2010). Individual countries in the region like Rwanda recorded the fastest economic growth in the world, while most of the developed economies suffered from the economic crisis and its consequences. The next few decades are expected to be a period of accelerated economic growth and development for the East African region. Our study focuses on the multidimensional characteristics of the economy of one of the fastest growing states in eastern Africa – Rwanda -- which has created macroeconomic stability and an increasingly attractive investment climate for businesses, entrepreneurs and other private sector actors.

The main objectives of the study are:

- 1) Assessing Rwanda's economic potential in the background of the East African states using taxonomic methods.
- 2) Evaluating the potential of Rwandan exports.
- 3) Formulating policy recommendations for developing Rwandan international economic relations.

The analysis covers the period 2001-15. In some cases the research period was extended to 2016, especially in foreign trade. To make sure that the results were consistent and comparable, data was obtained from databases kept by international organizations, mainly from the World Bank, the Organization for Economic Cooperation and Development (OECD), the United Nations Conference on Trade and Development, the African Development Bank and the World Trade Organization.

2. Rwanda's trade and capital flows with the world

Rwanda developed its international economic relations after the 1994 genocide (IPEP, 1998). The country is a member of a number of global and regional organizations and treaties of interest to potential investors including the African Trade Insurance Agency (ATI), the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC), the Cotonou Agreement between EU and the African, Caribbean and Pacific States, the International Centre for the Settlement of Investment Disputes, the Multilateral Investment Guarantee Agency, the Paris Convention on Intellectual Property, the World Intellectual Property Organization and the World Trade

¹ This paper assumes the division of Africa into regions as developed by the United Nations Conference on Trade and Development, therefore the Eastern African region consists of Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Uganda, Tanzania, Zambia and Zimbabwe.

Organization (WTO). Rwanda has also signed several bilateral investment treaties and double taxation treaties (Rwanda Development Board, 2016).

Rwanda is moderately open to the world. In recent years, the share of its international trade in goods in its GDP has been fluctuating at around 40 per cent, while at the beginning of the 21st century this did not exceed 20 per cent. Considering the turnover of goods and services, the openness index in 2015 was almost 49 per cent, which represented a 15 per cent increase over the decade. Rwanda's openness is slightly below the average for Eastern Africa (57 per cent in 2015) (UNCTAD, 2017).

In 2016, Rwanda exported goods worth US\$ 744 million, almost nine times more than their value in 2001. Imports amounted to nearly US\$ 2.3 billion in 2016, that is, eight times more as compared to 2001. The share of services' turnover was smaller: exports of services in 2016 amounted to US\$ 851 million, while the imports were worth less than US\$ 1.1 billion. Rwanda's trade balance has been negative for more than a decade: it was deficit of US\$ 1.5 billion in 2015, which accounted for over 18 per cent of its GDP. The share of Rwanda's trade deficit was higher compared to the whole region (15 per cent) (UNCTAD, 2017).

The country's share of global exports and imports of goods is small. In 2016, it was 0.005 per cent and 0.014 per cent respectively. Compared to 2001, the percentages had increased, but still remained at very low levels. In 2016, Rwanda's share of East African exports was less than 2 per cent; it was almost 3 per cent for imports. Given the tariffs, the effectively applied rate is not high in Rwanda. Its share of trade in services in global turnover is minor, but it exceeds the country's share in commodity trade. In 2015, exports of services accounted for 0.017 per cent and their imports represented 0.022 per cent of global turnover. The share of exports and imports of services in the region was 4 per cent (UNCTAD, 2017). The fact that Rwanda does not have direct access to any port increases transport costs significantly. High transport costs limit trade significantly, typically even more than tariffs.

Rwanda's participation in global value chains is limited (AfDB et al., 2014; Draper and Lawrence, 2013). However, the delocalization and fragmentation of production have not left this region unaffected. Transformations in the Rwandan economy resulted in foreign enterprises deciding to take advantage of the country's comparative advantages (Martin, 2013). Thanks to its factors of production and level of development, Rwanda is attractive for four types of investors looking for four things: resources, a ready market, a reduction in production costs and strategic assets (for example, the railroad network for the power industry) (Proksch, 2003) (Ernst and Young, 2014).

The country's export concentration is high.² In 2014, Rwanda sent about 117 products abroad.³ Many countries in the region such as Kenya, Tanzania and Uganda, provided a more diverse range of goods. Compared to 2001, Rwanda's export offers have improved considerably (back then the country exported 16 product groups) but despite the export expansion, Rwanda's export concentration is one of the highest in the region. In 2015, it amounted to 0.30;⁴ only a few countries in the region (for example, Zambia, Somalia or Malawi) had higher export concentration ratios. It should be noted that concentration

² The product concentration index shows how Rwanda's exports and imports are concentrated on a few products or otherwise distributed in a more homogeneous manner among a series of products.

³ Number of products exported at the three-digit SITC, Rev. 3 level.

⁴ For comparison, it was 0.49 in 2001.

values varied during this period, but in recent years the concentration has decreased slightly. Rwanda exports mainly vegetables, which accounted for almost 36 per cent of exports in 2015. It also sells minerals (22 per cent) and fuel (15 per cent). These three commodity groups account for almost three-fourth of the country's exports. Compared to 2001, Rwanda's export structure has evolved noticeably. At that time, the most important commodity group, accounting for more than two-third of exports. Other commodity groups, except for vegetables (17.5 per cent) and minerals (11 per cent) had a small share (Figure 1). An analysis of the export structure in terms of product processing shows that consumer goods and raw materials dominate (almost 42 per cent and 36.5 per cent respectively). In 2001, consumer goods accounted for over three-fourth of exports. As for services, Rwanda exports mainly tourist services, which accounted for almost 46 per cent of services sold abroad in 2016. This group of services over the period of study accounted for the largest share of exported services (WTO, 2017) (UN, 2017).

Insert Figure 1 about here

We used the merchandise trade specialization index⁵ to indicate commodities in which the country specializes. The index was calculated for commodity groups in accordance with the Standard International Trade Classification (SITC).⁶ The calculations show that in 2015 Rwanda specialized exclusively in exporting fuels and mining products, where this specialization refers mainly to fuels. From a historical point of view (data since 2001), these two commodity groups are the only ones in which Rwanda has ever specialized (Table 1).

Similar results were obtained by calculating the revealed comparative advantage index for Rwanda's exports as developed by Balassa. In general, the Balassa Index (BI) (Balassa, 1965, 1998) for the j commodity group in country A compared to the reference group of countries is represented by:

$$(1) \quad BI_j^A = \frac{s_j^A}{s_j^{REF}}$$

where, s_j means the share of a given commodity group in exports. Interpreting this index is simple. Values greater than 1 indicate commodity groups where the country has a revealed advantage compared to the reference group of countries. Another approach, somewhat simpler, is based on the following index (the revealed comparative advantage index):

$$(2) \quad RCA_i = \frac{X_i}{M_i}$$

where, X_i represents the volume of exports in a given commodity group and M_i represents the volume of imports in this commodity group. If the value of revealed comparative advantage exceeds unity for a commodity, the country is said to have a revealed

⁵ $TSI_{ji} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}}$ where, TSI_{ji} = the index of trade specialization of economy j for goods i in a specific period; i = product or product groups; j = economy (country or country group); X_{ij} = economy's j exports of goods i; M_{ij} = economy's j imports of goods i. The range of values is between -1 and 1, the positive value indicates that an economy has net exports (hence it specializes in the production of that specific product) and negative values means that an economy imports more than it exports (net consumption).

⁶ All product groups are defined according to Revision 3 of SITC.

comparative advantage in the production of that commodity. In contrast, if RCA_i is below 1, the country is at a comparative disadvantage in the production of that commodity.

Unfortunately, this index is faulty as it is not comparable over time because trade deficit changes. A corrected measure of revealed comparative advantage is then used:

$$(3) \quad CRCA_i = \frac{X_i}{\sum_i X_i} - \frac{M_i}{\sum_i M_i}$$

We also calculated the difference between the share of a given commodity in a given country's exports and the share of that commodity in its imports. Interpreting the index value is also simple. Values greater than zero indicate commodity groups where the country has a revealed comparative advantage. This method is used in Table 2.

It shows that in 2015 Rwanda had a revealed comparative advantage in the export of agricultural products, food stuff, fuels and mining products. Unfortunately, there was no comparative advantage for other commodity groups. It should be noted that over the entire study period, except for 2002, Rwanda had a revealed comparative advantage in agricultural products and food stuff. Fuels and mining products also revealed comparative advantage during the analysis period, but the fuel sub-group did not show positive index values until recently (Table 2). The revealed comparative advantage index has improved lately in many groups of export commodities, except for fuels and mining products, chemicals and pharmaceuticals, integrated circuits and electronic components, transport equipment and automotive products.

Technically advanced products have a small share in Rwanda's exports.⁷ In 2015, the country exported high-tech products worth over US\$ 7.6 million. For comparison, the value of such products exported in the 1990s was less than several tens of thousands of dollars. The highest increase in the sale of high-tech products abroad was in 2002, when Rwanda exported products worth over US\$ 9 million. At that time, their share in the export of industrial goods accounted for almost 84 per cent. By 2015, this share had fallen to less than 13 per cent (World Bank, IBRD, IDA, 2017). In 2015, ICT products accounted for 0.81 per cent of the country's exports, while imports of this group of commodities were 9.82 per cent. At present, the country does not have a comparative advantage in any of the high-tech product groups; it mainly imports goods from the category of high-skill and technology-intensive manufactures (Table 3).

Insert Table 1, 2, 3 about here

The commodity concentration in imports is significantly lower than the concentration in exports. Although Rwanda does not import much in terms of quantity (212 products in 2015)⁸ the imports' concentration factor is one of the lowest in the region at 0.073. Only Eritrea had more diverse imports. During the analysis period, the volume of imported goods did not increase as significantly as in the case of exports -- in 2001 Rwanda imported 155 commodity groups. However, the concentration decreased from 0.18 in 2001. Rwanda imports machinery and electronics (23 per cent), chemicals (12 per cent) and metals and vegetables (11 per cent each). Other commodity groups have a small share in imports. Since 2001, the structure of imports has not changed significantly as machinery and electronics continue to rank high (14.5 per cent) followed by fuels (14 per

⁷ More about high technology exports' impact on development is available in Srholec (2005) and (Mani (2000).

⁸ Number of products imported at the three-digit SITC, Rev. 3 level.

cent), vegetables and wood (less than 14 per cent) (Figure 2). Rwanda imports mainly consumption goods (39 per cent), but the share of capital goods and semi-finished products is also not much smaller (27 per cent and 28 per cent respectively). In 2001, consumer goods dominated (over 54 per cent) in imports. An analysis of imported services shows that Rwanda mainly purchased transport services from abroad (in 2016, their share in imports was 38 per cent), followed by other services and tourist services (WTO, 2017) (UN, 2017).

Insert Figure 2 about here

In 2015, Rwanda's leading export and import trading partner in terms of value was sub-Saharan Africa (US\$ 885 million, which accounted for over 36 per cent of the trade). Its most important trading partners in that year were China (US\$ 372 million, 15 per cent of total trade), Uganda (US\$ 243 million, 10 per cent) and Kenya (US\$ 238 million, 10 per cent). In regional integration groups of which Rwanda is a member the share was: COMESA (exports: US\$ 303 million, imports: US\$ 697 million) and EAC (exports: US\$ 82 million, imports: US\$ 711 million); they were the country's most important trading partners. Besides Uganda and Kenya, DRC and Tanzania play an important role in Rwanda's trade. Trade between members of COMESA and EAC is quite intense, but an increase in trade between Rwanda and the groups has remained steady in recent years.⁹

Rwanda's exports are more focused on sub-Saharan African markets. In 2015, more than 57 per cent of its exports went to these markets, while in 2001 the region was the recipient of 48 per cent of Rwandan goods. The second major market for the country's exports is Europe and Central Asia (20 per cent in 2015 and 35 per cent in 2001). The geographic structure of exports has changed since 2001, when Rwanda's most important partners were Kenya (36 per cent), Switzerland (14 per cent) and the Netherlands (12 per cent). Currently Rwanda's export partners include DRC (32 per cent of export value in 2015), Kenya (16 per cent) and Switzerland (9 per cent). The first two countries mainly buy consumer goods (from 66 per cent to 86 per cent of the exports) such as vegetables, fuels and food stuff. Switzerland is the main recipient of raw materials (99 per cent of exports) (WTO, 2017).

The geographical concentration of the Rwandan export market was investigated with the Herfindahl-Hirschman Index (HHI)¹⁰ which amounted to 0.08 in 2015. Rwanda experienced generally unconcentrated exports in the geographical concentration of exports.

The situation is the opposite for imports: less goods are imported from sub-Saharan countries (only 39 per cent in 2001 and only 30 per cent in 2015) in favor of markets in developing East Asia and the Pacific (27 per cent). The geographic structure of Rwanda's

⁹ Rwanda is actively engaged in COMESA and EAC, and has also assented to the COMESA-EACSADC tripartite free trade area agreement, whose objective is to promote deeper economic integration to facilitate strong trade performance and economic growth in Africa. In the context of recent developments in business interests in Central Africa, Rwanda was officially readmitted to the Economic Community of Central African States in 2015.

¹⁰ A HH index below 0.01 indicates a highly competitive market. A HH index below 0.15 indicates an unconcentrated market. A HH index between 0.15 and 0.25 indicates moderate concentration. A HHI above 0.25 indicates high concentration. HH index formula: $HHI = \sum S_i^2$, where S_i : market share of country i.

import partners has also changed: in 2001, Belgium was the most important import market for Rwanda (18 per cent), followed by Saudi Arabia (11 per cent) and Kenya (10 per cent). In 2015, Rwanda's main import partners were China (19 per cent), Uganda (13 per cent) and India (10 per cent). China sold mainly machinery and electronics (44 per cent) and metals (14 per cent), Uganda provided vegetables (31 per cent) and minerals (27 per cent), while metals, chemicals (23 per cent) and food stuffs (20 per cent) were imported from India (WTO, 2017). Import market concentration indices measured in HHI are the same as HH indices in exports and in 2015 amounted to 0.09. This means that the import market was also unconcentrated.

In general, Rwandan trade balance remains negative -- the country recorded a US\$ 1.2 billion trade deficit in 2015. Until about 2010, the increasing trade deficit was not due to deteriorating export prices. In fact, Rwanda enjoyed a major improvement in its terms of trade, even better than the average for sub-Saharan Africa (WTO, 2017).

The country's trade deficit with COMESA and EAC has been reported for years (US\$ 394 million and US\$ 629 million respectively in 2015). Rwanda also recorded a trade deficit with its main trading partners such as China, (US\$ 345 million), Uganda (US\$ 224 million) and Kenya (US\$ 58 million) (WTO, 2017).

Compared to East Africa, Rwanda neither attracts foreign direct investment (FDI) nor is it an investing country itself. An analysis of Rwanda's financial flows shows that there is a huge disproportion between FDI inflows and outflows. Since 2001, the country has been attracting more FDI, but practically it does not invest abroad at all. In 2015, FDI inflows amounted to US\$ 471 million, while FDI outflows did not exist. In general, Rwanda's FDI inward stocks amounted to less than US\$ 1.2 billion by 2015, representing just 1 per cent of FDI inward stocks in the region. The share of FDI inflows in Rwandan GDP increased from 3.9 per cent in 2014 to 4.2 per cent in 2015. The FDI outward stocks are much worse, as by 2015 Rwanda had invested only US\$ 15 million abroad.¹¹ FDI inflows also fluctuate a lot. In 2001-15, the average annual flow of investments was 67 per cent, but there were years when FDI inflows were up to 285 per cent (for example, in 2006) and years when they were significantly down (for example in 2002 and 2011). In 2015, FDI inflows increased by only 3 per cent. Such fluctuations show that Rwanda is considered a host economy for FDI inflows.

FDI outflows have been occurring sporadically over the study period and their average annual dynamics cannot be calculated. Rwanda is perceived to be a good place to do business. It is particularly valued for foreign investors' protection. For example, according to the Index of Transaction Transparency or Index of Shareholders' Power, Rwanda is at the same or even higher level than the USA. The main investors in Rwanda include Mauritius, South Africa and Kenya (UNCTAD, 2017).

Rwanda is a landlocked country with few natural resources. It has **resources such as gold**, tin, wolframite, tungsten, coltan, iron, methane gas and some arable land (U.S. Geological Survey, 2017). Some of the natural resources have not been completely exploited yet (for example, unexploited opportunities in ores) (New African, 2014). It is worth noting that deforestation is prevalent and is caused by the cutting of trees for fuel, as well as issues with the soil (erosion) and widespread poaching. Generally, Rwanda is not among the top countries in African mineral exporters. It has only recently seen a

¹¹ Only Malawi, Madagascar, Burundi and Mozambique had invested less by 2015.

significant increase in foreign direct investment in the mining sector. This can be attributed to Rwanda's adherence to all international regulations required for mineral exports, which has increased investor confidence in the area. The various concessions also indicate a desire to diversify the export market. Currently, the country's mining sector is mostly artisanal. The sector was developed first to a semi-mechanized and later to industrial level to increase production which is still low compared to existing potential. The fact that the country is not dependent on commodity prices in world markets favors a sustainable development of its economy and reduces its exposure to external shocks. In addition, it helps the government develop non-commodity sectors which are considered a key factor affecting the economic growth of the country.

In May 2015 the Government of Rwanda launched a new investment code aimed at attracting FDI into selected sectors -- tourism, energy and new technologies. FDI inflows are expected to reach US\$ 1.5 billion in a year. After these new measures, foreign investors are no longer required to invest a minimum of US\$ 100,000. The introduction of this code was written in line with the development program 'Vision 2020' which aims to significantly improve the business climate in Rwanda (Rwanda Development Board, 2012). Coffee, tea, tin, energy and telecommunications are some of the traditionally targeted sectors for foreign investments. In 2012, the Rwandan government and VISA Inc. signed a contract for developing electronic financial services, opening the door to new investments in this sector (VISA Inc., 2012). Rwanda has since continued to develop its technology sector; the country also has highly developed demonetized payment systems. In early 2016, the Rwandan Development Board signed an agreement with Thomson Reuters to support further innovations within the country (Rwanda Development Board, 2016).

3. Rwanda's foreign trade: Potential development

The diversity of Rwanda's revealed comparative advantage is also reflected in the degree of similarities between foreign trade commodity structures in Rwanda and those in the other states. We adopted the foreign trade commodity structures of the largest economic blocs in Africa as the model. This analysis enabled us to indicate the economic integration blocs that are similar to Rwanda in terms of foreign trade structures (applying Standard International Trade Classification, Rev.3). The Euclidean metric formula was used to study the degree of similarity. Comparing 2001, 2005, 2010 and 2016, it can be observed that the structure of commodities exported by Rwanda is becoming similar to EAC and COMESA's structures since 2005. We also observed that at the beginning of the 21st century, Rwanda had clearly drifted away from COMESA's model and had become similar to EAC. Rwandan exports are quite similar to Kenya's but differ from DRC's exports significantly (Figure 3). This raises the possibility that the larger the difference between export structures, the higher the possibility for bilateral trade development.

Insert Figure 3 about here

An evaluation of Rwandan export potential is the base of the index of indicative trade potential (ITP).¹² We took into account the country's most important exports partners: COMESA, EAC, DRC and Kenya.

ITP it is a purely mechanical indicator defined as:

$$(4) \quad ITP_{ijk} = \min (X_{ik}, X_{jk}) - X_{ijk},$$

where:

$$(5) \quad X_{i.k} = \sum_{j=1}^J X_{jik} -$$

$$(6) \quad X_{.jk} = \sum_{i=1}^I X_{ijk}$$

The idea behind the ITP indicator is identifying the goods for which there is the highest trade complementarity between the exports of a country (in our case Rwanda) and the imports of the target country/ region (COMESA, EAC, DRC and Kenya). The trade potential indicator assumes that the importing country/ region could in-principle absorb all imports from Rwanda perfectly.

Comparing the indicative trade potential of the analyzed countries and integration groups in 2016 we did not observe the largest trade potential in absolute numbers in the case of COMESA or EAC, but in the case of Kenya: US\$ 694.5 million, which is 7.19 per cent of actual exports. Actual trade with Kenya covered only a small part of Rwandan exports. This constitutes a great opportunity for increasing the value of trade, especially in the following product groups: petroleum oils or bituminous minerals > 70 per cent oil; tea and mate, zinc, rice; and fixed vegetable fats and oils, crude, refined, fract. We observed the greatest potential in bilateral trade in primary and not in advanced goods. This draws average or unfavorable prospects for future bilateral trade and shows the need for rebuilding export structures into more advanced products in the near future (Table 4).

Insert Table 4 about here

Rwanda's second export partner with the largest potential trade was members of EAC (US\$ 652.2 million). Actual Rwandan exports covered 14.14 per cent of the value of potential exports. Except for the product group 'petroleum oils or bituminous minerals > 70 per cent oil' of which the potential trade was the highest in 2016 (US\$ 96.8 million), the most promising product groups were zinc (EAC's members do not import this product from Rwanda), tea and mate and rice. Rwandan trade with EAC suffers from the same problem as it does with Kenya: the export structure is not dominated by advanced products. This indicates an urgent need to change the structure and focus on more technologically advanced goods (Table 5).

Insert Table 5 about here

DRC has been Rwanda's most important export market for many years. Rwanda's current exports to DRC cover more than half of its potential trade amounting to US\$ 468.3 million. In general there is the potential to increase trade in the following product groups: petroleum oils or bituminous minerals > 70 per cent oil, vegetables and other crude minerals. These three groups characterized the largest potential trade in 2016. It is important that the large export potential is in more advanced products such as telecommunication equipment and motor vehicles for people and also for special

¹² The methods are based on the study (Bano, et al., 2013).

purposes. This provides prospects of advancing and improving the trade structure with DRC (Table 6).

Insert Table 6 about here

The lowest potential in bilateral trade development is with COMESA, because the actual trade between Rwanda and COMESA was more than 96 per cent of indicative trade. The total amount of ITP was only US\$ 379.1 million. The most promising export niches for Rwandan products were petroleum oils, oils from bitumen materials, crude, copper ores and concentrates; copper mattes, cement and zinc. Like with EAC and Kenya, COMESA's imports from Rwanda seem to be very primary and the prospects of improvements are quite poor (Table 7).

Insert Table 7 about here

Petroleum oil, zinc and minerals were the most promising export goods for almost all Rwanda's analyzed partners. However, there is low potential in more advanced products. Therefore, the prospects for Rwandan exports are pessimistic if the country does not rebuild its exports structure.

However, we should be aware of some limitations of this study. Firstly, the analysis was carried out ex-post and did not take into account any future trends and developments in trade between Rwanda and its trade partners. Secondly, the construction of the ITP indicator is based on the assumption that all Rwandan exports within the scope of a product group may be intended to cover all the demands of the analyzed trade partners. However, we should treat Rwandan potential export values only as indicative values. These results can be used as future directions for Rwandan exports to analyze markets.

4. Selected doing business indicators in Rwanda

Rwanda is a country with a low level of international competitiveness, but its position is rapidly strengthening in many rankings. In terms of the best-known competitiveness index developed by the WEF (Global Competitiveness Index), Rwanda ranked 52nd out of 138 countries (the report covered 2016-17). It was 58th in the previous rankings. Only Mauritius ranked higher (45th place) (WEF, 2017). Labor market performance and institutional development were appraised highly but the size of the market and the level of higher education were poor. The main barrier to doing business in Rwanda is access to sources of finance and low educational levels of the Rwandan workforce.

The Global Innovation Index (2017) shows that the level of innovation in Rwanda is still low (the country was ranked 99th out of 127 countries). However, Rwanda was classified as a so-called 'innovation achiever.'¹³ The government has invested in developing ICT infrastructure and skill development in ICT is a priority of the current government. Rwanda was also evaluated positively in terms of government expenditure on education per pupil and secondary and general infrastructure. Its performance was the worst in ISO 14001 environmental certifications, trade, competition, market scale and ICT use (Johnson Cornell University, INSEAD, WIPO, 2017). The Global Information

¹³ Only Kenya was ranked higher in the region. Kenya, Rwanda and Uganda are considered the most innovative countries in sub-Saharan Africa.

Technology Report (2016) ranked Rwanda 80th among 139 countries covered in the ranking (WEF, 2017).

According to the Doing Business (2017) report, Rwanda was ranked 56th out of 190 countries in terms of the ease of doing business. This means that Rwanda has improved six places as compared to 2016. The most significant improvement has been in credit financing (the country was ranked second in the world) and in registration of property (it came fourth globally). The country came out poorly in obtaining construction permits (158th place in the world), getting electricity and protecting minority investors (IFC, The World Bank, 2017).

A business-friendly environment largely depends on the level of economic freedom in a country. In this respect, Rwanda was ranked 51st as a moderately free economy (The Heritage Foundation, 2017).

The country has also increased the effectiveness of its anti-corruption efforts. According to CPI, Rwanda ranked 50th (out of 176 economies), which means a four-step improvement compared to 2015. The Office of the Ombudsman is operating in Rwanda; it is an independent public institution preventing and combating corruption but it is a young institution (it was established in 2003) and its anti-corruption practices are still ineffective¹⁴ (Business Anti-Corruption Portal, 2017).

According to the Ibrahim Index of African Governance's 2016 annual statistical assessment, Rwanda was ranked as one of the top ten African countries with best governance practices. Taking the 9th place, except for Mauritius (leader in the ranking), Rwanda has become the best-rated economy in East Africa and is moving up the ranking every year (Mo Ibrahim Foundation, 2016).

The country is not considered in many of the world's most popular investment attractiveness rankings (for example, AT Kearney or Fraser Institute) because of lack of detailed data needed for evaluation. Rwanda is unlikely to be favored by potential investors in terms of long-term ratings prepared by international agencies. Some rating agencies do not take the country into account (for example, Fitch last rated Rwanda in 2014), while others like Moody's or S&P, assign a B2 or B rating to Rwanda. Therefore, the country is counted among the group of highly speculative countries. In practice what this means is that credit risk in Rwanda is still considered high and investments in securities issued by the country are considered speculative (Standard & Poor's, 2017).

5. Data description, survey method and results

To assess the conditions for doing business in Rwanda compared to East Africa, the methods of multidimensional comparative analysis seem particularly useful as they provide researchers with a synthetic measure to describe objects with many statistical indicators. Hence, we classified conditions for doing business using non-model methods. A non-model classification of objects is one of the multidimensional data analysis methods to deal with objects characterized by many features. Information on the objects to be analyzed is placed in the observation matrix. The use of non-model methods in our study was necessary because it was difficult to find countries in this region of Africa that could serve as a model to be followed by others. But this was not the only obstacle as

¹⁴ The Office of the Ombudsman declares that it is largely based on solutions adopted by Botswana.

using standard models typical of developed countries such as the United States or the EU, with reference to African countries is pointless.¹⁵

To describe the level of development of conditions for doing business in individual countries in East Africa, the following diagnostic variables were selected:

- 1) X_1 – labor productivity per employer (OECD);
- 2) X_2 – average labor productivity growth (OECD);
- 3) X_3 – minimal wage (ILO);
- 4) X_4 – rank in ‘Doing Business’ (the World Bank);
- 5) X_5 – Index of Economic Freedom (Heritage Foundation);
- 6) X_6 – Global Competitiveness Index (World Economic Forum);
- 7) X_7 – Global Innovation Index (INSEAD and World Intellectual Property Organization);
- 8) X_8 – *Corruption Perceptions Index* (Transparency International);
- 9) X_9 – Ibrahim Index African Governance (Mo Ibrahim Foundation); and
- 10) X_{10} – Human Development Index (UNDP).

The study was based on data from institutions constructing these indices (information in parentheses); the minimum wage figures were derived from ILO data, while data on labor productivity and its dynamics was derived from OECD databases. All figures refer to the last available year, which means that most of them refer to 2015 or 2016. An exception is made in the case of an increase in minimum wages, which is the average of the years 2011-14 (ILO, 2017). The countries in East Africa, except for Djibouti, Eritrea, Comoros, Madagascar, Somalia and South Sudan, are the subject of the study. These countries were not considered because statistical data was incomplete.

Although only 10 diagnostic variables were included in the analysis, a significant amount of information carried by individual variables must be considered. Many of them contain a whole set of other, detailed measures that accurately describe the business climate in the analyzed countries.

With an arbitrary selection of variables that illustrate the advancement of the business environment in the analyzed countries, three guiding principles were followed. First, the diagnostic variables that are important from the point of view of business conditions were selected, which together adequately describe the scope of the area concerned (in this case, the climate for doing business). Secondly, the variables were selected in such a way that they remained separate as far as possible. Unfortunately, meeting this requirement is quite difficult, especially when analyzing phenomena based on multidimensional, often qualitative indices. GCI and a place in the World Bank's Doing Business ranking are examples of variables carrying similar information. Thirdly, efforts were made to maintain proportionality in the variables that illustrate the level of development of a business-friendly economic environment.

Limited access to statistical data remains a major barrier in our study. Considering the lack of some competitiveness indices, these features had to be omitted in the study in the

¹⁵ The methods were based on a study by (Pociecha, et al., 1998).

case of some countries that were analyzed. The indices that were taken into consideration include the Knowledge Economy Index, international agency ratings and returns on investments.

In a multidimensional analysis, it is important to standardize the level of variability or the range of variability of the features concerned. High value variables more significantly affect the distance between objects to a greater degree than variables with lower values. In addition, partial indices of some aspects of the potential are expressed in different measurement units (for example, in percentages or with respect to the value) and have different ranges of variability. That is why their direct aggregation to a synthetic measure is impossible. Hence, to compare these indices and to be able to use them to perform arithmetical operations which are necessary for constructing one measure, it is essential to transform them suitably. The transformation of diagnostic variables (partial indices assigned to different aspects of conditions for doing business in analyzed countries) includes a stimulation of variables, their normalization and, should the diagnostic features be negative, additional transformation. The effect of the transformations is a set of variables that satisfy the following conditions: uniform preference, additivity, range constancy and non-negativeness.

In the variable stimulation process, neutral variables and inhibitors are transformed into boosters (stimulants). Transformation of this type is necessary because individual diagnostic variables can affect the phenomenon concerned differently. For our purpose, the differential transformation method was applied:

$$(7) \quad x_{ij}^S = a - bx_{ij}^D, \quad b > 0,$$

where, a, b – arbitrary variables, usually $b = 1$ and $a = 0$ or $a = \max_i \{x_{ij}^D\}$.

$$(8) \quad x_{ij}^S = -|x_{ij}^N - x_j^N|$$

where,

x_j^N – nominal (desirable) value of the j variable

x_{ij}^N – value of the j neutral variable in the i object

The first step was to normalize the variables according to the formula:

$$(9) \quad z_{ij} = \left(\frac{x_{ij} - a}{b} \right)^p, \quad i=1,2,\dots,n; j=1,2,\dots,m; b \neq 0,$$

where, z_{ij} – normalized value of the j variable in the i object, and a, b, p – normalization parameters

Three types of standardizations were used in the study: classical standardization, standardization by average and standardization by range.

- 1) For performing classical standardization, the following normalization formula was used:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{S(x_j)}, \quad i=1,2,\dots,n; j=1,2,\dots,m.$$

- 2) In the case of standardization by average, the following formula was used:

$$z_{ij} = \frac{x_{ij}}{(\bar{x}_j)}$$

- 3) To obtain variables with a uniform range of variability, defined by the difference between their maximum and minimum values in classical terms, the so-called standardization by range was used. Because the following normalization formula was used, variables with values in the [0; 1] range were obtained:

$$z_{ij} = \frac{x_{ij} - \min_i \{x_{ij}\}}{\max_i \{x_{ij}\} - \min_i \{x_{ij}\}}, \quad i=1,2,\dots,n; j=1,2,\dots,m.$$

Once the data was normalized and the negative values were eliminated, they were ranked according to the following standardization formula:

$$z_{ij} = h \quad \text{dla} \quad x_{hj} = x_{ij}, \quad h, i=1,2,\dots,n.$$

where, h – rank assigned to the i object on the h th place in an ordered array of objects because of the j variable.

Due to limitations about the length of this paper, we do not give the presentation of a long process of normalization and ways of standardizations according to diagnostic variables and present only the results of the calculations - ranking of East African countries in terms of doing business conditions in 2015 (Table 8).

Insert Table 8 about here

Our study shows that Mauritius had the highest potential for foreign business partners. Regardless of the standardization formula, this island nation in the south-western Indian Ocean was classified high in the ranking. The country has a high level of GDP per capita and according to the World Bank, it belongs to upper-middle-income economies. It is also counted among countries with high levels of human development and its level of internationalization remains substantial (Mauritius is second only to Seychelles in the region). Mauritius takes the highest position among East African countries in terms of ease of doing business. The areas in which the country is rated high include economic diversity, starting a business, financial market development, institutional advancement, enforcing contracts, tax system, dealing with construction permits, getting credit and protecting minority investors. These features, along with its high position in the Financial Secrecy Index, make the country a tax haven, where financial services are the basis of the economy and a well-developed infrastructure is driving the growth in tourism. Further, Mauritius has been ranked as having the 8th most free economy in the world,

which makes the country the preferred seat for more than 30,000 offshore companies. Goldman Sachs, Moran Stanley, JP Morgan Chase, Citi group and Pepsi have registered their branches on the island.

In the case of two standardizations (by range and classic), the study pointed to Seychelles as second to Mauritius in terms of the ease of doing business. This country, like the leader in the ranking, ranked high in the diagnostic variables applied. Seychelles, like Mauritius, has long been considered one of the most popular tax havens in the world, hence its high position in various rankings. It is the most developed country in East Africa, leaving other countries of the region far behind. As the only African country, it has been considered a high-income country. Seychelles' economic freedom status is moderately free. However, corruption remains at an average level (like in Mauritius). Seychelles is well perceived in labor market efficiency, infrastructure, institutions and macroeconomic environment, tax system, resolving insolvencies and ease of registering businesses. Seychelles, unlike Mauritius, has improved its position in many rankings. Tourism and financial services remain the primary industries on the island.

Considering the specifics of Mauritius and Seychelles' economies, it seems justified to exclude them from the ranking of East African countries. These island countries are different from the other countries mainly because they are tax havens.

Rwanda is the first non-tax haven in the ranking. Twice it ranked third (by range and classic standardizations) and once it ranked second. Rwanda's prospects for development are good as evidenced by multidimensional indicators improving year to year. According to the Global Competitiveness Index, the Rwandan labor market efficiency is particularly effective (7th place in the world) and its institutional development is rapid (13th place in the world). The country's chief assets are financial market development, market efficiency and innovations; its position in all these areas is getting higher. According to the Doing Business rankings, the ease of getting credit, obtaining construction permits and starting a business proves Rwanda's attractiveness. The rule of law indices, respect for political rights and civil liberties, participation in political decisions and integration and the level of internal security in Rwanda have improved considerably in recent years. In addition, the development strategies implemented by the government have created a positive image of the country. Rwanda is among the free economies in Africa and its level of corruption is relatively low as compared to other analyzed countries. Although there are many symptoms of accelerated development in the country and Rwanda is rated high in selected areas against other East African economies, the country is still perceived as under-developed. Market size and the level of education, technology and infrastructure look particularly unfavorable.¹⁶

Potential foreign investors are faced with formidable barriers in the issuance of construction permits, there are serious problems with the supply of electricity and the protection of minority investors remains negligible. Considering the comprehensive indicators of socioeconomic development (such as HDI), Rwanda is in the group of countries with low levels of human development; it had the 159th place in 2015 (Uganda, Malawi, Djibouti, Ethiopia, Mozambique and Burundi were ranked lower). In terms of

¹⁶ This strict assessment perhaps does not consider the latest plans of the Rwandan government which are connected to improvements in educations (for example, ICT in education, promoting quality education) and infrastructure, for example, a new railway line (Mombasa-South-Sudan- Kampala-Kigali; almost 96 per cent of paved roads are in good conditions).

all HDI components, Rwanda is at a low position. However, its index value is growing and the country's position is getting higher annually. Moreover, the country is spending more on education (5 per cent of GDP in 2016) than the average for Africa (4.7 per cent) (UNDP, 2017). A big chunk of Rwanda's adult population is illiterate, particularly women (adult literacy rate among women was 68.3 per cent and among men was 74.7 per cent in 2010-15). According to the African Development Bank, in 2010-15 about 71.2 per cent of the citizens knew how to read and write. Rwanda has also made huge strides in gender equality.

Zambia had the 4th position in the rankings, regardless of what standardization method was used. For several years, the country has been dealing with an economic crisis caused by falling copper prices in international markets. The country is also struggling with an energy crisis. It has created major barriers to foreign trade and its level of education development and healthcare is low. However, despite these problems, Zambia was rated relatively well in terms of institutional development, innovations, commodity market efficiency, getting credit and a foreign investment-friendly tax system. Zambia was ranked higher than Rwanda in terms of human development (among middle-income countries). However, the Corruption Perceptions Index and the Index of Economic Freedom show serious economic problems in the Zambian economy; the country suffers significantly from corruption and its economic freedom is also severely limited.

Zambia is followed by either Kenya or Ethiopia, depending on the adopted standardization method. These two major economies in the region are responsible for most of the region's production, capital flows and trade, although their Economic Freedom Index has declined and the level of human development is low. Ethiopia is much better perceived in terms of dealing with corruption as compared to Kenya. It is difficult to point out the assets of these countries because according to international rankings they come out poorly in terms of the ease of doing business. Labor market efficiency is a strength of both the countries. Kenya, on the one hand may boast of a fairly good level of financial market development, the ease of getting credit and high innovations as compared to the region. On the other hand, the Ethiopian internal market is of the right size and the macroeconomic environment in the country is relatively well-developed. Moreover, there is a tendency that shows that both the countries are moving up in international business reports on conditions for doing business.¹⁷

Burundi ranked the lowest, regardless of the type of standardization method applied. The country is particularly disadvantaged in terms of financial market development, the level of higher education, technological development, energy supply, dealing with construction permits and getting credit. Burundi is counted among countries with the lowest level of human development and massive corruption. Its economic freedom status is mostly not free. In addition, its position in many international reports is deteriorating.

Based on our analysis, it can be confirmed that tax havens with well-developed economies offer the most favorable terms and conditions for doing business, which translates into a considerable intensity of their relations with the world, mainly tourism and capital. However, Rwanda which is taking advantage of its improving economic situation and has intensified the processes of internationalization is just behind them. Although foreign investors or business partners may encounter many issues when

¹⁷ More about the East African economies' development see (Heshmati, 2017), (Heshmati, 2016).

starting a business in Rwanda, the country looks promising as compared to the others in the region, especially in terms of efforts to maintain internal stability, internal security and resistance to external shocks.

6. Conclusion and policy recommendations

The Rwandan government's current priority is reducing the development gap between the country and the developed states. One of the ways of achieving this goal is by ensuring the proper management of foreign trade, gradually joining the global economy (being a signatory to many international agreements) and shaping its doing business environment. Moreover, Rwanda characterizes sustained and high economic growth, which is supported by sound macroeconomic management and a good fiscal discipline. A clear vision of the government for growth and its engines makes the country attractive. Rwanda's institutions are stable and functional. Moreover, introduction of the rule of law and zero tolerance for corruption has created an investor friendly climate. The Rwandan market may not be huge and developed, but it has grown rapidly and the middle class is getting richer. Rwanda is also very labor efficient and offers a flexible supply of employees. Of late its workforce has been improving its capacity in knowledge-based industries.

It is noticeable that Rwanda has climbed in almost all important global rankings. Its infrastructure is advanced and rail, air, logistics and investment opportunities abound to develop Rwanda as an EAC hub. Rwanda continues to be one of the fastest growing African countries in ICT (key priority in 'Vision 2020') and there are several avenues for the growth of the advanced technology sector: from e-commerce and e-services, mobile technologies, applications' development and automation to becoming a regional center for the training of top quality ICT professionals and researchers.¹⁸ The intensification in the economic expansion of the Rwandan market is linked to economic and geopolitical reasons such as developed countries, inter alia, the EU's economic and political problems, Brexit, debt and the migration crisis. Moreover, developed and developing countries are focused on geographic diversification of their foreign trade and capital flows in order to ensure their positive impact on the level of foreign income in their economies. Therefore, Rwanda can be perceived as a prospective market for trade and investment in the geographical diversification process.

Based on our research, the following conclusions and recommendations are offered to stimulate Rwanda's international expansion in terms of foreign trade and foreign investments:

1. Rwanda is characterized by high economic potential, development opportunities and growing competitiveness (in international terms) in the background of the East African states. Moreover, Rwanda's prospects for development are good as evidenced by multidimensional indicators improving year to year. However, many areas of the Rwandan real economy and financial sector need improvement, for example, the level of development of education, technology and infrastructure, barriers to the issuance of construction permits, problems with electricity supply and the protection of minority investors. These critical areas need changes and

¹⁸ Tourists in Rwanda have access to the highest level of mobile internet, 4G.

improvements. They are pointed out, inter alia, by international organizations when they create multidimensional indices and rankings.

2. Rwanda's market still needs advanced technology solutions in almost every dimension of economic activity. In terms of foreign trade, Rwanda does not have any real competitive advantage or specialization in the export of any advanced products. The country still imports most of the technologically advanced product groups. Therefore, the Rwandan government should support and be interested in international cooperation for this.
3. Rwanda's total export potential is high, especially when we analyze its main trade partners and indicative trade potential. However, the export structures with its main trading partners (countries and integration groups) need improvements for more advanced product groups. The most popular export goods are primary. If Rwanda wants to join global value chains and wants to be ranked in upmarket segments in terms of value added embodied in the gross exports of its partners, it should rebuild its export structure and focus more on advanced products. At the moment, the structure of Rwandan exports to DRC seems to be the pattern to follow for rebuilding its export structure.
4. The intensification of economic expansion needs action at the level of central and local government administrations. It will be necessary to gather detailed information on African markets and other prospective global markets for Rwandan exporters and entrepreneurs, their potential, development opportunities, consumer demand, institutional conditions (including trade barriers, tax systems and investment incentives), conditions and the climate to operate and identifying priority markets and industry directions for potential cooperation.
5. The Rwandan government should consider expanding and developing its diplomatic missions, consular offices, chambers of commerce etc., not only in Africa, but also in its most important trade and investment partners. These entities will strengthen the presence of Rwandan enterprises abroad and support their businesses. Moreover, Rwanda should develop the economic sections of existing diplomatic missions and set up targeted governmental economic agencies. This will help to better understand the specifics of the markets and support Rwandan companies in foreign markets. An increase in the number of governmental agencies will also indicate its desire to strengthen relations with continental countries which could facilitate pursuit of business interests and increase interconnectedness.
6. An effective stimulation of economic expansion in Rwanda will require further development of trade and investment support instruments such as government guarantees, export credits (preferential ones) and interbank investment funds as well as the implementation of new measures. Another important element of governmental support can be encouraging the setting up of chambers of commerce in new agencies abroad and also in existing ones which also provide free advisory and consultation services. It will be important to create and support existing governmental consulting agencies and capital groups that serve Rwandan companies planning to move abroad.
7. It will be necessary to institutionalize promotional activities in selected (priority) markets with specific information campaigns for them. It is important to strengthen the promotion and long-term development of the perception of both the country and

the products and services offered by various Rwandan enterprises. National branding activities aimed at creating a proper image for Rwanda in African markets are also needed. It is important that the Rwandan products offered abroad are identified with modernity, solidity and high quality workmanship.

8. It is important for Rwandan entrepreneurs and supporting agencies to seek and identify international market niches in which they can achieve competitive advantage in the long term. Moreover, they should anticipate the changes that have taken place in export markets and the prospects for their further development.
9. In terms of foreign investments consideration should be given to the interests of internationalization in the form of investments of a minority character. In the initial stages of internationalization, Rwandan investors and entrepreneurs need business partners from well-developed or more developed countries in order to better understand the market and culture, including business culture, increasing efficiency in recruitment and confidence and efficiency in building relationships at the central and local government levels. This seems particularly important at the beginning of the expansion of the Rwandan capital. At the same time, such investment projects should allow Rwandan entrepreneurs' access to East African and global markets - increasing exports as a result - through existing distribution networks, business contacts and market knowledge.
10. In the context of international cooperation in investments, it is desirable for Rwandan government agencies to cooperate with other government agencies (from other countries) in promoting mutual investments. More bilateral or multilateral investment agreements can stimulate capital flows between Rwanda and the world.
11. It is advisable to use the knowledge of other countries (for example, China, the US and EU states) and economic operators with greater experience in international expansion, especially in more advanced markets. It is worth establishing cooperation with such foreign agencies, both public and private. Selection and implementation of selected actions and measures could contribute to improving the effectiveness of expansion in international markets with greater demand for Rwandan products and businesses.
12. If Rwandan companies (private and public ones) want to develop international relations, they should cooperate with well-developed and fast developing countries' enterprises in the form of joint ventures. These forms of cooperation can be extremely useful in common direct investments and undertakings that are logistic and distributional in nature. These forms of investment activities will help bridge the barriers associated with different business cultures and doing business standards in Rwanda and the developed and developing markets.
13. The reasons for intensifying foreign economic cooperation with Rwanda include growing private consumption and governmental expenditure, which are connected to building the transport, telecommunication and production infrastructure and social services; demographic potential and demographic structure, a growing middle class; and changing the global economy and joining global value chains (Dicken et al., 2001).
14. The Rwandan government should be interested in international cooperation in developing services such as research and development, banking, financial and

business services, transport and logistics, telecommunications and the energy sector, especially the renewable energy sector.¹⁹ For investment inflows, good progress can be made in the construction industry (mainly transport infrastructure), food and agriculture, pharmaceuticals, hotels and medical and chemical industries.

15. From the international perspective of well-developed and fast developing countries the export product groups that have the most prospects for Rwanda include different types of high quality industrial products, mainly mining machinery, construction machinery, agricultural machinery and equipment, simple and easy-to-use equipment, consumer goods especially electronics, cars and their parts, and furniture, telecommunications equipment, household appliances and office supplies. The growing middle class also offers an opportunity to export luxury goods, specialized high-standard services, jewellery, clothing, food products, advanced technology, electronics and automotive industry products.

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¹⁹ Rwanda withholds immense potential in solar and hydroelectric power. The Africa-EU Renewable Energy Cooperation Programme states that Rwanda's hydropower supplies amounted to 59 per cent of the existing electricity generation capacity at 59.43MV, and has the capability to achieve over 300MV.

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Table 1: Rwandan merchandise trade specialization index (2001-15)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agricultural products	-0.320	-0.852	-0.139	-0.052	-0.200	-0.018	-0.258	-0.185	-0.191	-0.348	-0.266	-0.193	-0.224	-0.276	-0.192
Food	-0.289	-1.000	-0.069	0.030	-0.178	0.020	-0.253	-0.114	-0.150	-0.337	-0.271	-0.193	-0.233	-0.273	-0.177
Fuels and mining products	0.000	-0.415	-0.508	-0.182	0.057	-0.125	0.135	0.223	-0.189	-0.015	0.091	0.120	0.362	0.482	0.556
Fuels	-0.250	-0.907	-0.864	-0.840	-0.818	-0.966	-0.963	-0.970	-0.978	-0.938	-0.728	-0.435	-0.236	0.137	0.421
Manufactures	-0.942	-0.819	-0.943	-0.931	-0.889	-0.938	-0.915	-0.944	-0.888	-0.952	-0.922	-0.896	-0.925	-0.859	-0.885
Iron and steel	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-0.977	-0.966	-0.973	-0.980	-0.918	-0.912	-0.788	-0.983
Chemicals	-1.000	-1.000	-1.000	-1.000	-0.967	-0.973	-0.966	-0.970	-0.979	-0.978	-0.964	-0.967	-0.962	-0.950	-0.954
Pharmaceuticals	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-0.954	-1.000	-1.000	-1.000	-1.000
Machinery and transport equipment	-0.906	-0.910	-0.923	-0.927	-0.803	-0.872	-0.871	-0.948	-0.833	-0.954	-0.889	-0.862	-0.920	-0.801	-0.858
Office and telecom equipment	-1.000	-1.000	-0.905	-0.900	-0.892	-0.949	-0.922	-0.976	-0.970	-0.961	-0.963	-0.986	-0.953	-0.922	-0.947
Electronic data processing and office equipment	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-0.949	-0.952	-1.000	-1.000	-0.950	-0.956	-1.000
Telecommunications equipment	-1.000	-1.000	-0.833	-0.750	-0.800	-0.909	-0.929	-0.955	-0.956	-0.963	-0.925	-0.976	-0.951	-0.901	-0.934
Integrated circuits and electronic components	0.333	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000
Transport equipment	-0.810	-0.857	-0.882	-0.931	-0.744	-0.773	-0.816	-0.878	-0.586	-0.950	-0.753	-0.621	-0.891	-0.731	-0.675
Automotive products	-0.889	-0.833	-0.929	-0.920	-0.742	-0.778	-0.818	-0.884	-0.644	-0.956	-0.696	-0.551	-0.887	-0.739	-0.714
Textiles	-1.000	-0.714	-0.600	-0.667	-0.778	-1.000	-1.000	-1.000	-0.826	-1.000	-0.926	-1.000	-0.952	-0.875	-0.920
Clothing	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-1.000	-0.909	-0.920

Source: Author's calculations based on WTO (2017).

Table 2: Rwandan exports' revealed comparative advantage index (2001-15)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agricultural products	0.1605	-0.1401	0.3338	0.3453	0.1906	0.3917	0.2385	0.2521	0.3505	0.2205	0.2225	0.2552	0.1829	0.1519	0.2121
Food	0.1657	-0.1653	0.3089	0.3571	0.1738	0.3828	0.2158	0.2585	0.3480	0.2110	0.2015	0.2331	0.1601	0.1408	0.2041
Fuels and mining products	0.3631	0.1068	0.0605	0.1835	0.3868	0.2177	0.3921	0.4377	0.2226	0.2671	0.3247	0.2593	0.3693	0.3836	0.2819
Fuels	0.1367	-0.1346	-0.1107	-0.1214	-0.0761	-0.0972	-0.0631	-0.0516	-0.0645	-0.0373	-0.0192	0.0306	0.0526	0.1118	0.1111
Manufactures	-0.5397	-0.3781	-0.5770	-0.5345	-0.5374	-0.5475	-0.5218	-0.5626	-0.4292	-0.6554	-0.4267	-0.4417	-0.5515	-0.4310	-0.4724
Iron and steel	-0.0392	-0.0363	-0.0502	-0.0458	-0.0488	-0.0584	-0.0532	-0.0687	-0.0393	-0.0484	-0.0454	-0.0424	-0.0398	-0.0243	-0.0465
Chemicals	-0.0890	-0.1371	-0.1236	-0.1480	-0.1291	-0.1246	-0.1379	-0.1058	-0.1352	-0.1219	-0.0978	-0.0967	-0.1050	-0.1166	-0.0985
Pharmaceuticals	-0.0320	-0.0565	-0.0502	-0.0740	-0.0651	-0.0639	-0.0740	-0.0400	-0.0604	-0.0468	-0.0374	-0.0339	-0.0439	-0.0397	-0.0353
Machinery and transport equipment	-0.1822	-0.2119	-0.2420	-0.2479	-0.1593	-0.1592	-0.1717	-0.2265	-0.1287	-0.2914	-0.1417	-0.1552	-0.2359	-0.1276	-0.1730
Office and telecom equipment	-0.0925	-0.0686	-0.0614	-0.0568	-0.0653	-0.0626	-0.0523	-0.0661	-0.0924	-0.0639	-0.0472	-0.0605	-0.0500	-0.0604	-0.0692
Electronic data processing and office equipment	-0.0214	-0.0363	-0.0309	-0.0388	-0.0372	-0.0292	-0.0260	-0.0315	-0.0248	-0.0253	-0.0226	-0.0235	-0.0155	-0.0164	-0.0236
Telecommunications equipment	-0.0676	-0.0282	-0.0266	-0.0145	-0.0258	-0.0315	-0.0294	-0.0329	-0.0595	-0.0337	-0.0207	-0.0340	-0.0315	-0.0383	-0.0434
Integrated circuits and electronic components	0.0197	-0.0040	-0.0039	-0.0035	-0.0023	-0.0018	-0.0026	-0.0017	-0.0038	-0.0042	-0.0039	-0.0030	-0.0030	-0.0057	-0.0042
Transport equipment	-0.0444	-0.0741	-0.0918	-0.0885	-0.0389	-0.0372	-0.0499	-0.0469	0.0239	-0.1188	-0.0240	-0.0054	-0.0852	-0.0196	-0.0177
Automotive products	-0.0489	-0.0579	-0.0884	-0.0744	-0.0306	-0.0312	-0.0439	-0.0404	0.0095	-0.1102	-0.0100	0.0059	-0.0762	-0.0158	-0.0180
Textiles	-0.0107	-0.0088	0.0004	-0.0074	-0.0106	-0.0401	-0.0221	-0.0145	-0.0075	-0.0384	-0.0106	-0.0183	-0.0164	-0.0094	-0.0173
Clothing	-0.0071	-0.0081	-0.0116	-0.0071	-0.0093	-0.0073	-0.0104	-0.0077	-0.0061	-0.0077	-0.0059	-0.0061	-0.0057	-0.0071	-0.0086

Source: Author's calculations based on WTO (2017).

Table 3: Rwandan high-technology exports' revealed comparative advantage index (2001-15)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
High-skill and technology-intensive manufactures	- 0.284	- 0.214	- 0.207	- 0.246	- 0.263	- 0.218	- 0.236	- 0.263	- 0.306	- 0.277	- 0.221	- 0.263	- 0.242	- 0.276	- 0.273	-0.364
High-skill: Electronics (excluding parts and components) (SITC 751 + 752 + 761 + 762 + 763)	- 0.023	- 0.025	- 0.018	- 0.029	- 0.025	- 0.016	- 0.020	- 0.030	- 0.026	- 0.018	- 0.020	- 0.031	- 0.021	- 0.021	- 0.028	-0.017
High-skill: Parts and components for electrical and electronic goods (SITC 759 + 764 + 776)	- 0.100	- 0.049	- 0.025	- 0.038	- 0.068	- 0.056	- 0.053	- 0.081	- 0.105	- 0.046	- 0.041	- 0.045	- 0.041	- 0.058	- 0.063	-0.064
High-skill: Other. excluding electronics	- 0.162	- 0.140	- 0.165	- 0.179	- 0.171	- 0.146	- 0.163	- 0.153	- 0.175	- 0.213	- 0.160	- 0.187	- 0.179	- 0.197	- 0.182	-0.284

Source: Author's calculations based on UNCTAD (2017).

Table 4: Indicative trade potential with Kenya in 2016 (in thousand US\$)

Products group	X_{ik}	X_{jk}	X_{ijk}	$\min(X_{ik}, X_{jk})$	ITP_{ijk}
[334] Petroleum oils or bituminous minerals > 70 % oil	119721.3	1446671	4427.363	119721.3	115294
[074] Tea and mate	73791.28	82051.81	36135.2	73791.28	37656.08
[686] Zinc	0	35657.96	0	35657.96	35657.96
[042] Rice	29104.59	123872.7	43.472	29104.59	29061.12
[422] Fixed vegetable fats and oils, crude, refined, fract.	14238.7	393565.1	0	14238.7	14238.7
[431] Animal or veg. oils and fats, processed, n.e.s.; mixt.	20446.79	14227.8	92.239	14227.8	14135.56
[046] Meal and flour of wheat and flour of meslin	23800.24	12209.13	6.192	12209.13	12202.94
[831] Travel goods, handbags and similar containers	11940.21	60363.21	12.305	11940.21	11927.9
[047] Other cereal meals and flour	9520.818	11731.11	0	9520.818	9520.818
[278] Other crude minerals	8198.481	26575.72	0.563	8198.481	8197.918
Total	744400	14141306	49921.78	744400	694478.2

Source: Author's calculations based on UNCTAD (2017).

Table 5: Indicative trade potential with the EAC states in 2016 (in thousand US\$)

Products group	X_{ik}	X_{jk}	X_{ijk}	$\min(X_{ik}, X_{jk})$	ITP_{ijk}
[334] Petroleum oils or bituminous minerals > 70 % oil	119721.3	4079317	11465.59	119721.3	108255.8
[686] Zinc	0	58116.53	0	58116.53	58116.53
[074] Tea and mate	73791.28	87358.33	37146.39	73791.28	36644.89
[042] Rice	29104.59	189034.3	51.588	29104.59	29053.01
[046] Meal and flour of wheat and flour of meslin	23800.24	22959.91	64.825	22959.91	22895.08
[071] Coffee and coffee substitutes	76308.78	24135.07	2512.179	24135.07	21622.89
[431] Animal or veg. oils and fats, processed, n.e.s.; mixt.	20446.79	77444.01	188.692	20446.79	20258.1
[422] Fixed vegetable fats and oils, crude, refined, fract.	14238.7	791669.5	6.905	14238.7	14231.8
[831] Travel goods, handbags and similar containers	11940.21	92471.75	46.107	11940.21	11894.1
[047] Other cereal meals and flour	9520.818	21855.31	64.714	9520.818	9456.104
Total	744400	31748280	92217.03	744400	652183

Source: Author's calculations based on UNCTAD (2017).

Table 6: Indicative trade potential with DRC in 2016 (in thousand US\$)

Products group	X_{ik}	X_{jk}	X_{ijk}	$\min(X_{ik}, X_{jk})$	ITP_{ijk}
[334] Petroleum oils or bituminous minerals > 70 % oil	119721.3	245904.9	98071.23	119721.3	21650.12
[054] Vegetables	7353.956	11420.18	173.288	7353.956	7180.668
[278] Other crude minerals	8198.481	56738.82	1081.285	8198.481	7117.196
[764] Telecommunication equipment, n.e.s.; and parts, n.e.s.	4855.509	70229.26	243.881	4855.509	4611.628
[081] Feeding stuff for animals (no unmilled cereals)	4741.939	4587.677	0.978	4587.677	4586.699
[781] Motor vehicles for the transport of persons	6690.693	49441.26	2480.292	6690.693	4210.401
[292] Crude vegetable materials, n.e.s.	4128.712	4890.127	217.783	4128.712	3910.929
[782] Motor vehic. for transport of goods, special purpo.	3736.498	83496.67	175.406	3736.498	3561.092
[716] Rotating electric plant and parts thereof, n.e.s.	2744.123	54521.17	53.144	2744.123	2690.979
[723] Civil engineering and contractors' plant and equipment	2378.788	154475	5.061	2378.788	2373.727
Total	744400	4698989	276092.1	744400	468307.9

Source: Author's calculations based on UNCTAD (2017).

Table 7: Indicative trade potential with the COMESA states in 2016 (in thousand US\$)

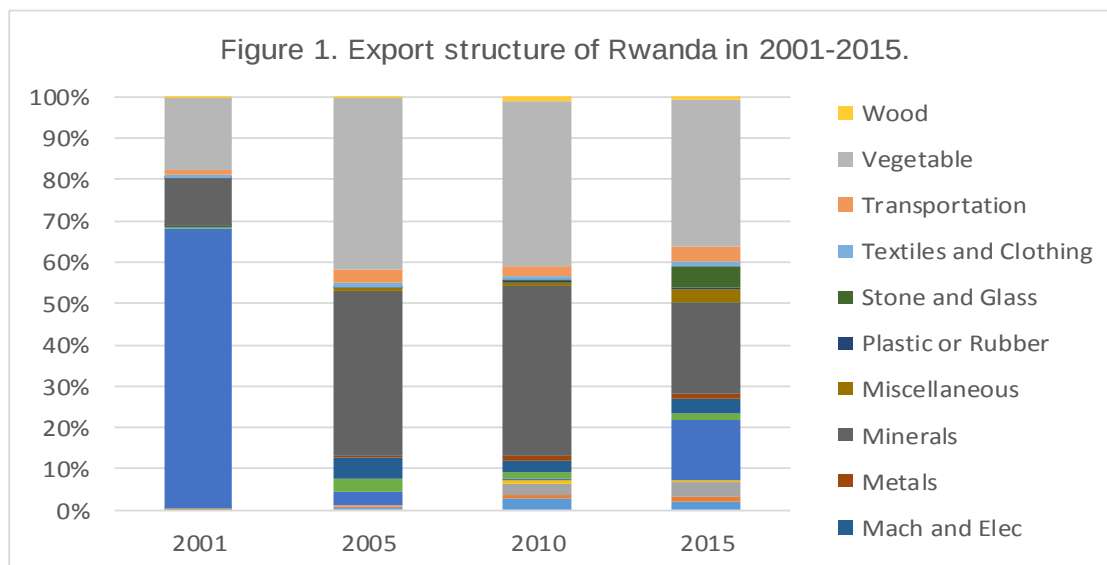
Products group	X_{ik}	X_{jk}	X_{ijk}	$\min(X_{ik}, X_{jk})$	ITP_{ijk}
[333] Petroleum oils, oils from bitumen. materials, crude	0	2256179	0	2256179	2256179
[283] Copper ores and concentrates; copper mattes, cement	0	631692.6	0	631692.6	631692.6
[686] Zinc	0	158173.4	0	158173.4	158173.4
[287] Ores and concentrates of base metals, n.e.s.	129913.5	206315.1	959.099	129913.5	128954.4
[043] Barley, unmilled	0	126419.4	0	126419.4	126419.4
[677] Rails and railway track construction mat., iron, steel	0	123158.5	0	123158.5	123158.5
[071] Coffee and coffee substitutes	76308.78	219844	2408.236	76308.78	73900.55
[971] Gold, non-monetary (excluding gold ores and concentrates)	56719.42	92702.31	0.229	56719.42	56719.19
[074] Tea and mate	73791.28	412829.3	37278.76	73791.28	36512.52
[831] Travel goods, handbags and similar containers	11940.21	242375.8	95.854	11940.21	11844.36
Total	744400	144837825	365231.8	744400	379168.2

Source: Author's calculations based on UNCTAD (2017).

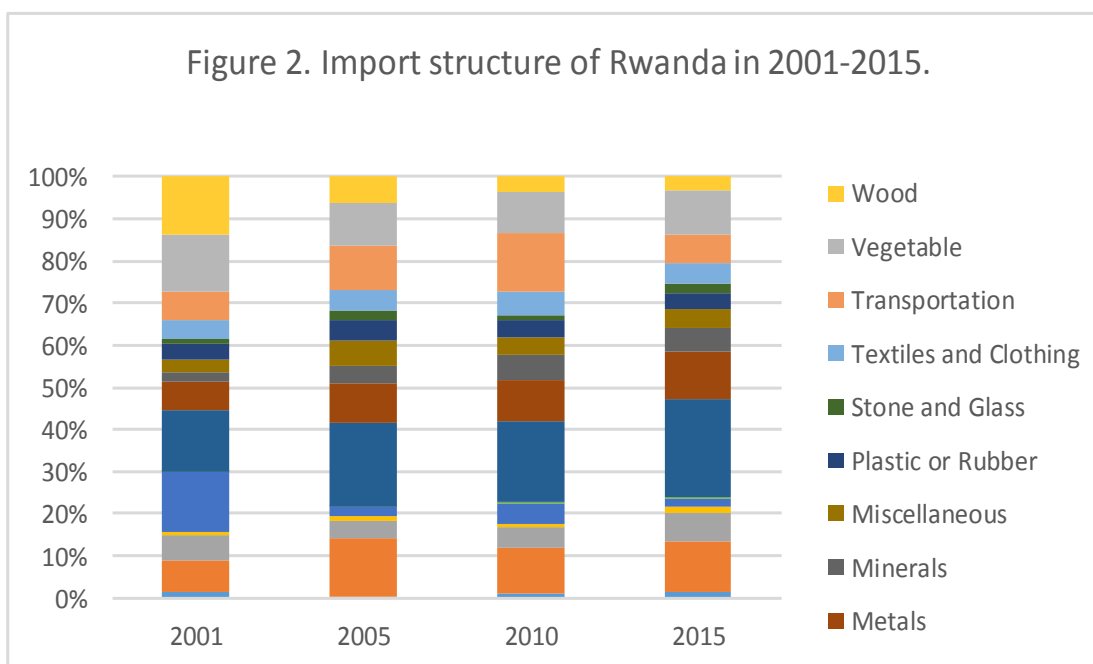
Table 8: Ranking of East African countries in terms of doing business conditions

standardization by average		standardization by range [0;1]		classical standardization	
Rank		Rank		Rank	
1	Mauritius	1	Mauritius	1	Mauritius
2	Rwanda	2	<i>Seychelles</i>	2	<i>Seychelles</i>
3	<i>Seychelles</i>	3	Rwanda	3	Rwanda
4	Zambia	4	Zambia	4	Zambia
5	Kenya	5	Kenya	5	Ethiopia
6	Ethiopia	6	Ethiopia	6	Kenya
7	Zimbabwe	7	Tanzania	7	Zimbabwe
8	Tanzania	8	Zimbabwe	8	Tanzania
9	Mozambique	9	Mozambique	9	Mozambique
10	Malawi	10	Malawi	10	Malawi
11	Uganda	11	Uganda	11	Uganda
12	Madagascar	12	Madagascar	12	Madagascar
13	Burundi	13	Burundi	13	Burundi

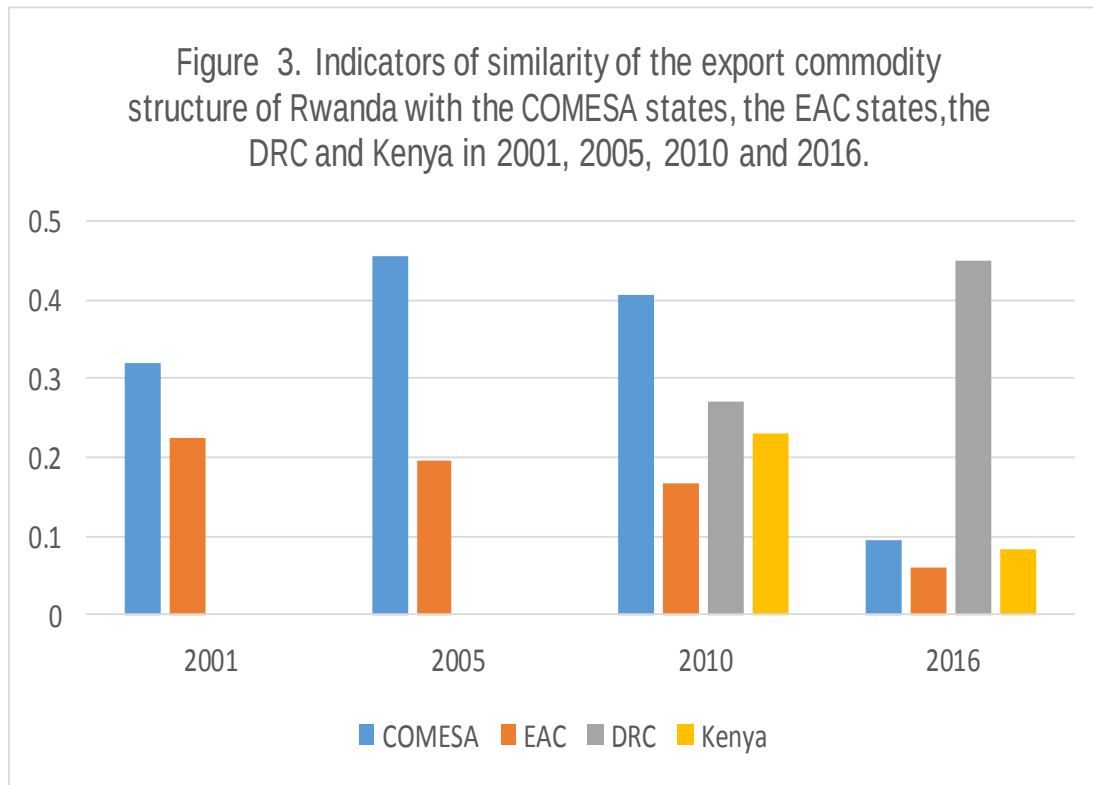
Source: Author's calculations based on ILO (2017), OECD (2017), (Mo Ibrahim Foundation (2017), (IFC, the World Bank (2017), WEF (2017), (Transparency International (2017), (Johnson Cornell University et al., (2017), UNCTAD (2017) and the Heritage Foundation (2017).



Source: Author's calculations based on UNCTAD (2017).



Source: Author's calculations based on WTO (2017).



Note: The Euclidean metric $\sqrt{\sum_{i=1}^n (x_i - y_i)^2}$ has been used as a measure of similarity. The closer the value is to one, the more different are the export structures of the analyzed blocs. The closer the value is to zero, the more similar the commodity structures.

Source: Author's calculations based on UNCTAD (2017) using SITC Rev.3.

Chapter Six

Achieving the Sustainable Development Goals in Rwanda: The Role of Administrative Data Inclusion

Theogene Rizinde¹, Ferdinand Nkikabahizi², Leonidas Babamwana³ and Josephine Umutesi⁴

¹Corresponding author:

Department of Applied Statistics,
University of Rwanda, Kigali, Rwanda,
E-mail: rizindeth@gmail.com

² Department of Economics,
University of Rwanda, Kigali, Rwanda,
E-mail: fnkikabahizi@gmail.com

³Department of Applied Statistics,
University of Rwanda, Kigali, Rwanda,
E-mail: leontosbanamwana@gmail.com

⁴Department of Management,
University of Rwanda, Kigali, Rwanda,
E-mail: j.mutesi@ur.ac.rw

Abstract

This study investigates the extent to which decision makers in Rwandan institutions appreciate and use administrative data in their everyday decision making to achieve sustainable development. The study is based on semi-structured interviews with 120 Rwandan establishments by institutional sector selected randomly in Remera sector in Gasabo district in Kigali city. The research reveals that a majority of the decision makers did not understand the need to use statistics in their decision making while others felt overwhelmed by the volume and complexity of the data. Our study finds that there is a strong lack of dissemination or sharing of data by institutions, especially in the private sector, to inform their decisions. The study also finds that the non-use of administrative data for decision making is highly linked to the size of the institution and the level of education of the decision makers.

Keywords: Sustainable development goals, decision making, administrative data, Rwanda.

JEL Classification Codes: D78; D81; M51; L31; L32;

1. Introduction

The sustainable development goals (SDGs), officially known as ‘Transforming our World: the 2030 Agenda for Sustainable Development’ are a comprehensive set of 17 goals, 69 targets and over 300 indicators (United Nations Development Program [UNDP], 2015), which will go above and beyond the remarkable accomplishments of the 16 targets and 48 indicators of the eight millennium development goals (MDGs) to create a sustainable world by 2030 (Lamin, 2015). Formed through extensive worldwide consultations with all segments of society with an emphasis on targeting global challenges the SDGs are a comprehensive development plan to leave no person behind (Dennis, 2015). This will be difficult if not impossible unless strong government systems, in particular strong statistical systems that can measure and incentivize progress across the goals, are put in place (National Institute of Statistics of Rwanda [NISR], 2014). Given the breadth and complexity of the SDG agenda, different types of data will be required with varying levels of coverage (NISR, 2015). In Rwanda, apart from NISR, other ministries and agencies in the national government as well as local government units produce sector and area-specific statistics needed in the planning and monitoring of SDGs. They generate these statistics mainly from administrative-based systems. Ministries and institutions have been compiling and producing statistics from administrative-based systems such as fiscal statistics, financial statistics, tourism statistics, trade statistics, justice, law and order and other governance statistics. However, the record keeping systems are fraught with unreliable and incomplete records, inconsistencies and lack of standard definitions and concepts (NISR, 2014).

The absence of reliable and accurate data, data management systems and skilled statisticians is a serious constraint in policymaking, adequate analyses of development challenges and the monitoring and evaluation (M&E) of interventions (NISR, 2014). It is essential that such gaps be addressed so as to better enable the use of country-generated statistics in calculating global SDG indicators so that they are responsive to the statistical needs of achieving the 2030 agenda and beyond.

Our paper examines the extent to which decision makers in Rwandan institutions use administrative data in decision making and the impact that this will have on monitoring the SDGs from today to 2030. Data dissemination aims to raise the statistics and evidence-based decision-making culture in society (United Nations [UN], 2014). The SDGs have many targets and indicators and pursuing greater social inclusiveness in their monitoring requires the active engagement of many more stakeholders than were required for the MDGs. That is why our research targets decision makers not only in public institutions but also in NGOs, cooperatives and private institutions.

Data driven decision making (DDDM) is characterized by new technologies, new stakeholder partnerships, new platforms for bringing data together and new ways for decision makers, policymakers and citizens to use the data. It provides an important platform for implementing the SDGs and for monitoring the progress made towards their achievement. When integrated and analyzed into broader data use for decision making directed at SDG indicators, it can become an important asset.

Accessing, using and benefiting from data is assumed and expected by an increasing number of the people globally even though these people remain a minority. Here it is not just the data, but the outputs from data analyses that are critical. The SDGs are discussed with the ambitious aim that no one will be left behind. Hence, data use for decision making will be a powerful toolbox for securing development that is more sustainable, socially inclusive and global.

2. Literature Review

Recent calls for global data to inform sustainable development policymaking are unparalleled. In the document ‘Transforming our world: the 2030 Agenda for Sustainable Development’ Member States underscore the importance of ‘quality, accessible, timely and reliable disaggregated data to help with the measurement of progress and to ensure no one is left behind’ (UN, 2015). Further, Member States recognize the crucial role of ‘increased support for strengthening data collection and capacity building’ and are committed to addressing the gaps in data collection for the targets of the 2030 Agenda, so as to better inform the measurement of progress (UN, 2015). Further, in this document the sustainable development goal 17: ‘Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development’ targets 18 and 19 refer directly to capacity-building linked to data, monitoring and accountability.

The United Nations Statistical Commission was mandated to develop a global indicator framework. The inter-agency and expert group on SDG indicators (IAEG-SDGs) was established to conduct the work necessary for identifying the indicators and ensuring full implementation of related data development programs. In March 2016, at its 47th session, the UN Statistical Commission ‘agreed, as a practical starting point, with the proposed global indicator framework’ as developed by IAEG-SDGs. In June 2016, the Economic and Social Council (ECOSOC) took note of the UN Statistical Commission’s report and adopted its decisions including on the global indicator framework. Some of the indicators will require strengthening and on-going capacity building to define standards, developing methodologies and producing the necessary data and statistics for follow up and review. In the Addis Ababa Action Agenda of the third international conference on financing for development held in July 2015, Member States noted the importance of drawing on new data sources to meet user needs. ‘National statistical systems have a central role in generating, disseminating and administering data. They should be supplemented with data and analysis from civil society, academia and the private sector’ (UN, 2015).

The global statistical system is called to take decisive action to transform how data and statistics are produced and disseminated to inform development policy decisions with the vital support of governments and in closer partnerships with stakeholders from academia, civil society, the private sector and the public at large. This will entail concerted and sustained accounting and coordination of existing efforts and the strategic identification of investment for resources in order to significantly address existing gaps in the technical and institutional capacities of national statistical systems so as to improve the coverage, quality and frequency of data and statistics made available through transparent and public access.

Accordingly, at its 46th session, the United Nations Statistical Commission agreed to establish a high-level Group for Partnership, Coordination and Capacity-Building for the 2030 Agenda (HLG-PCCB), comprising of chief statisticians from 23 national statistical offices representing other countries in their respective regions. HLG-PCCB was tasked to promote national ownership of the 2030 Agenda monitoring system and fostering statistical capacity building, partnerships and coordination. NSOs must coordinate its implementation at the country level. To further ensure national ownership, HLG-PCCB prepared an action plan which was submitted for endorsement to the UN Statistical Commission at its annual meetings in March 2017 (UN, 2015).

Since 2004, when the Marrakech Action Plan for Statistics was developed, strategic planning has been recognized as a powerful tool for guiding the development of national statistics programs, increasing political and financial support for statistics and ensuring that countries are able to produce the data and statistics needed for monitoring and evaluating their development outcomes. At its third meeting held in New York in January 2016, HLG-PCCB members agreed to develop a proposal for a Global Action Plan for Sustainable Development Data (as a successor of the Busan Action Plan for Statistics from 2011) with the aim of outlining necessary actions to generate quality and timely data on a routine basis to inform sustainable development at the requested level of disaggregation and population coverage including the more vulnerable and hard-to-reach. The plan is also intended to fully account, communicate and coordinate existing efforts and to identify new and strategic ways to efficiently mobilize resources thereby addressing the recommendations of the Secretary-General's Independent Expert and Advisory Group on Data Revolution for Sustainable Development as well as the priorities identified in the Transformative Agenda for Official Statistics.

Increasingly funders of non-profit organizations are seeing DDDM as a way of assessing whether an organization is accomplishing its social mission and effectively targeting its resources (Kaplan, 2001). Such an emphasis, combined with the increasing competition for funding, has increased the use of evidence-based funding in organizations with a social mission which in turn has increased the resources devoted to assessing their performance (Carman and Fredericks, 2008; Davenport, 2006).

Unfortunately, few research studies can be used to guide funders or executives of mission driven organizations who strive to increase use of data in decision making. At least two specific gaps leave unanswered questions about how data processes are coordinated in mission-driven organizations and how processes might be embedded into an organization's culture to systematically integrate data into decision making (Maxwell et al., 2015).

First, little is known about how mission-driven organizations systematically integrate data into their decisions. Studies examining DDDM in non-profits have assessed the types of data that they collect (Carman, 2007; Carman and Fredericks, 2008) or the type of performance management indicators that they use (Carrilio et al., 2003). Such research generally examines one component of DDDM in isolation from other components and processes and from the organization's established culture of taking decisions. LeRoux and Wright (2010) used a broader DDDM framework to examine an organization's reliance on performance and output indicators including customer satisfaction and industry standards; however, their

survey was not designed to understand how these individual DDDM components combined or did not combine to form a systematic process for collecting, analyzing and using data to take decisions. Such static measures of DDDM activities are necessary but not sufficient indicators of an organization's use of valid data to make decisions because the measures do not reveal the extent to which organizations have a coordinated process of sequential DDDM activities and a belief that using data over intuition enhances decisions. If funders or non-profit executives want to strengthen the use of evidence in making strategic and operational decisions, they must understand both how static measures of DDDM activities combine or do not combine to form a process by which DDDM is used and supported in non-profit organizations (Maxwell et al., 2015).

A second potential knowledge gap exists in the accuracy of information about DDDM obtained from a single respondent in an organization which is the basis of most research on DDDM. If stakeholders hold different perceptions about an organization's DDDM activities and use research relying on a single individual in that organization may be inaccurate. Building a body of knowledge about DDDM either within an organization or across non-profits requires information from multiple individuals in an organization (Maxwell et al., 2015).

Alternatively, if stakeholders hold similar perceptions about an organization's use of data in decision making, the current practice of fielding surveys to individuals across organizations might efficiently build a body of knowledge about DDDM in non-profit organizations. Using verifiable data instead of intuition to take decisions can be a valuable business strategy in both for-profit and non-profit organizations. Research on for-profit firms suggests that DDDM increases their performance (LaValle et al., 2010) and their output and productivity by 5 to 6 per cent (Brynjolfsson et al., 2011). Research on non-profit organizations also suggests that DDDM increases the effectiveness of management decisions (LeRoux and Wright, 2010). Effectively using data to take decisions requires at least two key elements. First, the DDDM process must be embedded in an organization such that its staff members value and embrace the use of data over intuition in developing and implementing strategies (Julnes and Holzer, 2001). Such a process enables individuals to take appropriate and timely action (LaValle et al., 2010).

Second, it requires a coordinated process of sequential DDDM activities in which an organization collects, analyzes and uses data. Each stage is important. If data is not collected, organizations cannot analyze information to draw conclusions. If data is not analyzed consistently and correctly, staff members might use it to draw incorrect conclusions. Finally, if the results of the data analysis are not incorporated fully into decision making, the monies spent on collection and analysis is for naught (Maxwell et al., 2015). Until recently, relatively few non-profits had an incentive to adopt a DDDM strategy (Nonprofit Technology Network, 2012), in contrast to both for-profit firms and public sector organizations. However, the tide is shifting as some funders are now providing financial incentives or technical assistance for institutionalizing DDDM in the non-profits that they assist. This requirement is based on the belief that in order to position the social sector for impact and innovation beyond the limits of any one funder's engagement, DDDM must be developed and institutionalized at the organization level (Maxwell et al., 2015).

2.1. What are the 17 Sustainable Development Goals?

The SDGs cover a wide range of issues. They include traditional MDG areas such as poverty, hunger, health, education and gender inequality and also cover new topics such as energy, infrastructure, economic growth and employment, inequality, cities, sustainable consumption and production, climate change, forests, oceans and peace and security (CAFOD, 2015).

The 17 SDGs are:

Goal 1: End poverty in all its forms everywhere

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 3: Ensure healthy lives and promote well-being for all at all ages

Goal 4: Ensure inclusive and quality education for all and promote lifelong learning

Goal 5: Achieve gender equality and empower all women and girls

Goal 6: Ensure access to water and sanitation for all

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8: Promote inclusive and sustainable economic growth, employment and decent

Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation

Goal 10: Reduce inequalities within and among countries

Goal 11: Make cities inclusive, safe, resilient and sustainable

Goal 12: Ensure sustainable consumption and production patterns

Goal 13: Take urgent action to combat climate change and its impacts

Goal 14: Conserve and sustainably use the oceans, seas and marine

Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halting biodiversity loss

Goal 16: Promote just, peaceful and inclusive societies

Goal 17: Strengthen the means of implementation and revitalizing the global partnership for sustainable development, on finance, technology, capacity-building, trade and systemic issues

Lessons have been learned and the SDGs attempt to address the root causes of poverty, inequalities within and between countries, climate change and environmental degradation and peace and justice along with other important issues. Since 2011 the international community has been discussing what should follow from the MDGs in a process that includes governments, academicians, the private sector and civil society. The SDGs have more ability to respond to the experiences and priorities of the people on the ground.

While the MDGs focused mainly on poverty in developing countries, the SDGs are applicable to every country. This ambitious agenda moves beyond the MDGs by addressing the root causes of poverty and calling for all to take action for sustainable development. To understand how people's lives are changing, better information is needed on progress in the goals and targets. When data is broken down along the lines of age, gender, location and disability, it can give a more accurate picture of who is benefiting and who is being excluded.

New technology can create exciting opportunities to improve data but open, accessible data and data literacy for all is a key for the success of the SDGs.

2.2. SDGs domestication in Rwanda

Rwanda is among the very few countries worldwide that have embarked on the process of SDGs domestication. Through collaboration with development partners, the country has started assessing how to domesticate the SDGs' targets in national development and poverty reduction strategies such as Vision 2020, the Economic Poverty Reduction Strategy (EDPRS) and the Sector Strategic Plans (SSPs) and the District Development Plans (DDPs) at the local government level. This domestication process goes beyond an assessment of whether the SDGs' targets are reflected in national development strategies and also involves their integration in the sense of implementation towards reaching the 2030 development goals (Bizozza, 2016). To judge whether SDGs will be achievable will depend on a number of considerations. With reference to the MDGs, the country has made enormous progress especially in areas of poverty reduction (from 60.4 per cent in 2000 to 39.1 per cent in 2014-15), net enrolment (from 72.6 per cent to 96.8 per cent), food security, reduction of under-5 mortality (from 196 in 2000 to 32 in 2015), gender promotion and environment and natural resource management (MINECOFIN, 2016).

From the lessons learned so far from the MDGs, Rwanda needs to continue eradicating poverty, addressing issues related to child malnutrition, promoting sustained and inclusive economic growth, youth productivity and employment and quality education that is customized to the challenges of development and employment. Social protection programs still need to feature among priorities due to their double sided effects – ensuring equity in wealth distribution and creating more jobs through public investments such as feeder roads in rural areas. Further, efforts should be made for improving the private sector's productivity in areas with greater multiplier effects in terms of wealth creation and poverty reduction. Climate change adaptation and resilience that is especially adapted to small scale farmers will also need adequate consideration because this remains one of the main impending factors in agricultural development. Since governance is a key in this process, ensuring inter-institutional coordination through existing mechanisms such as sector working groups is still an issue in achieving the SDGs. In addition, Rwanda's economy needs diversified products for diversified markets especially those that may substitute imports. This sounds classic but industrialization remains significant in sustaining Rwanda's different ventures for its economic and structural transformation to address some of the structural challenges faced by the country such as unemployment and heavy dependence on imports. If ICT has been able to revolutionize some of the sectors and has promoted efficiency in service delivery (such as in the banking sector) then deciding on what industrialization Rwanda needs and implementing it should continue to feature on the development agenda.

The role of administrative data needs to be updated to respond to the needs of policy and emerging challenges calling for more technology innovations. It is clear that the implementation of SDGs will need more and efficient coordination mechanisms customized to local institutional arrangements, generation of data required to inform the monitoring and evaluation frameworks that are flexible for reporting purposes, clear division of labor

between and within sectors and capacity development in various areas to uptake this very dynamic development pathway of the world.

2.3 Administrative and Statistical Data

In our study, the distinction between administrative and statistical data for producing official statistics is rooted in the primary purpose of acquisition of data: administrative data is collected primarily for non-statistical purposes and adopted for producing statistics while statistical data is collected for preparing statistics and is in general not available for any other purpose (Nordbotten, 2008). Administrative data may be drawn from internal systems or supplied by external organizations. Administrative data sources are often used to manage the day-to-day operations within an organization or to deliver a service. Statisticians across the government's statistical system use administrative data for producing official statistics. There are good reasons to base statistics on administrative data sources: data often provides a readily available, rich source of information without placing any significant burden on data suppliers. However, they are also susceptible to data quality issues.

Common data quality concerns with administrative data include incomplete data, incorrect data formats and mistyped data. There can also be variations in recording practices between suppliers who contribute to an administrative data source. Some of these issues arise because the data is not usually collected with statistical purposes in mind. There have also been some high profile cases where statistics based on administrative data have been found to be affected by intentional misreporting of the underlying data. Any of these problems not only affects the usefulness of the resulting statistics but can also lead to mistrust in the statistics and adverse publicity; in the high profile cases there have been parliamentary inquiries and a de-designation (National Statistician's Office, 2014).

2.3.1 Early use of Administrative Data

It is difficult to state when official statistics were first produced and used, but it was probably when rulers of communities wanted to compare their power with that of their enemies.

According to Statistics Canada (2009), enumeration of different resources was regularly carried out in Babylon. About 4,000–5,000 years ago, Egyptian pharaohs also carried out censuses for tax collection and to determine fitness for military and labor services as well as for surveying progress in construction work. It was quite common in many countries to enumerate the male population within certain age brackets in order to provide the rulers with statistics about their potential power and records for recruiting soldiers to their legions. These statistics have in more recent times been utilized retrospectively to estimate the total populations and their age distributions.

Recording land properties was a usual means for rulers to determine the taxation of their populations. Based on statistics from these records, heads of countries could evaluate their potential income and wealth and keep control by means of the collection process. Trade in commodities passing frontiers was another early source for collecting taxes. This is when the first international trade statistics appeared.

The first formal offices for official statistics were established in the 18th century. They were frequently named 'Table Offices' reflecting the fact that their purpose was to summarize administrative micro-data into tables of macro-data and not to collect the data themselves (Koren, 1914). At that time, demographic records, tax data, public accounting data, health data, social data, medical data and school data were aggregated to separate types of statistics to describe the prosperity in a country.

International cooperation on official statistics was initiated in the middle of the 19th century. Some countries established national statistical bureaus which were responsible for all official statistics, while other countries chose to organize statistical departments within several ministries. In both cases, the statistics prepared were mainly based on administrative data, later to be supplemented by data collected solely for statistical purposes such as population censuses and statistical sample surveys. Typical of the official statistics up to the Second World War was that the collection of data and production of statistics on different matters was to a large extent carried out independently (Sundgren, 2004, 2010). This made integration of the statistical results difficult. After the Second World War, the need for creating comprehensive and consistent descriptions of the economic, demographic and social aspects of countries increased. In particular the national accounts system became an important vehicle for organizing economic statistics into a conceptually consistent system (Vanoli, 2005). However, because of the diversified nature of the data on which the different parts of the national accounts were prepared, the compilation of national accounts became a very complex operation. Hence, the intention of developing a similar system of social and demographic accounts was never realized.

2.3.2 Current Use of Administrative Data

Few industries, if any, can present a faster technological development than the electronic computers and communication industries during the last 50 years. Online data storage capacity, processing speed and communication facilities have increased far more than anybody anticipated a few decades ago. From being an expensive and huge tool for a small group of mainly academic users, IT technology is approaching one billion users, ranging in applications from advanced research to everyday email and message exchanges.

In parallel to the technological development, statisticians have continuously refined their computer processing methods to take advantage of these new possibilities. Advances have been made in a number of fields, from organization of statistical production in general to methods for online data collection and communication, data storage and retrieval, data editing and imputation, parameter estimation and predictions, on-demand access for users and so on. Architectures for organizing computer facilities to suit the requirements of individual NSI are available from single computers to advanced multi-computer clusters (Nordbotten, 2008).

Some methods and implementation of the use of administrative data in statistical production in accordance with the 50-year old ideas and principles have been refined and have become accepted as register-based statistics also outside the Nordic countries (Houbiers 2004;

Longva et al., 1998; Statistics Denmark 1995; Statistics Finland 2004; UNECE 2007; Wallgren and Wallgren 2007).

An important issue is organizing the stored data for effective retrieval when requested. Since the 1960s, the development of modern database management systems has made significant progress from which the NSIs have benefitted. Recently, an outline of a structured data storage scheme for a process-oriented statistical production was presented indicating another step towards the realization of 50-year old dreams (Lundell, 2009). Administrative data has proved to be very useful for adjusting and improving collection frames of statistical censuses and sample surveys by using available additional information about the objects (Nordbotten, 2008).

Use of administrative data as compared to statistical data in a statistical application requires more attention since the administrative source has not usually tailored its collection in accordance with statistical concepts, standards and requirements. Data from administrative sources may therefore need statistical pre-processing to solve intricate conceptual and matching problems before it can be used. The pre-processed data is typically organized by NSIs in statistical base registers for subsequent statistical processing (Nordbotten, 2008).

3. Methodology

Our research adopted a descriptive research design. This design was preferred for its fact finding and exploratory features in establishing the truth. We used a quantitative technique since the expected information from the field involved factual elements that were to be presented using descriptive statistics. The target population comprised of decision makers from private institutions, public institutions, NGOs and cooperatives based in the Remera sector, Gasabo district in Kigali city. They comprised of 12,378 individuals among the 154,236 (Establishment Census, 2014) for the whole country. A stratified random sampling technique was used to select the research size. A sample size of 118 was selected from the target population, considering 5 per cent as the significance level and 10 per cent as the margin error.

The research instrument used was a questionnaire. The field survey was conducted in respective institutions; 118 structured questionnaires were distributed to the various institutions and information on administrative data use for decision making was obtained. Secondary data for this study was gathered from existing published works, that is, current data use in decision making journals and books, UN Rwanda reports and the World Bank reports. However, secondary data was not used in the analysis but was used in the introduction and literature review sections of the study.

The questionnaires were checked for completeness and consistency of information at the end of every field data collection day before storage. An analysis was done using the statistical package for social science (SPSS). The data was tabulated by making logical interpretations, conclusions and recommendations. Descriptive statistics (frequency analysis) were computed for presenting and analyzing the data. Data was presented in the form of frequency

distribution tables, graphs and pie charts that facilitated a description and explanation of the study's findings (see Table 1).

Insert Table 1 about here

4. Data analysis and interpretation

4.1 The profile of the respondents and the response rate

The sample for this research was a stratified sample totaling 120. This sample was divided into four strata, with one of these strata sub-divided into three more strata or groups. The data was collected in the Remera sector, in Gasabo district in Kigali city. This location was selected for its record as the highest emplacement of institutions in Rwanda.

As shown in Table 2, there were 13 non-responses which accounted for 10.8 per cent of the sample population. These non-responses were mainly due to the reluctance of some of the respondents to share information.

Insert Table 2 about here

Since all the institutional sectors had the same questionnaire, Table 3 gives the responses of cooperatives, NGOs and public institutions who were reached for the study.

Insert Table 3 about here

4.2 A brief profile of the respondents

Figure 1 shows that a majority of the respondents were either owners themselves or were representatives of the owners. This ensured that the collected information could be trusted since the respondents were in a position to answer the questions truthfully.

Insert Figure 1 about here

4.3. Education Levels

Figure 2 shows that a majority of the respondents had either completed or attended university in their lifetimes. This shows a satisfying level of education in Rwandan private, public and non-governmental institutions.

Insert Figure 2 about here

4.4. Respondents' Gender

Figure 3 shows that there was an equal share of men and women (50 per cent each) among the respondents regardless of the institution's size or sector.

Insert Figure 3 about here

4.5 Use of Statistics in the decision making process

The decision makers were asked to answer with ‘Yes or No’ on whether they used administrative data in decision making for the developing their institutions. Figure 4 shows that a majority of them said ‘No.’ This response was however highly dependent on the institution’s size and its sector (whether public, NGO, cooperative or private) as 61 per cent of the respondents who did not use administrative data in their decision making process were then requested to choose among a few probable reasons and the main reason(s) why they did not use administrative data in their decision making processes; 75 per cent answered that they did not see the need for using statistics (Figure 5).

Insert Figure 4 about here

Insert Figure 5 about here

Figure 6 shows that only 13.33 per cent of the respondents who produced administrative data shared or disseminated their data outside their own institution in any form. Among those who disseminated data, 25 per cent responded that it was in a magazine while 15 per cent of the respondents disseminated it in the form of regular reports.

Insert Figure 6 about here

4.6. The underlying relationships among the variables

We investigated the relationships between the following independent variables: the institutional sector (public, private, NGO or cooperative), education level, the number of employees (or the size of the institution) and the dissemination of data against the dependent variable of data use in decision making.

Table 4 shows that there was a very strong relationship between the lack of use of statistics for decision making and the private institutional sector.

Insert Table 4 about here

It is apparent from Table 5 that the higher the education level, the more the institutions used statistics in decision making. However, drawing conclusions from the education level might need to be done carefully as only the respondents’ education levels were recorded and not the average years of study in each institution. However, since most institutions had less than three people in their teams we decided to use this variable.

Insert Table 5 about here

As can be seen from Table 6 the use of statistics depended on the size of the institution. The larger the institution, the greater the use of statistics in the decision making process.

Insert Table 6 about here

5. Conclusion and recommendations

Not much research has been done on statistical use by the general population, especially on the use of statistics as a managerial tool for measuring and monitoring development in Rwanda. Most of the studies either focus on the use of official statistics by professionals or focus on studying the short lifespans of SMEs in Rwanda and usually conclude that they lack finances and managerial skills among other things.

Our research focused on the grossly neglected tool of statistics for development in any institutional sector and examined the underlying main causes of the lack of use of statistics to measure and monitor the UN's SDGs and Rwanda's aspirations for 2050. Our main findings include: a majority of the decision makers in the sample population did not use statistics to inform their decision making. This confirms the recent assessment made by the National Institute of Statistics of Rwanda (NISR, 2014). This pattern got stronger when the size of the institution (measured using the number of employees) was smaller and the education levels of the respondents were lower.

The main reason advanced by the respondents as to why they did not use statistics to inform their decision making process was that they saw no need to use statistics in their activities. The study also found that those who used statistics in running their businesses found them extremely useful and indispensable while those who did not use statistics to inform their decisions did not see any need for their use.

There is a strong lack of dissemination/sharing by institutions, especially in the private sector, which use statistics to inform others about their decisions. The main reason advanced for this was that they did not feel comfortable sharing information that they found sensitive and which they felt the competition could use against them.

In light of these findings, this paper recommends that the government should develop and implement educational programs to increase data literacy and empower institutions and individuals to use statistics effectively in their decision making processes to promote the development of a technological infrastructure for better data dissemination. There is also a need for developing effective communication and data dissemination strategies and guidelines for a public and private dialogue oriented at policymakers, legislators, the media, the general public and the economy. Further, the use of e-learning platforms to share knowledge between producers and users of statistics should also be enhanced.

More research should be done on the subject of administrative data production and use for decision making in Rwanda preferably using a much larger sample population since our research used information from only one respondent in an institution and thus it might not be reliable.

Institutions' owners or managers should also adopt statistics as a decision making tool and also use ICT.

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Table 1: The overall sample population

Institutional sectors	No. of questionnaires derived		Per cent
Private	Total:113		96%
	Micro (1-3 employees)	106	
	Small (4-30 employees)	7	
	Medium and Large (31+ employees)	1	
Public		1	1%
NGOs		2	2%
Cooperatives		1	1%
Total		120	100%

Table 2: Response rates with respect to the institutional sector

	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid 0	12	10.0	10.0	10.0
NGOs	2	1.7	1.7	11.7
Private	102	86.7	86.7	98.3
Public	1	.8	.8	99.2
Cooperative	1	.8	.8	100.0
Total	120	100.0	100.0	

Table 3: Response rates with respect to the number of employees (size of institution)

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	small (1-3 employees)	78	65.0	73.6	73.6
	Medium(4-30 employees)	24	20.0	22.6	96.2
	Large (31+)	4	3.3	3.8	100.0
	Total	106	88.3	100.0	
Missing	0	12	10.0		
	System	2	1.7		
	Total	14	11.7		
Total		120	100.0		

Table 4: Relationship between the use of statistics in an institution and the institutional sector

		Do you Use Administrative Data for Decision Making?		Total
		No	Yes	
Institution Type	NGOs	0	2	2
	Private	61	42	103
	Public	0	1	1
	Cooperative	0	1	1
Total		61	46	107

Table 5: Relationship between the use of administrative data in an institution and the respondent's educational level

		Do you Use Administrative Data for Decision Making in your Institution?		Total
		No	Yes	
Education level	Primary education level	4	0	4
	O level	8	0	8
	A level	24	13	37
	University	23	25	48
	Master's degree	1	5	6
Total		60	43	103

Table 6: Relationship between the use of administrative data in an institution and the number of employees (or size of the institution)

		Do you Use Administrative Data for Decision Making in your Institution?		Total
		No	Yes	
Number of employees	small (1-3 employees)	58	20	78
	Medium (4-30 employees)	2	22	24
	Large (31+)	0	4	4
Total		60	46	106

Figure 1. Respondent's position in the institution

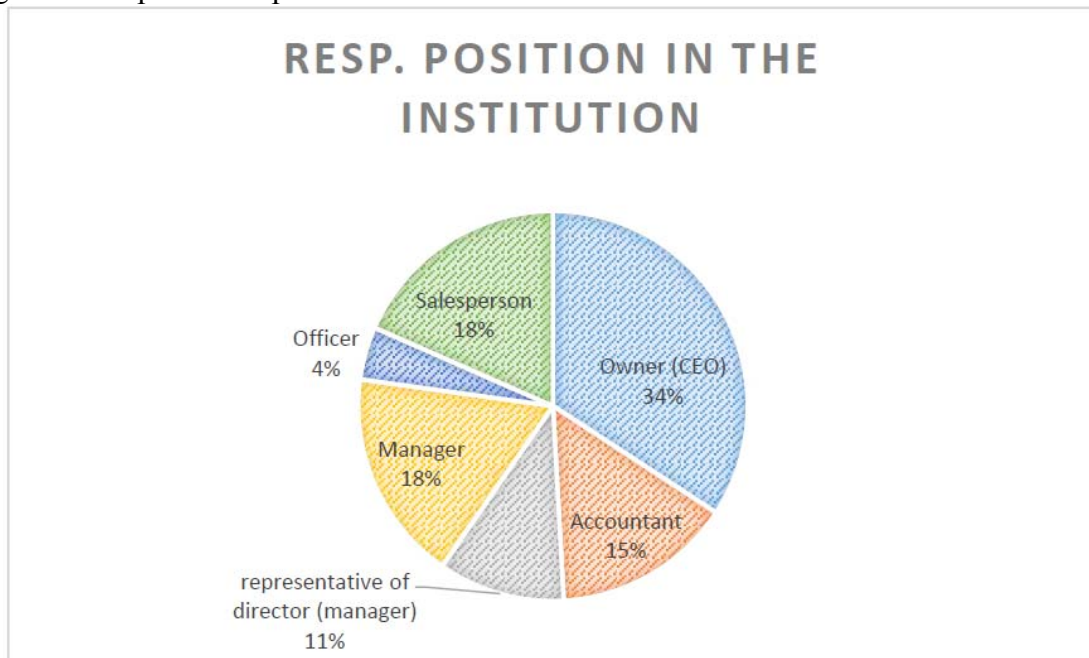


Figure 2. Education levels of respondents

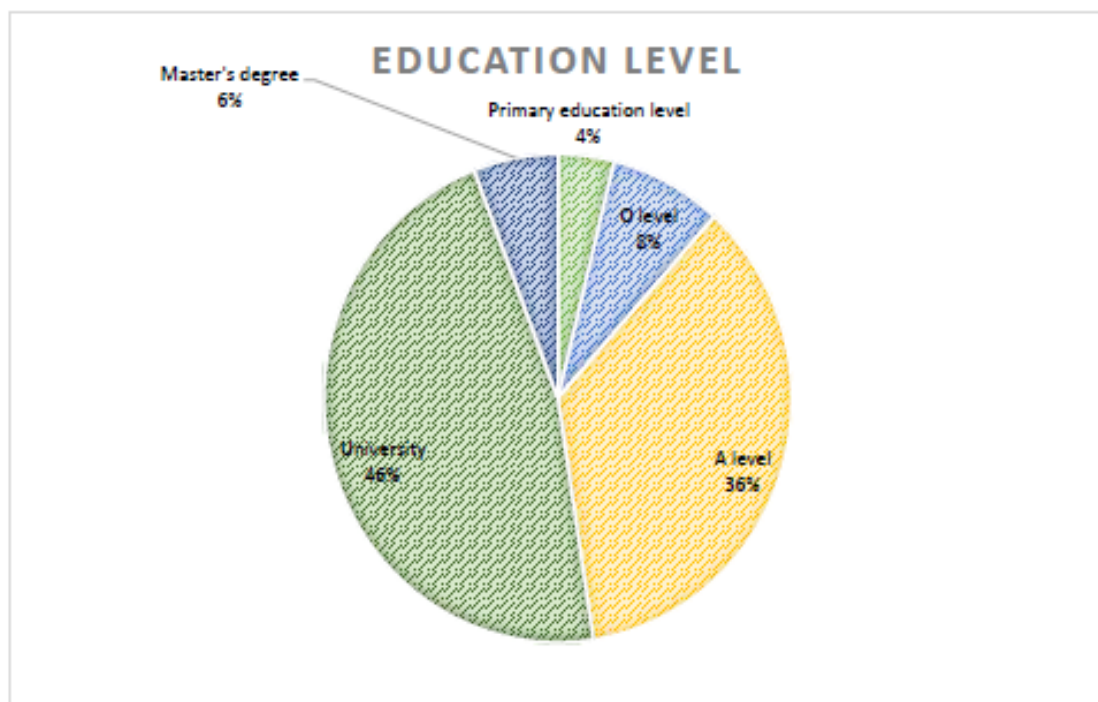


Figure 3. Gender of the respondents

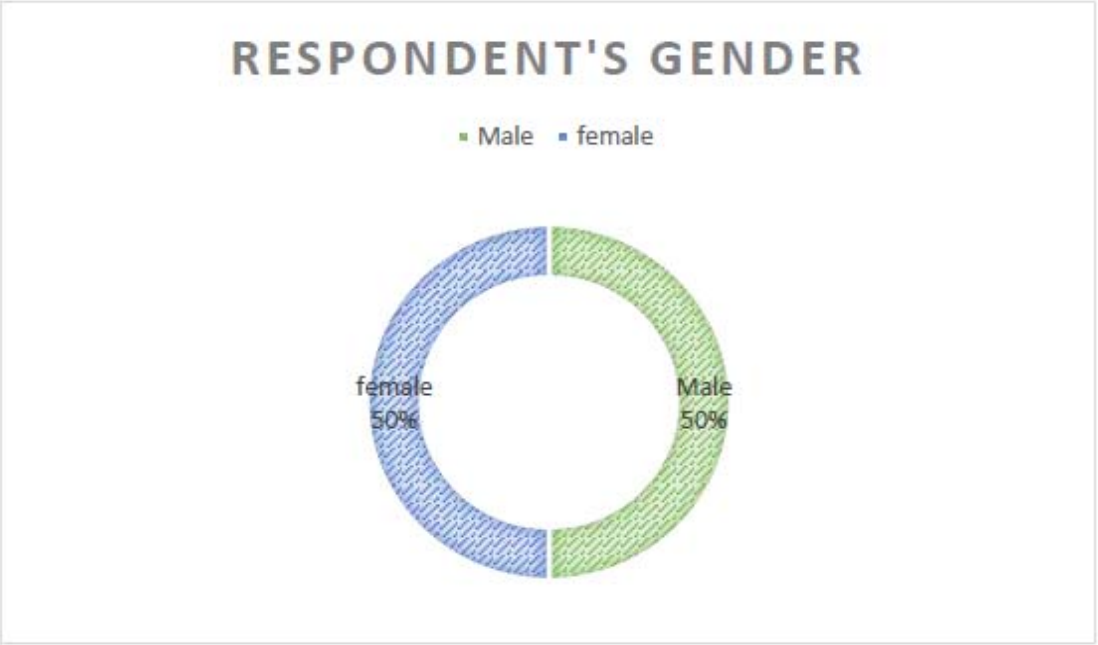


Figure 4. The use of statistics in decision making in different institutions

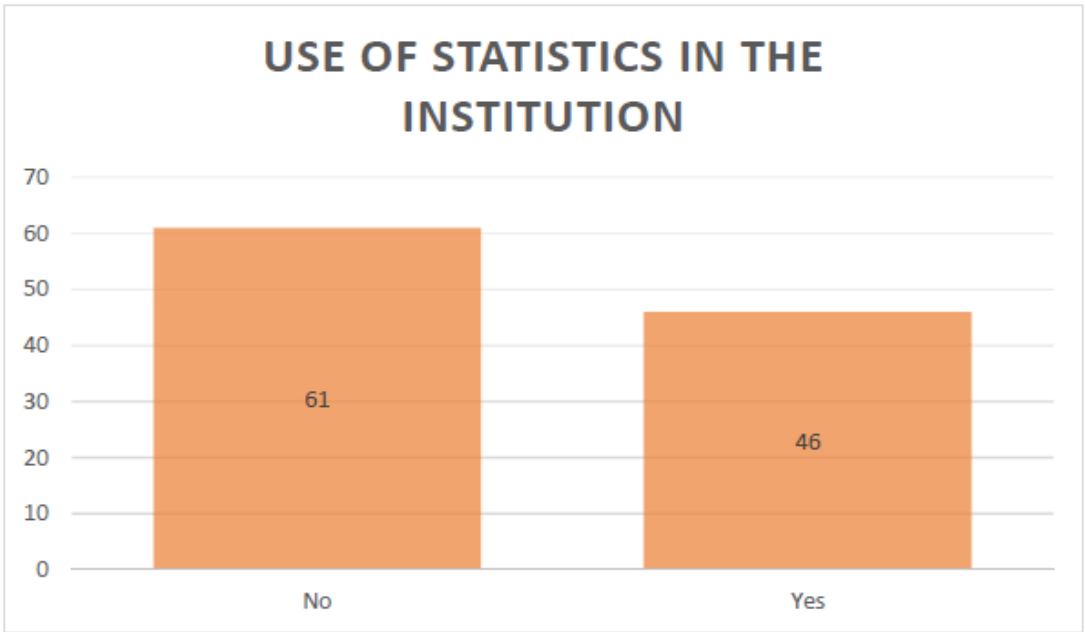


Figure 5. Reasons why data not used in the decision making process

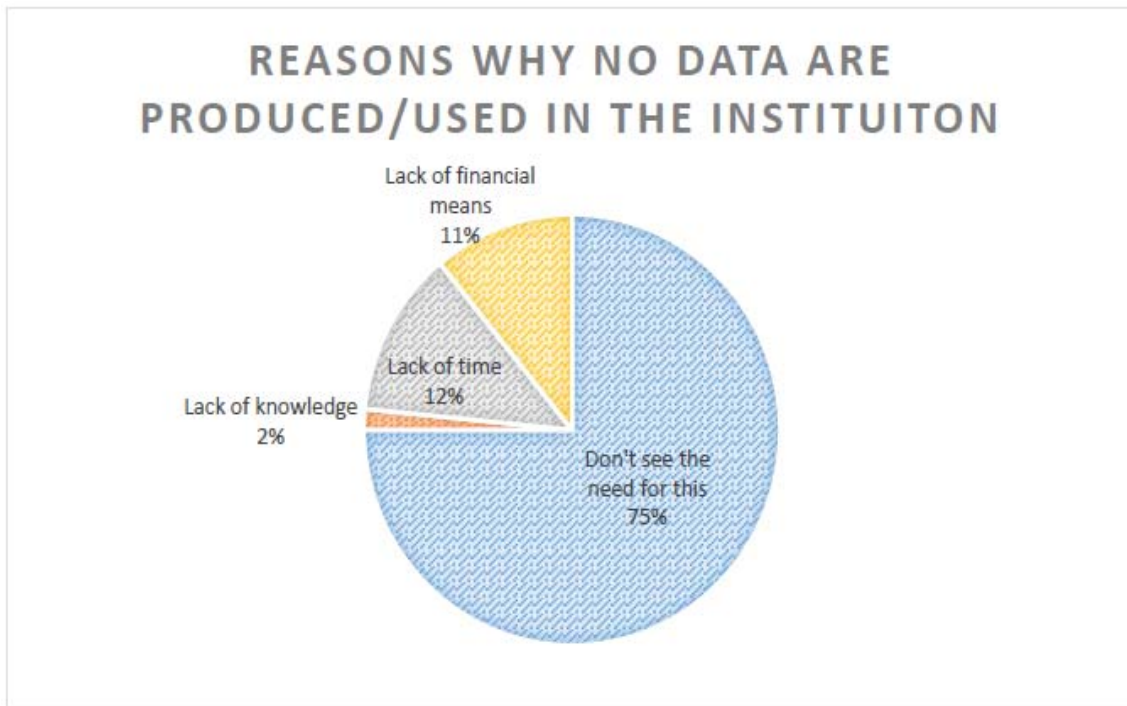
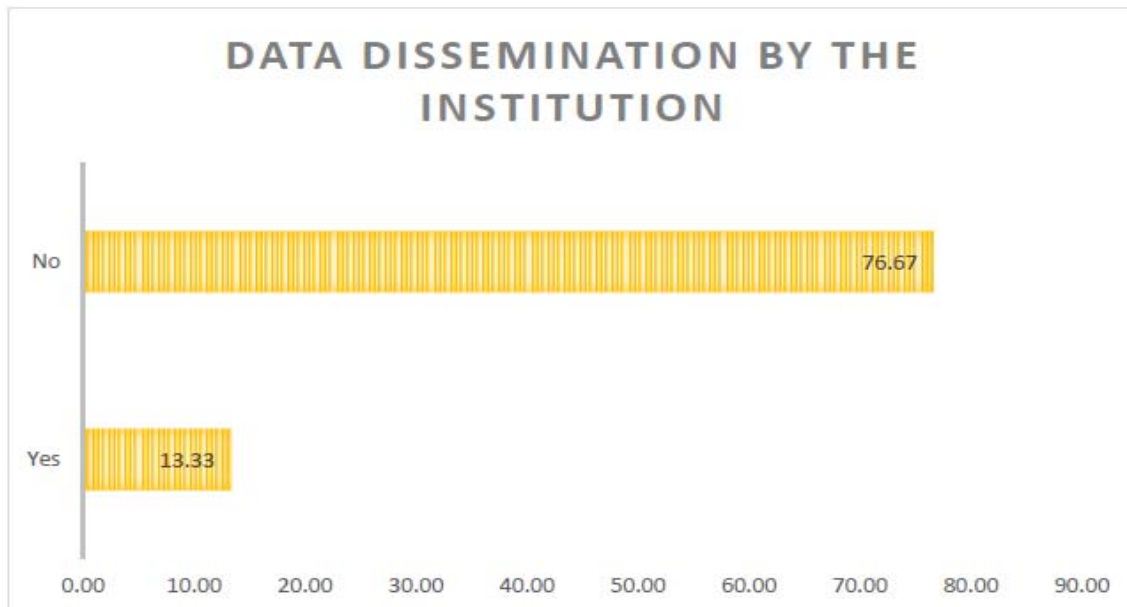


Figure 6. Data dissemination/sharing by the institutions



Chapter Seven

An Evaluation of Rwanda Vision 2020's Achievements

NIMUSIMA Perez¹, KARUHANGA Nathan² and MUKARUTESI Dative³

¹Corresponding author:
School of Business, University of Rwanda
College of Business and Economics,
Kigali, Rwanda,
E-mail: pereeznimusima@gmail.com

²School of Business,
University of Rwanda College of Business and Economics,
Kigali, Rwanda,
E-mail: karuhanga1900@gmail.com

³School of Business,
University of Rwanda College of Business and Economics,
Kigali, Rwanda,
E-mail datismuk@gmail.com

Abstract

This paper evaluates the extent to which Rwanda has achieved its Vision 2020 targets. To address this, it reviews the six-pillar composite indicators -- good governance and a capable state; human resource development and a knowledge based economy; a private sector-led economy; infrastructure development; productive and market oriented agriculture; and regional and international economic integration. It uses descriptive and analytical approaches in analyzing the data and also in its reporting. It also reviews different theories that explain the development discourse and contrasts these with Rwanda's growth path since 1994. Further, it also reviews short-term country development strategies (PRSP, EDPRS 1&2, the seven-year government program (7YGP) and imihigo (annual performance targets).

Keywords: Rwanda, governance, Vision 2020, development.

JEL Classification Codes: D13; D63; H53; I131; I138; J13;

1. Introduction

Research shows that the per capita gross domestic product (GDP) in the world quadrupled between 1900 and the early 1990s, corresponding to an average growth rate of about 1.5 per cent per year. Aggregate production increased steadily in most countries in the world in the 20th century. This growth scenario, however, seemed to have bypassed Rwanda because of its post-independence leadership that lacked strategic foresightedness in its national political, economic, social and technological planning. In general, Rwanda was badly governed during most of the last regimes. Both the colonial and post-colonial regimes ruled Rwanda on the basis of divisionism, favoritism and prejudices that sparked the 1994 Tutsi genocide that killed more than 1 million people. As a consequence, Rwanda was one of the poorest countries in the world and, the people of Rwanda were until recently strongly divided. However, despite this historical scar Rwanda's average annual GDP growth rate of 8 per cent today is higher than that of Western European countries in the early 1990s (5.6 per cent). This success story largely hinges on the strategic roadmap that the Government of Rwanda laid down in 2000 in its Vision 2020. After 1994 a set of integrated development programs were put forth by the government which highlighted unity which justifies all the economic, social, political and technological transformations.

The future that Rwandans wish to see is embedded in its Vision 2020, a statement of the kind of society that Rwandans want to become. It is a reflection of their aspirations and determination to construct a united, democratic and inclusive Rwandan identity without discrimination between its citizens after so many years of authoritarian and an exclusivist dispensation. Through this vision, Rwanda wants to transform into a middle-income nation in which Rwandans are healthier, educated and generally more prosperous; it also wants to be a united and competitive country both regionally and globally (Vision 2020).

The government turned the post-genocide adversity into an opportunity by creating a national vision in Vision 2020 which is a translation of Rwandans' aspirations for the future of their country and society. The vision presents a framework and key priorities for Rwanda's development and is a guiding tool to overcome poverty and foster unity and reconciliation in the future.

Rwanda's Vision 2020 stands on six pillars and three crossing areas: Good governance and a capable state, human resource development and a knowledge-based economy, a private sector-led economy, infrastructure development, productive and market-oriented agriculture and regional and international economic integration. The cross-cutting areas are gender equality, protection of the environment, sustainable natural resource management and science and technology including ICT. Some of the Vision 2020 outcome indicators are GDP per capita of \$ 900 which was later revised in 2012 to \$1,240, average GDP growth rate of 8 per cent, 50 per cent wood energy in national energy consumption, a population growth rate 2.2 (per cent) (the Rwandan population to be 13 million), life expectancy of 55 years, reducing the infant mortality rate from 107 to 50, reducing the maternal mortality rate from 1,070 to 200, reducing the percentage of the population in extreme poverty from 64 to 30 per cent (revised in 2012 to less than 10 per cent of Rwandan households), reducing child malnutrition from 30 to 10 per cent of the population, increasing net primary/ secondary school enrolments from 72 to 100 per cent, increasing the rate of admissions in tertiary

education from 1 to 6 per cent, gender equality in decision-making positions from 10 to 40 per cent, reducing the HIV/AIDS prevalence rate from 13 to 8 per cent, reducing malaria-related mortality from 51 to 25 per cent, increasing the growth rate of the industrial sector/services sector from 7 to 11 per cent and increasing non-agricultural jobs from 200,000 to 1,400,000 annually.

Vision 2020 has been converted into action by a series of medium-term national poverty reduction and economic development strategies.

PRSP (2002-06) was the Government of Rwanda's (GoR) first systematic assessment and finding out the action needed to reduce poverty and generate pro-poor economic growth. It was elaborated in a post-conflict environment where the main emphasis was on managing a transition from emergency relief to rehabilitation and reconstruction.

EDPRS 1 (2008-12) was based on PRSP's experience (significant progress particularly in health and education) and focused more on accelerating growth, creating employment and generating exports. This was largely because under PRSP productive sectors including agriculture, infrastructure and industry remained a challenge. These were outlined in three flagship programs: Growth for jobs and exports, the Vision 2020 umurenge (VUP) and good governance.

The overarching goal of EDPRS 2 (2013-18) is 'Accelerating progress to middle income status and better quality of life for all Rwandans through sustained average GDP growth of 11.5 per cent and accelerated reduction of poverty to less than 30 per cent of the population.' EDPRS 2 is guided by revised targets of Vision 2020 adopted in May 2012 which clearly outline the objectives to be achieved as a pre-requisite for rapid growth and poverty reduction. EDPRS 2's objectives were aligned with the objectives of Vision 2020 (Table1).

Insert Table 1 about here

Different theories explain governance, leadership and growth processes in market economies across the globe. These theories in some way answered the recurring question in 2000: What will be Rwanda's sources of economic growth? Other key questions which Vision 2020 had to address were: How do Rwandans envisage their future? What kind of society do they want to become? How will they construct a united and inclusive Rwandan identity? What are the transformations needed to emerge from an unsatisfactory social and economic situation? Remember 60 per cent of Rwandans were living below the poverty line (PRSP) which was unacceptably high for GoR though it was not too surprising given the history of the country when there were years of economic decline and bad governance. With the conviction that it was possible to vanquish hunger, misery and deprivation, in 2000 the government set priorities that would see Rwanda progress in all spheres.

Realistically none of these theories alone sufficiently explain the growth trend in Rwanda considering its national budget of \$260 million francs in 1998 and 1,768.3 billion francs in 2015-16 where 64 per cent of the national budget was domestically financed. As the Minister of Finance told the cabinet recently, 80 per cent of the national budget for financial year 2017-18 will be financed domestically.

The energy and determination invested in the Vision 2020 concept and the implementation of this vision generated an economic recovery which has dramatically impacted growth, income and poverty. Long-term indicators tell the story of socioeconomic rebound after a major upheaval. Average annual economic growth averaged more than 10 per cent in the decade after 1995. Since 2000, this momentum was sustained and culminated in a perfect developmental 'hat trick' of sustained economic growth, poverty reduction and a reduction in income inequalities by the end of the EDPRS 2 period. Despite the disruptions caused by the 2008-09 global financial crisis, Rwanda's the annual economic growth during 2005-11, was a robust 8 per cent, the headcount poverty and extreme poverty ratios both fell by nearly 12 percentage points taking a million people out of poverty and income inequalities also declined. In short, Rwanda has been 'on the move' and has provided real improvements in living standards for its population.

If theoretical models are not capable of replicating at least the most important facts their relevance is only limited. This appears to be a promising route, although one has to admit that it is still ambiguous and debatable. Nevertheless, it seems that empirical regularities about economic growth which are pretty robust can be identified. This was done in the 1960s and the following observations represent stylized facts in the growth theory:

1. The on-going growth in aggregate production and in the productivity of labor with no tendency of a falling rate of growth.
2. A continued increase in the amount of capital per worker.
3. Steady capital-output ratios over long time periods.
4. A steady rate of returns to capital which exceed the long-term rate of interest.
5. A high correlation between the share of profits in income and the share of investments in output and a steady share of wages and physical capital in national income.
6. There are considerable differences in the rate of growth of labor productivity and of total output in different sectors.

Since these observations date back to the 1960s, the question arises whether these can be confirmed. Modern empirical studies have tried to answer this question for different countries. The conclusion they have reached is that all stylized facts can be more or less confirmed for developed countries with the exception of the fourth one. It is argued that the assumption of a stable real rate of return should be replaced by the hypothesis of a slightly declining rate of return as an economy evolves over time. The justification for this is seen in observations that show that the real rates of return in some fast growing countries like South Korea, Singapore and Taiwan in the second half of the 20th century were much higher than those in advanced economies, but these rates declined over time. This leaves lessons for Rwanda and PRSP to draw from the experiences of developing countries both in Africa and in particular in South East Asia. It should be remembered that PRSP was Rwanda's dynamic living document between 2002 and 2006 which had to be continuously reviewed and updated.

Other features of modern economies considered as characteristic for the growth process are a fast rate of structural transformation implying first a shift from the agricultural sector to an industrialized one and later to the services and information technology sectors; the role of technological changes becomes more important in the growth process as countries grow; there is also increased significance of governments in the process of economic growth in terms of laws to regulate economic transactions and also because of the growing significance of public infrastructure in the growth process. Some characteristics of these economies are reduced dependence on natural resources, the rising importance of foreign trade and the increased role of formal education in schools and universities.

Another aspect which should be pointed out is that economists often maintain a theoretical dichotomy between growth and business cycles. This means that growth theories tend to explain the medium- and long-run trends in output and in production possibilities rather than short run fluctuations in production. The latter is the object of the business cycle theory which needs equally serious scrutiny in understanding a country's growth path.

Researchers strongly believe that empirical facts play an important role in defining the future of any country. They also believe that countries derive policy implications from empirical observations. Our study evaluated the six pillars of Vision 2020 and identified whether all the pillars have been achieved and also looked at challenges affecting their implementation.

2. Methods

Our study used a qualitative research design to achieve its objectives. It is analytical and descriptive in nature and uses secondary data.

Our study did a qualitative analysis as a method to review designed policies, reports, published papers, the Vision 2020 revised report of 2012 and country integrated development programs.

A multivariate analysis helped achieve the objectives by looking into the relationship between Vision 2020's pillars and their outcome indicators between 2000 and 2016.

3. Results and discussion

3.1 Introduction

Rwanda is experiencing one of the most exciting and fastest periods of growth and socioeconomic progress in its history. It was the tenth fastest growing economy in the world during the decade from 2000. At the same time more than a million people were lifted out of poverty. Population growth is stabilizing and the country is making great strides towards achieving the millennium development goals (MDGs) and middle-income status.

3.2 Discussion of results

Vision 2020 has been converted into action by a series of medium-term strategic plans.

The six broad areas identified as priorities for action under PRSP (2002-06) were rural development and agricultural transformation, human development, economic infrastructure, governance, private sector development and institutional capacity-building. These led to very good progress in the country's development with major gains in social sectors including in health and education. In terms of non-income poverty, PRSP was much more successful. Infant, under-5 and maternal mortality decreased by 20 to 30 per cent, poverty also reduced from 58.9 per cent to 56.7 per cent. Extreme poverty fell by 4.2 percentage points, from 40 per cent to 35.8 per cent between 2001 and 2005, while income inequality as measured by the Gini coefficient increased from 0.505 to 0.522.

EDPRS 1 (2008-12) was based on the experience of PRSP (significant progress particularly in health and education) and focused more on accelerating growth, creating employment and generating exports. This was largely because under PRSP the productive sectors including agriculture, infrastructure and industry remained a challenge. Hence, in EDPRS 1 these were outlined in three flagship programs: Growth for jobs and exports, the Vision 2020 umurenge (VUP) and good governance. Development analysts have described the achievements under EDPRS 1 as the perfect development 'hat trick' of growth, poverty reduction and reduction in inequalities which have put Rwanda back on track to achieve the MDGs. Economic growth averaged 8.2 per cent over the period while poverty reduced from 56.7 per cent to 44.9 per cent allowing more than 1,000,000 Rwandans to be lifted out of poverty in less than five years. Income inequalities also reduced to 0.49 in 2011 below the level of 2001.

The track record of past achievements has strengthened confidence and the belief of the population in its ability to deliver on development ambitions. Rwanda has the potential to grow rapidly and to exceed the levels of growth and poverty reduction and to exceed the levels of development experienced during PRSP, EDPRS 1&2 and 7YGP.

The overarching goal of EDPRS 2 (2013-18) is 'Accelerating progress to middle income status and better quality of life for all Rwandans through sustained average GDP growth of 11.5 per cent and accelerated reduction of poverty to less than 30 per cent of the population.' EDPRS 2 is guided by the revised targets of Vision 2020 adopted in May 2012 and it clearly outlines the objectives to be achieved as a pre-requisite for rapid growth and poverty reduction (Table 2).

Insert Table 2 about here

Since 2000 Rwanda has made much progress towards attaining Vision 2020's objectives and has even surpassed some of the targets (Table 3).

Insert Table 3 about here

According to Vision 2020's revision report (2012), 26 per cent (12) of the 47 indicators in the original Vision 2020 had already been achieved. In 2011, with less than 10 years for the realization of the vision it was necessary to assess the relevance of the indicators and targets and ensure that they continued to reflect the ambitions and the progress of the country towards attaining its long term development goals. This culminated in a revision of the original Vision 2020 targets through a consultative process where the revised targets were

adopted at the 9th Leadership Retreat in February 2012. The original Vision 2020 contained 47 indicators and targets, which were revised to 48.

The rationale for the revision was based on:

1. Aligning targets to the level of low-middle-income countries: An analytical comparison was done of Rwanda and middle-income countries and adjustments made where necessary. The most notable change is the adjustment of GDP per capita to meet the changing thresholds of middle-income countries. The existing Vision 2020 target for GDP per capita was revised from \$ 900 to \$ 1,240. The current threshold for lower-middle income countries is \$ 1,006 to \$ 3,975; for upper-middle-income countries it is \$ 3,976 to \$ 12,275; and for high-income countries it is \$12,276 or more. Meeting this target will ensure that Rwanda moves into the lower-middle-income category by 2020.
2. Harmonizing with the more ambitious 7-year government program's (7YGP) targets: Some 7YGP targets were found to be more ambitious than those contained in Vision 2020. These include the target for percentage of population below poverty line (20 per cent in 7YGP while it was 30 per cent in Vision 2020) and target for access to electricity in 7YGP (70 per cent while it was 35 per cent in Vision 2020).
3. Inclusion of indicators and targets for climate change, governance, ICT and regional integration: Vision 2020 had already considered these as important areas in the six pillars. This was now reinforced with high level indicators such as biodiversity, citizen satisfaction with service delivery, rule of law and the degree of openness reflected by the proportion of trade in GDP.
4. Some targets already achieved which needed to be more ambitious: Out of the original 47 indicators in Vision 2020, 12 (26 per cent) had already been achieved and 16 (34 per cent) were well on-track to be achieved among which are the average GDP growth rate, agricultural production (kcal/day/person), infant mortality rate, secondary school transitional rate, malaria-related mortality and admission rates in tertiary education. More ambitious targets were set for the indicators already achieved.

For other indicators extremely above average level of achievement had been realized. Life expectancy for an average Rwandese drastically increased from 49 years in 2000 to 66 years in 2016; child mortality rate reduced from 76/1,000 in 2000 to 50/1,000 in 2015. Women mortality rate reduced from 476/100,000 in 2000 to 210/100,000 in 2015. Population still living under the poverty line reduced to less than 20 per cent, extreme poverty drastically decreased from 64 per cent of the population to a less than 16 per cent, more than 1,704,000 million new off-farm jobs were created, 17.3 per cent of the population living was living in urban centers and there was steady exports growth of 15 per cent per annum. The private sector is yet to take a dominant share of investments given the public-private partnerships all over the country. Growth in net primary and secondary school enrolments registered 100 per cent success.

3.3 Vision 2020's pillars

Good governance and a capable state

Governance is defined by UNDP as ‘the exercise of economic, political and administrative authority to manage a country’s affairs at all levels, comprising the mechanisms, processes and institutions through which that authority is directed.’ While referring to good governance, we seek to highlight attributes of governance that are most likely to promote development, human rights, justice and peace. Some attributes of good governance that we considered are:

1. **State capability:** The government should be capable of ensuring security and rule of law and providing the goods and services required for development.
2. **Accountability:** Mechanisms should exist for the public to hold politicians and civil servants responsible for their performance. Accountability may be horizontal between governmental bodies or vertical between government and citizens.
3. **Responsiveness:** Government policymaking should be responsive to the demands emerging from society. Participatory mechanisms can promote this.
4. **Fairness:** Established rules should apply equally to everyone.
5. **Inclusiveness:** Government employment, institutions and services need to be open to all individuals and groups in society without discrimination.
6. **Legitimacy:** The basis of state institutions should be widely accepted across society.

Our paper argues that Rwanda’s governance performance is the most important measure of all sustainable development; it captures the country’s main sectors as reported by different indices both nationally and internationally. Among the national indices, the Rwanda Governance Scorecard (RGS) produced by the Rwanda Governance Board has been assessing the state of governance in Rwanda over three years along eight indicators --- participation, rule of law, transparency, responsiveness, consensus oriented, equity and inclusiveness, effectiveness and efficiency and accountability. RGS (2016) measures Rwanda’s governance performance along eight indicators -- rule of law; political rights and civil liberties; participation and inclusiveness; safety and security; investing in human and social development; control of corruption, transparency and accountability; quality of service delivery; and economic and corporate governance.

Outside Rwanda, many indices have also been reporting annually on the country’s progress including Gallup, Inc., the Mo Ibrahim Index on Africa Governance (IIAG), the Doing Business Index, the Global Competitiveness Report (World Economic Forum), the Human Development Index, the Corruption Perception Index and the Global Open Data Index. In 2015, Rwanda’s transformational journey was noticed by many international ranking institutions that report on countries’ performances in different areas. Rwanda was ranked among the top performers on the African continent as well as on a global scale.

According to World Bank’s (2015) Doing Business Report, in global competitiveness Rwanda was among the leading economies in Africa in policy and structural reforms. Open Knowledge International’s Global Open Data Index (2015) ranked Rwanda as a country with

the most available open government data in Africa, jumping over 30 places in a period of two years. The emphasis put on Rwanda's robust governance policies also earned it great rewards in terms of the country's competitiveness measures, on economic growth and on the public sector's effectiveness in a number of areas including the low level of waste in government spending. These were a result of the government's efforts in promoting a transparent and accountable governance system. The Rwandan leadership's efficiency and effectiveness was captured by the World Economic Forum in its 2015 report. The report produces an annual overall global ranking in which Rwanda was ranked the 7th most efficient government globally (GCI, 2015). On issues of transparency and accountability, Transparency International's Corruption Perceptions Index (CPI) ranked Rwanda among the least corrupt seven states on the continent. The Rwanda Governance Scorecard (RGS), an index produced by the Rwanda Governance Board (RGB) assessed corruption, transparency and accountability in the public sector on which Rwanda scored 79.04 per cent (RGS, 2014).

Human Resource Development and a knowledge-based Economy

The country has shown progress in all three underlying sub-categories – welfare, education and health. Rwanda's best performance is in sub-category health, scoring 85.1 and ranking 7th on the continent. Rwanda's health gains were also captured by the Lancet Global Health report (June 2015) in its state capability and Rwanda's health gains. Rwanda's health achievements surpassed those of its peers and even of countries with higher levels of economic development. Rwanda has the highest primary school enrolment rate in Africa and is one of the continent's best performers in fighting corruption (WEF, 2015). Rwanda, like any other society that is making socioeconomic changes, continues to invest in its people as the core resource for success.

According to RGS (2014), over the last five years the education sector performed better than other sectors with a score of 84.75 per cent and health slightly improved from 77.78 per cent in 2012 to 79.64 per cent. By 2012 school completion rates had also increased significantly for both boys (79 per cent) and girls (82 per cent).

In the health sector, health transformation over the last 10 years is highly remarkable where life expectancy increased from 51 years in 2002 to 64 years in 2012. Infant, under-5 and maternal mortality all decreased by 20-30 per cent. By 2013, all the health MDG targets for 2015 had been achieved while others were on track. In 2012 the population per doctor was 15,428; this represented an increase of 9 per cent from 2011 (RGS, 2014).

As of 1 January 2017, the population of Rwanda was estimated to be 12,033,749 people. This is an increase of 2.40 per cent (282,385 people) as compared to a population of 11 751 364 the year before. In 2016 the natural increase was positive, as the number of births exceeded the number of deaths by 298 485. Due to external migration, the population declined by 16 099. The sex ratio of the total population was 0.965 (965 males per 1,000 females) which was lower than the global sex ratio. The global sex ratio was approximately 1 016 males to 1 000 females in 2016.

Total life expectancy (both sexes) at birth in Rwanda is 66 years. This is below the average life expectancy at birth of the global population which is about 71 years (according to the Population Division of the Department of Economic and Social Affairs of the United Nations).

According to our estimates 4 853 352 persons or 70.58 per cent of the adult population (aged 15 years and above) in Rwanda are able to read and write. Accordingly, about 2 022 611 adults are illiterate.

The literacy rate for the adult male population is 73.21 per cent (2 485 715 persons); 909 607 people are illiterate. The literacy rate for adult female population is 68.02 per cent (2 367 636 persons); 1 113 005 women are illiterate.

Youth literacy rates are 78.47 per cent and 82.19 per cent for males and females respectively. The overall youth literacy rate is 80.37 per cent. The definition of youth literacy covers the population between the ages of 15 to 24 years (UNESCO Institute for Statistics).

A private Sector-led Economy

Private sector development is one of GoR's key development strategies transitioning from an agrarian society to an economy led by the private sector. The Government of Rwanda has put private sector development at the forefront of poverty reduction and economic transformation since 2000 as one of its strategies for attaining middle-income status. The country consequently adopted the private sector development strategy in 2013 to address key constraints in private sector development including high costs of energy and access to finance and entrepreneur deficits particularly among small and medium enterprises (SMEs). Supporting the private sector to become the engine of growth is the core objective of most development partners in the country. SME development has had a big impact on unlocking the contribution of Rwanda's private sector to inclusive growth, job creation and poverty reduction. The share of private sector investments which was 10 per cent in 2010 increased to 13 per cent in 2016 and many government strategic interventions which will enable the private sector to get a dominant share of investments through private-public partnerships are underway.

In the second quarter of 2014, GDP at current market prices was estimated to be Rwandan francs 1,314 billion, up from 1,185 billion francs in the same quarter in 2013. The services sector contributed 47 per cent of GDP while the agriculture sector contributed 33 per cent of GDP. The industry sector contributed 14 per cent of GDP and 6 per cent was attributed to adjustment for taxes less subsidies on products (NISR, 2014). In the second quarter of 2014, the agriculture sector grew by 5 per cent and contributed 1.5 percentage points to the overall GDP growth. Activities in the 'industry sector' grew by 5 per cent and contributed 0.7 percentage points to GDP growth. The services sector increased by 9 per cent and contributed 4.2 percentage points to GDP growth. This growth trend is in keeping with the Vision 2020 indicator of becoming a knowledge based middle-income country. The inter-sectoral shift of labor from agricultural to non-agricultural activities has been particularly fast in Rwanda and has been the main driver of poverty reduction and economic growth. The

extent to which Rwanda can sustain this shift will determine in part whether the country can keep up its pace of growth and poverty reduction. If Rwanda moves gradually towards a middle-income status and its labor force continues growing rapidly, jobs, especially in the non-farm sector, will become increasingly important as a transmission mechanism between aggregate growth and household living standards.

Infrastructure development, enterprises and institutional development were designed to complement each other to reduce the cost of doing business and to strengthen the business environment in Rwanda. One of the key flagship programs to support private sector development is the Skills, Employability and Entrepreneurship Program (SEEP), which is supporting a comprehensive set of policy reforms to enhance critical skills and attitudes for the labor market and nurturing entrepreneurship and business development skills in order to generate 200,000 off-farm jobs per annum.

Loans have been disbursed to SMEs in key growth sectors of the economy including agribusiness, manufacturing, micro-finance, information and communication technology, hospitality, education, healthcare, energy and water enabling SMEs to access long term loans to expand their operations.

The informal economy remains dominant and accounted for 65 per cent of GDP in 2011 (NISR 2012). Private sector investments while growing remain low and job creation has been well below what the government targeted and what is necessary for Rwanda to become a middle-income country by 2020.

Infrastructure Development

Development of basic infrastructure is one of the key indicators of Vision 2020. It covers areas of transport, ICT based communication, cooking and lighting energy, water and sanitation. This was one of the rational ways of land use updated in terms of land development, housing and urbanization.

Connecting rural communities to economic opportunities through improved infrastructure is one of the key development investment priorities for Rwanda because infrastructure is critical for rural communities to grow.

Rural populations are becoming more connected to each other through the use of ICT devices. This success is primarily through mobile phones owned by an estimated 45 per cent of households (EICV3 survey). This contributes to increased economic interaction and also for demand-driven services such as agricultural market information and mobile banking.

Mobile money enables transfers to those in poor areas and facilitates trading.

Water supply and sanitation play a critical role in preventive healthcare and socioeconomic development in rural areas. Ready access to water reduces the time spent searching for water and may improve educational outcomes. Evidence suggests that women/girls bear more of the cost of distant water sources in Rwanda. Hygiene and sanitation is a strong complement to effective access to clean water.

According to the Rwanda Transport Development Agency (RTDA), the transportation environment is a basic economic interaction between supply and demand. A mature transportation system displays this interaction best in the area where the biggest demand exists, for example, a densely populated urban area would typically have a dense road network and public transport infrastructure to serve the demand for transportation that exists there. In a developing environment though the challenge is to use transportation interventions to have a catalytic effect in ‘creating’ a demand where, at present, it may not be to the extent that warrants investments.

Thus, to develop a vibrant private sector, Rwanda as a country is investing in roads, air, railways and also in water transport infrastructure with the intent to dramatically reduce the cost of transport for businesses and individuals.

Development of physical infrastructure like energy generation and distribution, road construction and rehabilitation and ICT has been the government’s priority to improve the business environment and reduce the cost of doing business in Rwanda (Table 4).

Insert Table 4 about here

Productive and Market-oriented Agriculture

Modern agriculture and livestock has been a priority for Rwanda since 1994. Government expenditure has been directed to agriculture supply, agribusiness, land reforms and promotion of value addition for exports. Strong emphasis has been put on implementing the pro-poor Vision 2020 umurenge program (VUP), introducing integrated development projects in all provinces and promoting non-traditional export crops.

The results of the 2016 SAS indicate that the main crops grown in 2016 Season A were banana followed by cassava, beans, sorghum and maize. In Season B, the main crops grown were banana followed by cassava, beans, sorghum and maize. Season C was different as the main crops were Irish potatoes followed by sweet potatoes, vegetables and beans.

The government policy is to diversify agriculture and encourage more mixed farming; farm animals provide food for the household, a potential source of income and organic fertilizers.

Farming by and large remains non-mechanized; farmers mainly use a simple hoe and other equipment to cultivate (EICV3). The use of improved inputs remains low, although it is being encouraged by the government with subsidies being given for inputs used for growing priority crops on consolidated land.

Rwanda has so far achieved strong, inclusive economic growth and there are signs of economic transformation, a reduction in dependency on agriculture and an increase in non-farm employment with 1.2 million new jobs being created between 2000-01 and 2010-11. Agriculture still dominates in terms of employment and contributes about 55 per cent of the export earnings and meets about 80 per cent of the country’s food needs, although there has been a small decline in its contribution to GDP in recent years.

Regional and International Economic Integration

Rwanda is now a part of regional communities like the East African Community (EAC), the Common Market for East and Southern Africa (COMESA) and the Countries of the Great Lakes (CEPGL) which has opened it to many markets and business opportunities that can be tapped by the private sector to create jobs and in fighting poverty.

Increased regional integration has expanded market potential and economies of scale. Rwanda's alertness and pro-activeness in environment mainstreaming has also provided a natural center for green growth and investments.

3.4 Cross-cutting issues

Gender Equality

Strong political commitment in Rwanda has resulted in significant positive strides in the promotion of gender equality and women's empowerment. Rwanda is currently the world leader in terms of the number of women in Parliament (64 per cent after the 2013 Parliamentary elections) although women still remain under-represented in politics at the local and sub-regional levels. Conducive policy and legal frameworks for mainstreaming gender in socioeconomic sectors are in place at all levels (including a national gender policy and gender sensitive laws such as the Gender Based Violence Law, Inheritance Law and Land Law). Pro-poor and gender friendly programs such as Girinka have been initiated and gender mainstreaming approaches such as the Gender Responsive Budgeting Initiative have been undertaken. Gender parity at five primary levels is commendable with girls' net enrolment rate of 98 per cent which is higher than for boys (95 per cent).

Environmental protection

Rwanda is already equipped with policies, strategies, action plans and financial instruments to further upscale and expand green agricultural practices that will increase both food production and protect and sustain the ecosystem services that underpin economic development. The balance between production and protection will be a delicate one, especially given the country's growing population, its landlocked location and the changing global climate among other drivers of environmental change. Resource efficient, low carbon and climate resilient agriculture is a priority for Rwanda and is reflected in different reports.

Rwanda aims to introduce and implement green farming practices and innovation for sustainable agricultural pathways with the twin goals of productivity and ecosystem protection.

Information and communication technology

The Government of Rwanda prioritized ICT as an enabler of its socioeconomic development through the new five-year (2013-17) national strategy on ICT development called 'Smart Rwanda.' ICT development is private sector led though the government can facilitate its

growth in rural areas by putting in the basic infrastructure such as internet connectivity. Market information systems for farmers covering trade and price information can improve the efficiency of the market.

Recognizing ICT's potential in transforming how government services to citizen and business can be improved and the efficiency and effectiveness that the government is gaining by using ICT efforts to digitize public service delivery were accelerated in 2015 through Irembo by the Rwanda Online Platform Limited. Irembo is envisioned to become the government's one-stop-shop for all services for citizens and businesses. Its objective is to achieve a fully cashless and digital society with at least 95 per cent of all transactions being done electronically by 2017. To date, 30 services are on the platform while more than 100 have already been digitized under the respective institutional platforms.

In the business sector, in 2013 Rwanda had 2,538,651 mobile payment subscribers. Compared to 12,012 in 2012, there was a net increase of 1,098,110 new subscribers in a just a period of 12 months. As a direct effect, the volume of transactions more than doubled, reaching 57,147,777 transactions during one year alone. In the education sector, distribution of XO laptops had reached 203,763 units covering 407 schools by December 2013. Digital content was also used in these schools, allowing primary school students to access courses in a digital format thus improving the quality of education and their learning experience.

In Africa, Rwanda remains the country with the largest deployment of laptops under the One Laptop per Child Initiative (OLPC). In 2016, in partnership with different companies the government launched a laptop purchase program for students in university on a loan scheme to facilitate ICT-based learning and for accelerating the penetration of smart devices and increasing country-wide broad band penetration. These laptops are locally manufactured in Rwanda by Positive BGH.

In the health sector, the use of ICT for the delivery of health services across the country by connecting internet to health facilities has reached 93.8 per cent. This continued development brings health information systems and medical record systems closer to health facilities and helps in providing better and timely reporting. In partnership with the California-based robotics company, Zipline Inc. the government launched the world's first national drone health delivery service across the country to increase the efficiency of transporting blood to 21 transfusion facilities located in the western part of the country.

As a supplement to traditional patterns of healthcare delivery, telemedicine and e-diagnosis have improved the way medical professionals share medical expertise. Numerous benefits have resulted from the use of telemedicine and e-diagnosis, ranging from the creation of a network of specialists; improving access to specialists; and improving the quality of diagnostics and treatment.

In the agriculture sector, the utilization of the flagship e-soko system has been on the increase, empowering more farmers with timely market price information for crops. e-soko has supported more than 11,000 farmers to make informed market pricing decisions.

In 2013 the government continued to be a large consumer of ICT for service delivery to citizens. One key highlight of 2013 was the completion of the telepresence/videoconference

network currently deployed in all districts, provinces and ministries. The use of this technology has dramatically reduced the number of trips by local leaders to other cities. This has translated into several gains such as reduction in fuel expenses, time saving, environmental carbon footprint reductions and most importantly additional time to serve citizens better.

4. Challenges in the implementation of Vision 2020

A range of challenges were confronted in the medium and long term development aspirations but were balanced by exploitable opportunities: poverty and inequalities are high; land, a basic resource for many people's rural livelihood and for new productive activity is being pressured by increasing population density and demographic trends; and the growing share of the youth in the population requires 200,000 jobs to be created each year. The labor force is characterized by low skills and productivity; the private sector is constrained by its small scale and lack of suitable infrastructure; and delivery of development faces horizontal (across sectors) and vertical coordination (center to district to community) challenges (Table 5).

Insert Table 5 about here

5. Policy recommendations

The Government of Rwanda should invest more in building the capacity of its citizens. If all Rwandans have the knowledge to understand the available opportunities and challenges they can get out of poverty. Rwanda is surrounded by countries which are rich in mineral resources and are bigger in size so the only way that Rwanda can survive is by building capacity and becoming an industrialized place for their materials.

The Rwandan government should distribute service centers, NGOs and other big projects that are right now allocated to Kigali to other areas that are under-developed so as to help people get jobs.

To deal with high population density, the government should put more effort in sensitizing Rwandans on the advantages of family planning.

The government should invest in establishing industries and encourage other international industries to invest in Rwanda; this will enhance exports and the accessibility of jobs to nationals.

It should aggressively promote and prioritize the 'Made in Rwanda' program.

Develop a comprehensive plan to exploit key emerging sectors of mining, finance, biomedical and pharmaceutical industries, textile and garments etc.

Mobilize innovative financing (the export growth fund, agriculture financing, low cost housing and BPO industry and implement the Capital Market Master Plan).

On good governance, local levels should have programs on a specified day in a week to reach out to citizens to solve their complaints; the government must strengthen awareness campaigns on the usage of online services.

On corruption at the lower levels, the government through the Ombudsman office must implement punitive measures for culprits (including seizing their property) and protect whistle blowers.

In the agricultural sector, Rwanda has less land and the only way to make it productive is to modernize it by improving seeds, scaling-up small and large scale irrigation and improving management models. There is a need to finalize the agriculture decentralization model to ensure efficiency and plan for increased productivity of irrigation sites and inputs (fertilizer and seed distribution) and construction of dam sheets that can keep rain water that can be used at the time of a drought.

In the services sector growth in hotel and restaurant services in Rwanda is disappointing at below 5 per cent. The government should put more effort in establishing technical institutes in every district that can develop and train people on how to give satisfactory services. There is a need to develop a joint plan (public and private) to improve the quality of services in priority sectors like hotels, restaurants, banking, telecommunications and transport.

On energy the government must ensure that all the people are living in planned settlements such that they can have access to electricity:

- Need strong strategies for those who can/ cannot afford off-grid services by working with the private sector.
- Need a strong program for cooking energy – scattered efforts have not yielded significant results especially in rural areas.
- Develop a long term strategy for large scale organized settlements.

On education the Ministry of Education should ensure that teaching programs match employers' demands. There is a need to strengthen reforms in education at all levels with a focus on the quality of education.

On health the Ministry of Health should make sure that health facilities are accredited, audits and peer reviews for enforcing hygiene and service delivery standards are done, IFMIS for health facilities is implemented to improve financial management, early identification and management of malnutrition cases is strengthened, fortified blended food distribution for malaria should distribute bed nets, spraying and there should be community sensitization on hygiene.

6. Conclusion

Despite many challenges, Rwanda has made remarkable progress since 2000 in improving peace and security and also in designing and implementing sound policies in line with her vision of transforming into a middle-income economy by 2020. According to the World Bank (2015) Doing Business Report, in global competitiveness Rwanda was among the

leading economies in Africa in policy and structural reforms. This was a result of the government's efforts towards promoting a transparent and accountable governance system. The Rwandan leadership's efficiency and effectiveness was also captured by the 2015 report of the World Economic Forum which produces an annual overall global ranking; Rwanda was at the 7th position for the most efficient government globally (GCI, 2015). More than 1,704,000 million off-farm jobs were created closing the poverty gap to less than 16 per cent in the country and increasing life expectancy from 49 years in 2000 to 66 years in 2016. The literacy rate moved from 48 per cent in 2000 to 72 per cent in 2016. The proportion of the population that now had electricity was 30 per cent compared to 2 per cent in 2000. The population of Rwanda was 8,300,000 million in 2000. It is now 11,809,295 million. This population increase is because of peace and improvements in social and health spheres. Based on the current outcome indicators and with three years still left Rwanda will achieve its Vision 2020 targets.

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Table 1: Linking EDPRS 2's objectives with Vision 2020's targets

EDPRS 2 objectives	Vision 2020 targets
Rapid economic growth to middle-income status	*GDP per capita of \$1240 *Avg. GDP growth of 11.5%
Increased poverty reduction	*Poverty reduced to 20% *Extreme poverty eliminated
More off-farm jobs, more urbanization	*1.8 million new off-farm jobs *35% of the population urban
Reduced external dependency	*Exports growth of 28% p.a.
Private sector as the engine of growth	*Private sector takes dominant share of investment

Source: EDPRS 2.

Table 2: Linking EDPRS 2's objectives with Vision 2020's achievements

EDPRS 2 objectives	Vision 2020 achievements
Rapid economic growth to middle-income status	*GDP per capita of \$ 689.69 *Avg. GDP growth of 6.10%
Increased poverty reduction	*Poverty reduced to 20% *Extreme poverty reduced to less than 16%
More off-farm jobs, more urbanization	*1,704,000 million new off-farm jobs *17.3% of the population urban
Reduced external dependency	*Exports growth of 15% p.a.
Private sector as the engine of growth	*Private sector takes dominant share of investment where 10% in 2010 changed to 13% 2016

Source: National Budget (2015-16).

Table 3: Indicators by 2012

Indicator	Status in 2000	Current status	Original target	7YGP target	Average LMIC	Proposed new Target
Women representation in decision making organs (%)	None	30	40	None	40	40
Citizens' satisfaction with service-delivery (%)	None	66	None	80	None	80
Rank in world corruption	None	49 th	None	<10 th	None	10 th
Index on Rule of Law (%)	None	67.7	None	None	None	80

Source: Vision 2020's revised report (2012).

Table 4: Key statistics on Rwandan infrastructure

Infrastructure area	Status
Road Transport	The National Paved Road Network is currently 1,210 km. The target is to pave around 500 km more in the coming years (up to 2018). It started with Kivu Belt project (158 km of new tarmac road). Great care is taken in the maintenance of the paved national road network with currently 86% of the roads in good condition with a target of 95% in 2017-18.
Air Transport	The Kigali International Airport terminal has recently been upgraded. The Kamembe Airport (Rusizi) runway was resurfaced in the 2014-15 fiscal year. The New Bugesera International Airport project is progressing with expropriation completed. Rwandair is growing and expanding with a larger fleet of aircraft; an increased target of 20% more passengers for the next 12 months and opening of new destinations.
Regional Projects	Rwanda is currently part of the Railway Line Projects of Dar-es-Salaam - Isaka - Kigali and Mombasa - Nairobi - Kampala - Kigali.
Energy Sector	Increase in electricity connections: From 6% in 2008 to 22% August 2014 Steady increase in generation: 119.6MW in August 2014 Electricity Generation: 59% Hydro, 40% Thermal, 1% Methane. Regional Interconnections: Developing Uganda - Kenya - Ethiopia lines. Biomass Consumption: Reduced from 99% in 2000 to 85% in 2013. Resource Potential: 400 MW Hydro: 84% still available, 350 MW Methane: 79% still available. 700 MW Peat: 89% still available, 4.5 kWh per m ² - solar for 5 hours per day Average tariffs: \$0.22c/kWh for industry, \$0.21c for other consumers
The Water and Sanitation Sector	Due to its success in water and sanitation, Rwanda is being used as a case study for all of Africa. Abundant supply of lakes and high altitude water. Access to clean water: 75.2% in June 2014 Sanitation coverage: Around 75% by C.O.B 2014
Housing and Urbanization	For the first time since Rwanda's independence, the urbanization and rural settlement sector is part of the country's political and strategic environment with its importance to the built environment and rapid change being acknowledged. Urbanization in both urban and rural areas is accelerating. Housing and Urban Planning Targets - 2012 to 2020: Main targets: (i) Increase urban population from the current low of 14.8% to 35%, (ii) The sector is in tandem with achieving other infrastructure targets. Urbanization is related to macro targets: • Increasing off-farm jobs from 1.4m to 3.2m • Reducing the agricultural population from 71.6% to 50% • Increasing access to financial services from 47% to 90%

Information and Communication Technology	During 2015, the ICT sector continued to be a major driver of Rwanda's economic growth. The sector recorded an average growth of 16% ahead of the rest of the economy which grew at 6.9%.

Source: Ministry of infrastructure (2014).

Table: 5 Vision 2020's key outcome indicators and challenges

Outcome indicator (area)	Challenges
Governance	➤ Poor quality of services in public and private sectors (attitudes, speed, etc.) ➤ Problem solving at the local level ➤ Sophisticated corruption mechanisms
Economic Growth Trends	
Agriculture	• In agriculture; productivity, use of fertilizers and improved seeds, quality of livestock and plant disease control have not improved enough to grow agriculture output at the targeted rate of 8.5%.
Industry	• In industry manufacturing remained stagnant while growth in mining was affected by a decrease in international prices and regulations.
Service	• In services growth in hotel and restaurant services was disappointing at below 5% reflecting challenges in the quality of services and low spending per tourist. Trade growth was consistently high though short of targets.
Savings and Investments	Low level of long term saving deposits for investments. High cost of financing.
Energy sector	• Poor quality of network resulting in power interruptions and grid losses • Incurring capacity charges for unused electricity and low utilization of available energy • Scattered settlements /households are settled far away from the grid • Limited accessibility to off-grid solutions (estimated 3%) • Low awareness about affordable cooking technologies e.g., LPG and modern cooking stoves
Job creation and ICT	• Poor quality of graduates – mismatch with labor market demands • Access to finance; start-up capital, start-up toolkits • Low survival rate of SMEs (50% not surviving beyond first year); poor follow up services, low managements skills, etc. • Low computer and digital literacy among citizens (8%) Last mile connection for public facilities yet to be realized

Urbanization	➤ Under-developed economic potentials of secondary cities – pull factors still lacking (jobs, services) ➤ High costs of housing especially in Kigali city ➤ Adherence to master plans and land use plans – one-stop-centers not fully operational
Education Sector	➤ Low quality of education at all levels: ▪ Dropout rates still very high (Primary 5.7%; Lower Secondary 6.5%, Upper Secondary 4.6% (2015 data) ➤ Low completion rate for primary levels (at 60.4% in 2015) ➤ Weak inspection functions
Health Sector	➤ Insufficient specialized services, low quality of health services, mismanagement in hospitals ➤ Chronic malnutrition – poor feeding practices ➤ Recurrence of malaria ➤ Delayed health infrastructure projects: Nyabikenke, Munini, Byumba hospitals, etc. ➤ Financial sustainability of the CBHI scheme

Source: MINICOFIN (2015-16).

APPENDIX A

Status summary of Vision 2020's attainments

Indicators	Status in 2000	Target in 2010	Target 2020	International standard	Current status
Rwandan population	8,300,000	11,000,000	14,000,000		11,809,295 (Source: National Institute of Statistics (NISR), 2017)
Literacy level	48	80	100		77% (RDB)
Life expectancy (years)	49	50	55		66.6 (Source: NISR, 2017) Life expectancy at birth to increase by 3.5 years in 2020
Women fertility rate	6.5	5.5	4.5		4.2 (DHS 2014-15)
Infant mortality rate (0/00)	107	80	50		32 deaths per 1,000 live births (DHS 2014-15)
Maternal mortality rate (0/00.000)	1070	600	200		210/100,000 (DHS 2014-15)
Child Malnutrition (weight insufficiency in %)	30	20	10		
Population growth rate (%)	2.9	2.3	2.2		
Net primary school enrolments (%)	72	100	100	100	
Growth in secondary school enrolments (%)		100	100		
Primary to Secondary school transitional rate (%)	42	60	80		
Growth in secondary school enrolments (%)	7	40	60		
Qualifications of teachers (%)	20	100	100	100	
Professional and technical training centers		50	106		
The rate of admission in tertiary education (0/00)	1	4	6		
Gender equality in tertiary education (F %)	30	40	50	50	
Gender equality in decision-making positions (% of females)	10	30	40		
HIV/AIDS prevalence rate (%)	13	11	8	0	3% (DHS 2014-15)
Malaria-related mortality (%)	51	30	25		
Doctors per 100,000 inhabitants	1.5	5	10	10	1/15,428 inhabitants (Source: Demographic &

					Health Survey 2014-15)
Population in a good hygienic condition (%)	20	40	60		
Nurses per 100,000 inhabitants	16	18	20	20	1/1,200 inhabitants (Source: DHS 2014-15)
Laboratory technicians per 100,000 inhabitants	2	4	5		
Poverty (%< 1 US \$/day)	64	40	30		
Average GDP growth rate (%)	6.2	8	8		
Growth rate of the agricultural sector (%)	9	8	6		
Growth rate of the industry sector (%)	7	9	12		
Growth rate of the services sector (%)	7	9	11		
Gini coefficient (income disparity)	0.454	0.400	0.350		
Growth in national savings (% of GDP)	1	4	6		
Growth in national investments (% of GDP)	18	23	30	30	
GDP per capita in US\$	220	400	900		
Urban population (%)	10	20	30		
Agricultural population (%)	90	75	50		
Modernized agricultural land (%)	3	20	50		
Use of fertilizers (kg/ha/year)	0.5	8	15		
Financial credit to the agricultural sector (%)	1	15	20		
Access to clear water (%)	52	80	100	100	
Agricultural production (kcal/day/person (% needs)	1,612	2,000	2,200		
Availability of proteins/person/day (% of needs)	35	55	65	70	
Road network (km/km2)	0.54	0.56	0.60		
Annual electricity consumption (KhW/inhabitants)	30	60	100		
Access to electric energy (% of population)	2	25	35		
Land portion against soil erosion (%)	20	75	90		
Level of reforestation (ha)					
Wood energy in national energy consumption (%)	94	60	50		
Non-agricultural jobs	200.000	500.000	1.400.000		

Source: Compiled by the authors.

Part Four. Poverty and Wellbeing

Chapter 8. Almas Heshmati and Masoomeh Rashidghalam, “Poverty in Rwanda”.

Chapter 9. Almas Heshmati, Masoomeh Rashidghalam and Pia Nilsson, “Measurement and analysis of multidimensional well-being in Rwanda”.

Chapter Eight

Measurement and Analysis of Poverty in Rwanda

Almas Heshmati¹ and Masoomeh Rashidghalam²

¹ Corresponding Author,
Department of Economics,
Sogang University, Seoul, Korea,
E-mail: heshmati@sogang.ac.kr

² Department of Agricultural Economics,
University of Tabriz, Tabriz, Iran,
E-mail: maso.azar@gmail.com

Abstract

This study examines the extent of poverty in different provinces and districts in Rwanda using both consumption and income per capita. It also looks at the determinants of household poverty and focuses on four categories for studying the determinants of poverty in the country. The income based study of poverty is based on information from the household survey and uses 14,810 observations in 2006, 2009 and 2012, while the consumption based poverty analysis is based on 7498 observations from 2012 database. The results is found to be very sensitive to the definition of poverty line and use of income or consumption in analysis of poverty. This study shows that older household heads and female-headed households are more likely to be poor. Also living in rural and semi-urban areas increases the probability of being poor. Asset ownership (having a garden, cash crops, banana trees) decreases the probability of being poor. The findings of this study serve as evidence for policymakers to employ poverty alleviation policies. Increasing investments in physical infrastructure, creating jobs for female-headed households and improving educational levels of household heads should also be focused on.

Keywords: Headcount poverty, poverty gap, poverty severity, Rwanda.

JEL Classification Codes: C25; D69; O40; O55.

1. Introduction

Poverty is a global concern. Like inequality, the burden of poverty is unfairly spread among the regions of the developing world. In Africa poverty is severe and various reports have indicated that poverty increased significantly during the 1980s and 1990s and led to the 'Africanization of global poverty' (White and Kellick, 2001).

Most countries in sub-Saharan Africa (SSA) with very low saving rates and per capita gross domestic product (GDP) are in urgent need of substantial public investments through external assistance to reverse the current increasing poverty trends. A report published by the Economic and Social Research and Training Center for Islamic Countries (2007) points out that on average, sub-Saharan Africa's 726 million (45 per cent) people lived under the international poverty line (US \$1 a day). The highest level of inter-regional poverty is in SSA, where close to 50 per cent of the population is classified as poor. After SSA the next poorest region is South Asia in terms of poverty headcount indices (about 30 per cent of the region's population in 2000).

The facts are worse in Rwanda. The country is one of the poorest in the world. According to data retrieved from the World Bank's Development Indicators (WDI), Rwanda is one of the poorest countries in Africa. Rwanda is a landlocked, resource-poor country that is ranked 15 out of the 25 poorest countries in Africa with a GDP per capita of US\$ 689 in 2016. It was also ranked 167 out of 182 countries in the 2009 United Nations Development Program's (UNDP) Human Development Index (HDI) (Rashidghalam, 2017).

The most recent survey data available for estimating the multidimensional index (MDI) for Rwanda indicated that 69 per cent of its population lived in multidimensional poverty and about 19.4 per cent were vulnerable to multiple deprivations. On the other hand, the intensity of deprivation was 50.8 per cent. The country's MPI value, which is the share of the population that is multidimensionally poor adjusted by the intensity of the deprivations, was 0.35 (HDR, 2013). Therefore, as in many other developing countries even in Rwanda there is an urgent need to address the issue of poverty and to incorporate poverty reduction policies into development strategies. However, the most important question is: How is the government going to achieve this goal?

This question cannot be adequately addressed unless we have information on the level of relative and absolute poverty and characteristics of the poor and how these characteristics determine poverty in the country. With this background, studying these issues in terms of finding the causes and analyzing the ways of alleviating them is very important. This can be done at a micro-level on some groups of society or by concentrating on a particular area, or it can be studied at the macro level. The aim of our paper is: (i) to measure the level of relative and absolute poverty in Rwanda and to analyze the poverty gap and poverty severity in the country, (ii) to compare provinces and districts with regard to different poverty indices, (iii) to single out the major determinants of poverty on households, and (iv) to suggest suitable policy measures to alleviate poverty in the country.

The issue of poverty has been an important target of researchers in development literature and various studies point out the level of poverty and its determinants. Assefa (2003) found that female headship did not have a significant direct impact on poverty levels of households

in urban Ethiopia. On the other hand, household size, educational attainment of the head and the settlement location of the household were key determinants of poverty in this region. He suggests that gender-sensitive poverty alleviation policies that enhance endowments (such as those that increase education levels, employment and ability to control fertility) should be the key ingredients of poverty reduction strategies.

Fistum (2002) compares poverty indices between female- and male-headed households in Addis Ababa. He identifies the determinates of welfare and poverty in households. The results of his study indicate that female-headship had a positive influence on the welfare of the households. He concludes that educational attainment of the household head and number of children in the household are important determinants of poverty. Joo (2011) examined the changes in anti-inequality and anti-poverty effects of children's programs between 1995 and 2007 and suggests that although the poverty reduction effects of the federal child programs increased during this period, the programs' effects on reduction of children's relative and absolute poverty gaps decreased. Also, the anti-poverty effects of the federal child programs were weak for children in immigrant, female-headed and non-working families.

Asadullah and Chaudhury (2012) studied subjective well-being and relative poverty in rural Bangladesh. They show that households reported higher satisfaction levels when they experienced an increase in their incomes over the past years. Also, households which had incomes lower than their neighbors in the village showed less satisfaction with life. Similarly, individuals reported less satisfaction with life in villages with higher levels of inequality. According to their results, when compared to the effects of absolute income, relative income and local inequality are modest. Vaaltein and Schiller (2014) addressed multidimensional child poverty in the Eastern Cape of South Africa. They suggest that monetary support through the child support grant (CSG) should be increased to better accommodate the multidimensional child poverty needs of CSG recipients.

Rashidghalam (2017) studied poverty and its determinants in different provinces and districts of Rwanda in 2012. She concluded that a household's residence in the rural area and distance to market increased the probability of its being poor. She also found that female-headed households were poorer than male-headed ones. Her results show that literate household heads and ownership of property and assets reduced the probability of falling into poverty. Ucal (2014), Menon et al., (2015), Dzanku et al., (2015) and Grobler (2016) have also analyzed this important issue. Therefore, our study could be relevant to better emphasize and address the issue of poverty. It could contribute in filling the gaps in literature that have been left untouched by previous studies. Hence, unlike previous studies our study's scope has been extended to different areas and provinces in Rwanda and the models that we employ look into the determinants of different aspects of poverty.

2. Methodology

A poverty analysis involves a number of steps. The first step and starting point is establishing the poverty line, which is a tool to separate the poor from the non-poor. Absolute versus relative poverty lines can be set in relative or absolute terms. A relative poverty line is related to the general standard of living in a society (explained by median or mean income or

consumption). The relative poverty line is not fixed over time, therefore it changes as the standard of living of society decreases or increases (for example, change in the distribution of income will reduce the number of people in relative poverty). On the other hand, absolute poverty refers to the position of a family or an individual in relation to a fixed poverty line (Ravallion, 1992). The absolute poverty line is fixed over time and in different locations. Adjustments for inflation can be used to change the level of absolute poverty over time. An absolute poverty line has elasticity of zero with respect to changes in society's living standards. Economic growth of a society results in a reduction in the number of people in absolute poverty. A distinction between relative and absolute poverty lines is important in legislation and in poverty reduction policies. Relative poverty lines are mostly applicable in developed countries while absolute poverty lines are commonly used in developing countries (Assefa, 2003).

The second step in a poverty analysis is constructing poverty measures based on poverty lines including the headcount index, the poverty gap index and poverty severity. In literature, absolute and relative poverty lines are treated as constant across provinces, districts, household characteristics and over time. This is a very strong assumption as in reality prices and living costs develop differently across these dimensions.

2.1 Headcount Index

The headcount index (P_H) measures the proportion of the population with incomes less than the poverty line, regardless of its absolute or relative measurement; these people are considered as poor. P_H is denoted by:

$$(1) \quad P_H = N_P / N$$

where, N is the total population and N_P is the number of poor. Equation 1 can be rewritten as:

$$(2) \quad P_H = 1 / N \sum_{i=1}^N I(C_i < z)$$

where, (z) is the poverty line and (C_i) is income or consumption expenditure. If the bracketed expression is true, the index $I(.)$ takes the value of one and zero otherwise. If expenditure is less than the poverty line, then $I(.)$ equals one and the household is counted as poor. Headcount index has three weaknesses: (i) it does not take the intensity of poverty into account, (ii) it does not indicate how poor the poor persons are and hence does not change if people below the poverty line become poorer, and (iii) poverty estimates should be calculated for individuals and not households. On the other hand, the advantage of the headcount index is that as a frequency measure it is simple to construct and easy to understand.

2.2 Poverty gap Index

The other index which is used for measuring poverty is the poverty gap index (P_G). This index measures the extent to which households on average fall under the poverty line. This

index does not indicate the inequality changes among the poor. Poverty gap (G_i) is defined as:

$$(3) \quad G_i = (z - y_i)I(C_i < z).$$

For the poor, poverty gap equals poverty line less actual income or consumption and for the non-poor above the poverty line it is considered to be zero. The sum of these aggregate gaps is used for measuring the cost of eliminating poverty in a society. Using the index function, the poverty gap index (P_G) is written as:

$$(4) \quad P_G = 1 / N \sum_{i=1}^N G_i / z .$$

2.3 Poverty severity index

Headcount and poverty gap indices do not take into account the inequalities among the poor. Hence, some researchers have used the squared poverty gap index to measure the severity of poverty. Poverty severity (P_s) is a weighted sum of poverty gaps. This takes into account not only the distance separating the poor from the poverty line (measuring the poverty gap), but also the inequalities among the poor. That is, a higher weight is placed on those households which are further away from the poverty line (see Rashidghalam, 2017). The index is written as:

$$(5) \quad P_G = 1 / N \sum_{i=1}^N (G_i / z)^2 .$$

This measure may be thought of as one of a family of measures proposed by Foster, Greer and Thorbecke (1984), which may be written, quite generally, as:

$$(6) \quad P_\alpha = 1 / N \sum_{i=1}^N (G_i / z)^\alpha, \quad (\alpha \geq 0)$$

where, α is a parameter; when α is larger the index puts more weight on the position of the poorest (WBI, 2005).

2.4 Determinants of poverty

Measuring the incidence of poverty, its intensity and severity are important in themselves. However, poverty's causal factors are equally important as a means of its alleviation. An econometric analysis is useful in identifying the factors that influence the extent of poverty. We used the Probit and Tobit models and standard regression analysis for this.

A. Probit model of incidence of poverty

A Probit model is used to measure the incidence of poverty. In other words, it is adopted to model factors that determine the probability of a household being poor or non-poor. Therefore, the dependent variable is binary, indicating whether a household is poor (1) or not poor (0) relative to the poverty line. The binary Probit model is expressed as:

$$(7) \quad Y_i^* = X_{ij}'\beta_j + \varepsilon_i, \quad (i=1,2, \dots, n)$$

where, Y^* is the underlying response variable in which Y_i equal one if the household is poor and zero otherwise. X is a vector of household characteristics serving as explanatory variables determining the households' state of poverty, β is a vector of unknown parameters to be estimated and ε_i is the residual.

B. Tobit models of poverty gap and poverty severity

We used a generalized Tobit model to analyze jointly the incidence of poverty and poverty gap and poverty severity. It allowed us to estimate the effects of the determinants of poverty gap and poverty severity. In a Tobit model, the dependent (response) variable is not a binary variable and has a limited range. In other words, the response variable of non-poor is excluded. If the sample in this model is a sub-set of a whole population and only households which are below the poverty line are included, then the model is estimated using the ordinary least squares method accounting for sample selection by including the Mills Ratio from the first step Probit model. We analyzed household factors that influence poverty gap and poverty severity through a generalized Tobit regression analysis that accounts for sample selection. Negative coefficients in the model indicate that their variables inversely affected the poverty gap and poverty severity and the coefficient of the variables with a positive sign had a direct positive effect on poverty gap and poverty severity (see Gebru, 2010).

3. Data

We obtained the data for our research from three household surveys in Rwanda. Both incomes and consumption per capita are used in analysis of poverty. The income based data for the household surveys covered 14,810 household observations. There were 2,711, 5,351 and 6,748 observations in 2006, 2009 and 2012 respectively. The consumption data based poverty analysis is based on CFSVA 2012 household data with 7,498 observations. The two datasets do not match. The dataset includes urban, semi-urban and rural areas which in turn form the Southern, Western, Northern and Eastern provinces. Each province is further divided into a number of districts. Nyanza, Gisagara, Nyaruguru, Ruhango, Muhanga and Kamonyi districts are in the Southern province. The Western province includes Karongi, Rutsiro, Rubavu, Nyabihu, Ngororero, Rusizi and Nyamasheke districts and Rulindo, Gakenke, Musanze, Burera and Gicumbi districts are in the Northern province. The Eastern province includes Rwamagana, Nyagatare, Gatsibo, Kayanza, Kirehe and Ngoma districts.

Table 1.A presents the summary statistics of the income based variables used in our study, while Table 1.B shows the consumption based variables. This table can be divided into four broad parts. Income and livelihood variables are described in the first part (Part A). This part shows that about 6 and 26 per cent of the households were producers of cash crops and had access to credit respectively. The second part (Part B) describes the demographics and education variables. This part includes age of household head, household size, marital status of the head, gender of the head, literacy of the head, population density and population

growth; 59 per cent of the household heads were married. Table 1.A also shows that 23 per cent of the households were women-headed. Part C includes the location of the household. We included the location category to know the importance of region of residence in the poverty status of a household. This part of the table also covers area, distance to a road and distance to the market. In Rwanda a majority of the households (about 87 per cent) are in rural areas and only 4 and 8 per cent of them are located in urban and semi-urban areas respectively. We included these characteristics to study the effect of household assets and migration on the poverty status of households. Part D of Table 1.A includes five variables - number of income generating activities, having access to a farmland, vegetable garden, number of animals, crops and banana trees. According to the survey, about 93 and 56 per cent of the households had access to farmland and a vegetable garden respectively.

Insert Table 1.A and Table 1.B about here

4. Results and Analysis

An estimation of the poverty line facilitates identification of the poor from the non-poor. Different poverty measurements for Rwanda are presented in Table 2. According to this table the per capita relative poverty line based on income equaled 2,342 and based on this poverty line the relative headcount index was about 29 per cent. This value indicates that at least 29 per cent of the households in Rwanda were unable to meet the minimum income levels. Poverty gap, which is the average distance of a household from the poverty line, was found to be 340. The poverty gap square shows that the severity of poverty was 532,078. Coming to absolute poverty, the share of individuals whose incomes were below the absolute poverty line was 89 per cent, which is 60 per cent greater than the proportion of people who were living under the relative poverty line. Based on the absolute measure of poverty, absolute poverty gap (P_{G2}) and poverty severity (P_{S2}) were 15,698 and 300,487,390 respectively (all the figures are in Rwandan francs measured in per capita household).

Consumption poverty analysis show that when using relative poverty line based on 50 per cent of median consumption, on the average 26 per cent are classified as poor. The share increases to 53 per cent if one uses mean consumption. This suggests a skewed distribution of consumption despite 1% extreme high consumptions were censored at the 99 per cent. When using absolute poverty line of \$1.25 converted to Rwf and on a monthly basis, consumption poverty headcount is much higher 89 per cent. This is despite the shameless poverty line of \$1.25 per household capita and day.

Insert Table 2 about here

Table 3.A compares the extent of poverty indices across different districts, provinces and regions. Part A of this table includes different districts and gives the following information: First, Nyagatare district had the largest amount of mean per capita income (56,009), therefore the least value of absolute headcount poverty ratio (0.84) and the relative headcount poverty ratio (0.25). Second, the highest value of the relative headcount poverty ratio was in Kamonyi and Gakenke districts while Nyaruguru had the highest absolute

headcount poverty ratio. Therefore, these districts are considered the poorest districts in Rwanda.

Part B of Table 3.A provides the same information for Rwanda's different provinces. Due to lack of information for Kigali, we exclude this province from our study. The Southern province had the lowest total income; it also had the lowest relative poverty line. On the other hand, the maximum relative headcount poverty ratio, poverty gap and poverty severity were in this province.

The households were divided into three groups by region -- urban, semi-urban and rural. Based on Part C of Table 3, headcount poverty ratio in the semi-urban areas was 32 per cent, which is 9 per cent more than urban areas (23 per cent). The rural areas fell in between. On the other hand, the absolute poverty headcount ratio in rural Rwanda was the highest (0.90), indicating that 90 per cent of Rwanda's households in the rural areas were in absolute poverty. Poverty gap and poverty severity were the highest in semi-urban areas.

According to Part D of Table 3.A which compares different poverty indices in different years of the study, in 2012 almost one-third of the population of Rwanda was in relative poverty and about 88 per cent was in absolute poverty. At the all-Rwanda level the relative poverty gap declined from 375 in 2006 to 273 in 2009 and then increased to 375 in 2012. Accordingly, poverty severity decreased from 635,436 in 2006 to 431,684 in 2009 and then increased to 570,185 in 2012. Again all the figures are per capita and in Rwandan francs.

Insert Table 3.A about here

Measure of consumption based poverty and their variations across districts, provinces and urban-rural areas is presented in Table 3.B. It shows, despite use of relative poverty line, evidence of large variations in poverty rate, its gap and severity by location suggesting high degree of inequality related to fertility of land, development infrastructures, etc. The gaps are bigger when considering application of unified absolute poverty line to the entire country. Figure 1.A and Figure 1.B show the per capita consumption expenditures levels across districts, provinces and areas in 2012.

Insert Table 3.B about here

Insert Figure 1.A and 1.B about here

A multivariate econometric analysis can be used for identifying the determinants of poverty. Hence the second part of our results are adapted to identify the determinants of poverty incidence, poverty gap and poverty severity in Rwanda. For this we used the Probit and Tobit models. Before the estimation, we followed the dependent and explanatory exploration process. We provide a simple correlation coefficient matrix to test whether multicollinearity and the risk of confounded effects exist between variables. The results are presented in Table 4.A. Correlation matrix in Table 4.B shows that mean and median consumption per capita are low correlated (0.562). The incidence of poverty is highly correlated with poverty gap (0.830) and severity (0.523) in case of relative consumption poverty, and they are also highly correlated (0.749 and 0.597) when using absolute poverty line. Figure 2.A and Figure 2.B show the incidence of poverty in consumption expenditures across districts, provinces and areas in 2012. Different absolute and relative poverty lines are used. The gaps in

consumption poverty using absolute and relative poverty lines are shown in Figure 3.A and 3.B.

Insert Table 4.A and 4.B about here

Insert Figure 2.A and 2.B about here

Insert Figure 3.A and 3.B about here

Gujarati (1995) has a rule of thumb, that says that there is a serious multicollinearity problem if the correlation coefficient is 0.8 or above. In general, econometrics literature uses 0.5 as the threshold for the multicollinearity problem between explanatory variables. As Table 4.A and 4.B shows we did not find a problem since the correlation between the dependent and explanatory variables was less than 0.1. These results indicate that each variable in different models can capture a distinct feature of poverty.

We estimated six models. Models 1 and 2 are Probit models of the determinants of incidence of poverty using income data where poverty is defined based on relative and absolute poverty lines respectively. Income is defined as total real monthly income per capita with equal weights for household members. The relative poverty line is defined as 50 per cent of median income which varies by district. The absolute poverty line is defined as monthly income expressed in Rwf (\$1.25/day multiplied with 30 days multiplied with Rwf 620 per dollar). Models 3 and 4 are Tobit models of the determinants of poverty gap, where poverty gap is defined as done earlier. Tobit Models 5 and 6 estimate the effects of the determinants of poverty severity and again poverty is defined based on relative and absolute poverty lines.

Table 5.A presents estimation results for the six different models on the determinants of poverty in Rwanda. The models differ in the way in which the poverty line is measured namely relative and absolute approaches. These models include two Probit models (Models 1 and 2) and four Tobit models (Models 3-6). The Probit model helps identify the determinants to explain the probability that a household is poor given normal distribution of the error term. Coefficients of variables with positive signs are positively correlated with the probability of becoming poor and coefficients with negative signs are negatively associated with the probability of becoming poor.

Insert Table 5.A about here

According to Table 5.A and in terms of region it was observed that living in urban and sub-urban areas had a positive effect on the probability of being poor, which was expected from Part C of Table 3.A. This thus confirms the results of Table 3.A. Bigsten et al., (2002) showed that in terms of regions, living standards are significantly higher for households in urban areas. On the other hand, Table 4.A shows that population growth and population density had a negative effect on the probability of being poor. The negative coefficients of community characteristics such as distance to market and distance to road variables indicate that the households which were far from the road or the market were poorer. A study done by Christiaensen and Subbarao (2001) showed that households' market accessibility decreased the vulnerability to consumption shortfalls.

In terms of households' age, Table 5.A shows that the age of the household head was inversely linked with the incidence of poverty. The negative sign of the literacy status variable shows that a household head's literacy level reduced the probability of being poor. This result was expected because education is considered as one of the key determinants of poverty and educated people can improve their chances of getting better jobs and mean incomes. Another important demographic characteristic is marital status and gender of the household head. As indicated in Table 5.A, households with married heads were among the poor households; this contradicts the general expectation. On the other hand, female headed households were poorer than male headed households in Rwanda.

The other demographic variable to be considered is household size; households with larger family sizes had a higher probability of falling into the poverty gap. As expected, having access to productive inputs such as credit decreased the probability of being poor. Also by increasing the number of income generating activities a household was less likely to be poor. Asset ownership (for example, having a garden, cash crops, banana trees) decreased the probability of being poor.

The same measures of poverty (headcount, gap and severity) computed based on total consumption per capita household data for 2012 are used to estimate their determinants. The poverty incidence models are estimated using probit model, while poverty gap and poverty severity are estimated using tobit models. The results are presented in Table 5.B. The result shows that majority of the selected determinants influence the level and gap and severity of poverty.

Insert Table 5.B about here

5. Conclusion and policy implications

Understanding poverty in Rwanda requires an understanding of its measurement. It is only with accurate measurement tools that we can understand poverty and thus how well we are doing as a society in reducing it. In this regard we used data which covered 14,810 households in 2006, 2009 and 2012. Poverty is measured based on both income and consumption. Consumption is a better measure as it is closer to the needs and suffer less from income reporting problem. We did a descriptive analysis as well as a poverty measurement using different poverty indices and a multivariate regression analyses. In addition, our study also identified some of the key determinants of poverty in Rwanda. We used Probit and Tobit models for analyzing the determinants of household poverty. We also investigated the determinants of poverty gap and poverty severity in which the dependent variable was no more binary and was continuous with limited ranges.

Use of absolute and relative poverty measure and mean of median income or consumption provide different picture of poverty and its intensity due to skewed distributions. Median is a better measure. The two measure are close once one omit the extreme outliers. Our results indicate that in 2012, almost one-third of the population in Rwanda was in relative poverty and about 88 per cent of the population of Rwanda (Kigali excluded) was in absolute poverty. On the other hand, the Southern province had the highest poverty ratio among the

provinces while the largest relative poverty ratio was in Kamonyi and Gakenke districts. The results of the Probit and Tobit models show that female-headed households were poorer and that a larger family had a higher probability of falling into poverty. Also, as expected, asset ownership decreased the probability of being poor.

Based on our empirical findings, we draw the following policy implications to decrease poverty at the household level in Rwanda. First, since a majority of the poor live in rural and semi-urban areas, there is an urgent need to increase the incomes of households in these areas to help reduce poverty. Second, providing more credit to households is an effective way of reducing poverty. Third, it is important to facilitate improved educational levels of household heads so that they can provide their families with better jobs and sources of income. Fourth, by enhancing poor physical assets, most notably vegetable gardens, the government can generate livelihood options. Fifth, creation of special economic, educational and job opportunities for female headed households will have strong implications for family welfare. Finally, increasing investments in public physical infrastructure (for example, rural roads and markets) will also be effective ways of alleviating poverty.

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Table 5.A Summary income statistics of the variables (N=14,810)

Variables	Definition	Mean	Std. Dev.	Minimum	Maximum
A. Income and livelihood					
tincome	Total income from all income generating primary activities	39774.82	60940.27	0	2544000
income	Income	12139.07	38102.69	0	2544000
mincome	Mean income	12139.07	2902.24	7153.98	19442
dincome	Median income	4683.31	922.04	3547.20	6609.26
Nrincome	Number of income generating activities undertaken by household	1.77	0.68	0	10
nrcrops	Total number of farmed crops	3.37	1.73	0	10
cashcrop	Equals 1 if the household is a producer of cash crops	0.06	0.24	0	1
credd	Access to credit (=1 if household have access to credit)	0.26	0.44	0	1
B. Demographics and education					
agehead	Age of household head	44.38	14.81	15.00	103
size	Number of people in the HH	5.26	2.15	1	18
mshead	Marital status of head, equals 1 if the head is married	0.59	0.49	0	1
dfemale	Gender of head, equals 1 if the head is female	0.23	0.42	0	1
popdens	Population density - number of inhabitants per square kilometer	634.06	762.10	1.90	13009
populg	Population growth	3.16	3.37	-5.67	25.02
lithead	Household head can read and write a simple message	0.83	0.78	0	9
C. Location					
rural	Equals 1 if the households live in a rural area	0.87	0.33	0	1
semiurb	Equals 1 if the households live in a semi-urban area	0.08	0.27	0	1
distroad	Distance to road	3760.76	3525.21	0	21924.65
distmark	Distance to market	77.22	61.95	0	1200
D. Household assets and migration					
worksend	Working elsewhere and sending home remittances	0.05	0.22	0	1
fland	Access to farmland (=1 if household has access to farmland)	0.93	0.26	0	1
vegetd	Vegetable garden (=1 if household owns a vegetable garden)	0.56	0.50	0	1
nranimal	Number of animals	2.99	5.69	0	203
bantrnr	Number of banana trees owned by the household	22.06	112.86	0	3500

Table 1.B Summary statistics of consumption data, Rwanda 2012, 7498 obs.

Variable	Mean	Std Dev	Minimum	Maximum
Head age	46.997	15.598	15.000	103.000
Head literacy	0.607	0.488	0.000	1.000
Marital status	0.687	0.464	0.000	1.000
Number of spouses or partners	1.012	0.279	0.000	5.000
Roof material	2.443	0.544	0.000	6.000
Floor material	1.277	0.729	1.000	7.000
Number of rooms	2.506	1.028	1.000	11.000
Toilet and types	2.861	0.851	1.000	6.000
Electricity improved source	0.475	0.499	0.000	1.000
Number of income activities	1.642	0.635	0.000	4.000
Farming land	0.837	0.369	0.000	1.000
Vegetables plot	0.581	0.494	0.000	1.000
Number of crops cultivated	2.550	1.372	0.000	4.000
Access to credit	0.007	0.082	0.000	1.000
Per capita income	16716.093	43768.483	0.000	1350000.000
Altitude	1725.014	288.152	955.000	2739.000
Distance to road	3565.761	3639.801	0.000	21925.000
Distance to school	24.624	23.469	0.000	150.000
Distance to market	72.157	69.202	0.000	1200.000
Household size	4.967	2.184	1.000	18.000
Sources of water	3.997	2.311	1.000	8.000
Payment for water	0.304	0.477	0.000	6.000
Head female	0.287	0.453	0.000	1.000
Food expenditure	17636.109	24673.353	0.000	144062.000
Items expenditure	31731.004	65622.570	0.000	448617.000
Total expenditure	49808.171	86103.343	83.000	579133.000
Urban	0.120	0.325	0.000	1.000
Rural	0.797	0.402	0.000	1.000
Semi-urban	0.083	0.275	0.000	1.000
Monthly food exp. per capita	3843.529	5443.219	0.000	86800.000
Monthly item exp. per capita	6629.058	15373.576	0.000	418067.000
Monthly total exp. per capita	10503.976	19431.630	48.333	475133.000

Table 2. Income and consumption based poverty measurements

Variables	Definition	Mean	Std. Dev.	Minimum	Maximum
<u>Relative Income Poverty:</u>					
Z ₁	Relative poverty line based on 50% of median	2341.65	461.02	1773.60	3304.63
P _{H1}	Headcount poverty ratio by relative poverty line	0.29	0.45	0	1.00
P _{G1}	Poverty gap by relative poverty line	339.93	645.41	0	3304.63
P _{S1}	Poverty severity by relative poverty line	532078.40	1298410.00	0	10920575.00
<u>Absolute Income Poverty:</u>					
Z ₂	Absolute poverty line based on \$1.25 per day	23250	0	23250.00	23250.00
P _{H2}	Headcount poverty ratio by absolute poverty line	0.89	0.31	0	1.00
P _{G2}	Poverty gap by relative absolute line	15697.83	7353.17	0	23250.00
P _{S2}	Poverty severity by absolute poverty line	300487390.10	177680136.60	0	540562500.00
<u>Relative Consumption Poverty:</u>					
Z ₁	Relative poverty line based on 50% of median	2387.50	0	2387.50	2387.50
Z _{1x}	Relative poverty line based on 50% of mean	5252.00	0	5252.00	5252.00
P _{H1}	Headcount poverty ratio by relative poverty line	0.26	0.44	0	1.00
P _{H1x}	Headcount poverty ratio by relative poverty line	0.53	0.50	0	1.00
P _{G1}	Poverty gap by relative poverty line	275.14	553.98	0	2339.17
P _{S1}	Poverty severity by relative poverty line	382563.92	94695.20	0	5471701.00
<u>Absolute Consumption Poverty:</u>					
Z ₂	Absolute poverty line based on \$1.25 per day	23250.00	0	23250.00	23250.00
P _{H2}	Headcount poverty ratio by relative poverty line	0.89	0.31	0	1.00
P _{G2}	Poverty gap by relative poverty line	15645.45	7168.67	0	23201.67
P _{S2}	Poverty severity by relative poverty line	296162997.71	170317427.30	0	538317336.11

Note: \$1.25 x 620 Rwf x 30 = 23250 Rwf

Table 3.A Means of income based poverty measure variables by district, province and area

	Income			Poverty line		Head count		Poverty gap		Poverty severity	
	hh size	Total income	Income per capita	Relative Pov line	Absolute Pov line	Head C Relative	Head C Absolute	Gap Relativ e	Relative Absolute	Gap2 Relative	Gap2 Absolute
<u>A. Means by district</u>											
Nyanza	5	30057	7747	1774	23250	0.28	0.92	232	16682	253040	324242197
Gisagara	5	37317	12497	2700	23250	0.27	0.91	376	15218	659070	284355789
Nyaruguru	6	25344	7154	1831	23250	0.29	0.96	273	17878	337344	352779215
Huye	5	43693	12662	2757	23250	0.30	0.87	393	14908	677878	280510641
Nyamagabe	5	35573	12239	1875	23250	0.29	0.91	330	16890	454074	333206966
Ruhango	5	40873	12511	2623	23250	0.25	0.87	323	15023	526693	282224020
Muhanga	5	31101	9952	1875	23250	0.28	0.93	262	16672	308789	325317460
Kamonyi	5	33495	9226	1800	23250	0.33	0.91	306	16463	354452	325280245
Karongi	5	42495	14365	2724	23250	0.28	0.88	360	15186	601274	283345227
Rutsiro	5	39801	11006	2248	23250	0.31	0.90	329	15763	481543	302672124
Rubavu	6	49709	11508	2932	23250	0.29	0.90	459	14726	898349	270820617
Nyabihu	5	42085	10566	2400	23250	0.27	0.92	272	16015	373677	301284185
Ngororero	5	30157	8815	1809	23250	0.31	0.92	326	16811	423886	330666518
Rusizi	6	46646	14302	2400	23250	0.26	0.89	286	15581	423564	295815926
Nyamasheke	6	38308	10401	2155	23250	0.29	0.89	303	15768	403890	302776711
Rulindo	5	31498	9466	1916	23250	0.25	0.92	249	16827	319880	327479206
Gakenke	5	30302	8668	1902	23250	0.33	0.91	330	16654	423835	329586729
Musanze	5	49056	15527	3143	23250	0.31	0.85	477	14113	921259	261239830
Burera	5	44368	13223	2315	23250	0.32	0.87	392	15175	609749	292862616
Gicumbi	5	43590	11728	2582	23250	0.30	0.88	397	15240	653969	289396758
Rwamagana	5	42464	16879	2032	23250	0.31	0.89	323	15900	431847	309269200
Nyagatare	5	56009	19442	3305	23250	0.27	0.84	431	13741	951568	250470972
Gatsibo	5	35175	11344	1916	23250	0.27	0.90	272	16213	340305	315768651
Kayanza	5	48078	14918	2884	23250	0.30	0.86	398	14461	715518	269874841
Kirehe	5	46331	14893	2918	23250	0.28	0.87	419	14434	806899	266683718
Ngoma	5	37605	15204	1938	23250	0.31	0.88	348	15922	482526	312721988
Bugesera	5	35404	9274	2000	23250	0.27	0.93	267	16492	365690	317130149
<u>B. Means by province:</u>											
Southern	5	34716	10550	2164	23250	0.28	0.91	314	16217	451348	313404070
Western	5	41417	11675	2384	23250	0.29	0.90	333	15674	513011	297820783
Northern	5	40044	11809	2395	23250	0.30	0.89	373	15556	596903	298974171
Eastern	5	43099	14469	2444	23250	0.28	0.88	351	15289	589391	291016712
<u>C. Means by area:</u>											
Urban	5	54853	17354	2370	23250	0.23	0.83	311	13899	542857	259119936
Semi-urban	5	40937	14600	2474	23250	0.32	0.89	402	15785	647803	303045054
Rural	5	38843	11628	2328	23250	0.29	0.90	336	15788	520869	302517432
<u>D. Means by year:</u>											

2006	5	40829	13794	2416	23250	0.30	0.87	375	15358	635436	2.9E+08
2009	6	40111	8482	2326	23250	0.23	0.93	273	15654	431687	2.9E+08
2012	5	39084	14375	2324	23250	0.33	0.88	378	15869	570185	3.1E+08

Table 3.B. Mean consumption variables by province, district and urban areas, 2012 data, 7498 obs.

	Food exp	Item exp	Total exp	poor1	poor1 x	poor2	pgap1	pgap2	pgap1s	pgap2s
District:										
Casabo	12113	17682	30000	0.02	0.08	0.50	8	5401	6311	77277230
Kickiro	9540	15020	24844	0.08	0.22	0.66	83	9285	109560	155891668
Nyarugenge	14710	24519	39818	0.03	0.06	0.45	16	4804	23785	67644446
Nyanza	2009	2824	4634	0.57	0.81	0.98	724	19584	1146405	404832445
Gisagara	2369	3161	5367	0.30	0.69	0.98	258	18240	306000	354910967
Nyaruguru	2968	4864	7953	0.28	0.61	0.92	258	16740	336179	320433715
Huye	3038	3911	6951	0.34	0.67	0.94	296	17524	356907	343649823
Nyamagabe	3056	6342	9397	0.30	0.59	0.92	306	16643	412149	318536623
Ruhango	2434	5517	8141	0.36	0.62	0.95	357	17330	479364	336823150
Muhanga	2050	2933	4971	0.35	0.66	0.98	365	18462	511187	360285199
Kamonyi	1773	4378	6082	0.46	0.69	0.95	541	18006	805356	361146094
Karongi	2639	6019	8597	0.32	0.61	0.94	292	17059	372539	327631849
Rutsiro	2085	1797	3800	0.44	0.78	0.99	536	19501	784006	393480184
Rubavu	4866	6924	11823	0.12	0.38	0.87	90	13856	89807	244176161
Nyabihu	4190	4317	8668	0.17	0.44	0.94	123	15835	139119	284296471
Ngororero	1554	3085	4639	0.39	0.70	0.98	410	18698	563964	369158621
Rusizi	3416	4094	7489	0.28	0.53	0.94	371	16339	566911	311147036
Nyamasheke	2574	5515	8187	0.28	0.56	0.94	224	16546	284934	314922273
Rulindo	2380	4232	6618	0.40	0.73	0.96	378	18253	474334	363824642
Gakenke	2781	3820	6473	0.26	0.59	0.96	235	17179	314966	325852114
Musanze	6028	9092	14981	0.05	0.24	0.83	41	11868	47252	192791104
Burera	3094	5863	8847	0.27	0.58	0.92	283	16090	395020	306246122
Gicumbi	2620	6818	9440	0.25	0.56	0.92	292	16307	404402	310215817
Rwamagana	3049	8788	11985	0.22	0.45	0.90	235	15001	321947	274294375
Nyagatare	3351	7105	10523	0.15	0.41	0.90	164	14683	234558	262447422
Gatsibo	2427	3402	5650	0.28	0.65	0.97	293	17955	377921	347470526
Kayonza	3277	8019	11261	0.14	0.47	0.88	168	14597	249990	264259883
Kirehe	3085	7303	10701	0.12	0.42	0.91	103	14854	112411	262825562
Ngoma	3676	7032	10668	0.18	0.45	0.90	184	15011	264278	272056048
Bugesera	2143	4480	6585	0.49	0.67	0.94	619	17727	985297	356693468
Province:										
Kigali	12121	19074	31554	0.04	0.12	0.54	36	6497	46552	100271115
Southern	2462	4241	6687	0.37	0.67	0.95	388	17816	544193	350077252
Western	3046	4535	7600	0.29	0.57	0.94	292	16833	400199	320683543
Northern	3381	5965	9272	0.25	0.54	0.92	246	15939	327195	299785960

Eastern	3001	6592	9627	0.23	0.50	0.91	252	15689	363764	291403288
Urban-Rural:										
Urban	10731	18108	29115	0.07	0.18	0.59	60	7786	76211	127038910
Semi-urban	2828	4929	7748	0.29	0.58	0.94	307	16797	428896	321057972
Rural	3634	6355	10061	0.27	0.54	0.90	284	15954	380537	301629974
Sample:										
Mean	2387	5252	23250	0.264	0.531	0.895	275	15645	382564	296162998
Std Dev	0.000	0.000	0.000	0.441	0.499	0.307	554	7169	946952	170317427

Notes: poor1=relative poverty line based on 0.50 of median, poor1x=relative poverty line based on 0.50 of mean, poor2=absolute poverty line based on \$1.25 per day, pgap1=poverty gap based on poor1, pgap1x=poverty gap based on poor2; pgap1s=poverty severity based on pgap1; pgap2s=poverty severity based on pgap2.

Table 4.A Correlation matrix of the variables (N=14,810)

	Year	Househ. Size	Total income	Income percapita	Povline relative	Povgap relative	Povgap2 relative	Povgap absolute	povgap2 absolute	Populg growth	Distance road	Distance market	Age head	Nr income	Farm land	Vegetable garden	Nr animal	Nr crops	Cash crops	Banana tees nr
Year	1.00																			
House size	-0.09 (0.00)	1.00																		
Total income	-0.01 (0.18)	-0.23 (0.00)	1.00																	
Income per cap	0.03 (0.00)	-0.29 (0.00)	0.81 (0.00)	1.00																
Povline relative	-0.06 (0.00)	0.01 (0.17)	0.11 (0.00)	0.05 (0.00)	1.00															
Povgap relative	0.02 (0.01)	0.34 (0.00)	-0.30 (0.00)	-0.16 (0.00)	0.08 (0.00)	1.00														
Pgap2 relative	0.00 (0.85)	0.28 (0.00)	-0.24 (0.00)	-0.12 (0.00)	0.14 (0.00)	0.94 (0.00)	1.00													
Povgap absolute	0.03 (0.00)	0.53 (0.00)	-0.65 (0.00)	-0.45 (0.00)	-0.13 (0.00)	0.48 (0.00)	0.38 (0.00)	1.00												
povgap2 absolute	0.04 (0.00)	0.53 (0.00)	-0.61 (0.00)	-0.39 (0.00)	-0.14 (0.00)	0.60 (0.00)	0.48 (0.00)	0.97 (0.00)	1.00											
Popul growth	-0.03 (0.00)	0.02 (0.00)	0.06 (0.00)	0.03 (0.00)	0.21 (0.00)	0.02 (0.00)	0.04 (0.00)	-0.03 (0.00)	-0.04 (0.00)	1.00										
Distance to road	0.00 (0.86)	-0.02 (0.02)	-0.03 (0.00)	-0.01 (0.27)	0.06 (0.00)	0.02 (0.03)	0.02 (0.01)	0.01 (0.51)	0.01 (0.43)	0.09 (0.00)	1.00									
Distance market	-0.02 (0.02)	-0.01 (0.10)	-0.05 (0.00)	-0.02 (0.01)	0.02 (0.03)	0.01 (0.32)	0.00 (0.59)	0.03 (0.00)	0.03 (0.00)	0.02 (0.05)	0.18 (0.00)	1.00								
Age head	0.10 (0.00)	0.07 (0.00)	-0.05 (0.00)	0.01 (0.31)	-0.04 (0.00)	0.08 (0.00)	0.07 (0.00)	0.05 (0.00)	0.07 (0.00)	0.00 (0.61)	-0.02 (0.01)	-0.02 (0.07)	1.00							
Nr income	-0.18 (0.00)	0.15 (0.00)	0.09 (0.00)	-0.01 (-0.14)	0.04 (0.00)	-0.11 (0.00)	-0.10 (0.00)	-0.07 (0.00)	-0.09 (0.00)	-0.02 (-0.03)	0.02 (0.02)	0.01 (0.15)	-0.08 (0.00)	1.00						
Farm land	-0.07 (0.00)	0.07 (0.00)	-0.11 (0.00)	-0.10 (0.00)	-0.10 (0.00)	0.01 (0.18)	0.00 (0.83)	0.09 (0.00)	0.09 (0.00)	-0.08 (0.00)	0.09 (0.00)	0.09 (0.00)	0.04 (0.00)	0.20 (0.00)	1.00					
Vegetable garden	0.16 (0.00)	0.11 (0.00)	0.00 (0.63)	-0.05 (0.00)	-0.01 (0.24)	-0.02 (0.01)	-0.02 (0.00)	0.02 (0.00)	0.01 (-0.09)	-0.06 (0.00)	0.00 (0.77)	0.01 (0.11)	0.00 (0.94)	0.03 (0.00)	0.10 (0.00)	1.00				
Nr animal	-0.06 (0.00)	0.19 (0.00)	0.06 (0.00)	0.02 (0.02)	0.03 (0.00)	-0.02 (0.02)	-0.02 (0.02)	0.00 (0.57)	-0.01 (0.18)	0.10 (0.00)	0.03 (0.13)	-0.01 (0.00)	0.06 (0.00)	0.18 (0.00)	0.06 (0.00)	0.06 (0.00)	1.00			
Nr crops	-0.08 (0.00)	0.14 (0.00)	-0.01 (0.50)	-0.06 (0.00)	-0.06 (0.00)	-0.04 (0.00)	-0.04 (0.00)	0.01 (0.47)	-0.01 (0.15)	-0.02 (0.04)	0.09 (0.00)	0.02 (0.01)	-0.01 (0.35)	0.19 (0.00)	0.50 (0.00)	0.14 (0.00)	0.15 (0.00)	1.00		
Cash crops	0.02 (0.03)	0.06 (0.00)	0.03 (0.00)	0.00 (0.91)	-0.06 (0.00)	-0.04 (0.00)	-0.04 (0.00)	-0.01 (0.18)	-0.02 (0.03)	-0.04 (0.00)	-0.01 (0.12)	-0.01 (0.10)	0.05 (0.00)	0.04 (0.00)	0.07 (0.00)	0.06 (0.00)	0.04 (0.00)	0.19 (0.00)	1.00	
Banana tees nr	-0.17 (0.00)	0.07 (0.00)	0.03 (0.00)	0.00 (0.88)	0.09 (0.00)	-0.02 (0.00)	-0.02 (0.05)	-0.03 (0.00)	-0.04 (0.00)	0.07 (0.00)	0.05 (0.00)	0.02 (0.06)	-0.02 (0.02)	0.04 (0.00)	0.05 (0.00)	0.01 (0.38)	0.07 (0.00)	0.12 (0.00)	0.00 (0.97)	1.00

Table 4.B Correlation matrix, consumption data, 7498 obs.

	poor1	poor1x	poor2	pgap1	pgap2	pgap1s	pgap2s
poor1	1.0000	0.5620	0.2054	0.8301	0.5226	0.6752	0.6468
p-value		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
poor1x	0.5620	1.0000	0.3654	0.4665	0.7590	0.3794	0.8530
p-value	0.0001		0.0001	0.0001	0.0001	0.0001	0.0001
poor2	0.2054	0.3654	1.0000	0.1705	0.7490	0.1387	0.5968
p-value	0.0001	0.0001		0.0001	0.0001	0.0001	0.0001
pgap1	0.8301	0.4665	0.1705	1.0000	0.4579	0.9568	0.5813
p-value	0.0001	0.0001	0.0001		0.0001	0.0001	0.0001
pgap2	0.5226	0.7590	0.7490	0.4579	1.0000	0.3835	0.9667
p-value	0.0001	0.0001	0.0001	0.0001		0.0001	0.0001
pgap1s	0.6752	0.3794	0.1387	0.9568	0.3835	1.0000	0.4935
p-value	0.0001	0.0001	0.0001	0.0001	0.0001		0.0001
pgap2s	0.6468	0.8530	0.5968	0.5813	0.9667	0.4935	1.0000
p-value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	

Notes: poor1=relative poverty line based on 0.50 of median, poor1x=relative poverty line based on 0.50 of mean, poor2=absolute poverty line based on \$1.25 per day, pgap1=poverty gap based on poor1, pgap1x=poverty gap based on poor2; pgap1s=poverty severity based on pgap1; pgap2s=poverty severity based on pgap2.

Table 5.A Probit and Tobit models' estimation results

	<u>Probit, Headcount</u>				<u>Tobit, Poverty gap</u>				<u>Tobit, Poverty severity</u>			
	Model 1: Relative		Model 2: Absolute		Model 3: Relative		Model 4: Absolute		Model 5: Relative		Model 6: Absolute	
	Coeff.	StdErr	Coeff.	StdErr	Coeff.	StdErr	Coeff.	StdErr	Coeff.	StdErr	Coeff.	StdErr
Intercept	-1.79	0.10	-0.94	0.13	-1.42	38.36	7495.43	385.87	62246.55	79839.99	109270000.00	9202477.00
Rural	0.19	0.06	0.23	0.08	25.54	23.75	1311.94	238.85	-10093.60	49420.14	31740460.00	5696239.00
Semiurb	0.34	0.07	0.27	0.10	97.46	28.50	1533.98	286.69	123099.10	59317.61	36978269.00	6837036.00
Popdens	-0.00	0.00	-0.00	0.00	-0.01	0.01	-0.65	0.07	0.82	14.63	-15418.60	1686.32
Populg	-0.01	0.00	-0.01	0.01	1.04	1.52	-65.89	15.30	8814.60	3165.25	-1788472.00	364830.90
Distroad	-0.00	0.00	-0.00	0.00	0.00	0.00	-0.01	0.01	10.83	3.02	-148.76	347.81
Distmark	-0.00	0.00	-0.00	0.00	0.05	0.08	2.07	0.80	59.41	166.08	42607.89	19142.53
Agehead	-0.00	0.00	-0.00	0.00	-0.35	0.37	-28.91	3.69	-32.33	763.06	-581072.00	87951.31
Lithead	-0.12	0.02	-0.17	0.03	-34.45	7.30	-658.13	73.46	-46837.60	15198.50	-16170000.00	1751802.00
Mshead	0.02	0.03	-0.04	0.05	4.77	13.05	197.88	131.26	7440.65	27159.00	3811217.00	3130387.00
Dfemale	0.10	0.04	0.20	0.05	37.28	15.49	567.40	155.85	70684.91	32245.95	13065744.00	3716716.00
Hhsize	0.34	0.01	0.70	0.02	127.57	2.49	2122.56	25.03	209290.60	5179.15	52100272.00	596956.80
Nrincome	-0.36	0.02	-0.30	0.03	-145.99	7.57	-1600.40	76.15	-262164.00	15756.74	-43940000.00	1816146.00
Credd	-0.25	0.03	-0.37	0.04	-82.86	11.58	-1523.48	116.44	-137696.00	24093.02	-37330000.00	2776998.00
Worksend	-0.07	0.06	-0.13	0.08	-27.12	21.84	-567.50	219.64	-47180.90	45444.29	-10760000.00	5237977.00
Fland	0.40	0.06	0.59	0.07	117.43	22.56	2987.80	226.92	155985.10	46950.73	73359017.00	5411611.00
Vegetd	-0.12	0.03	-0.02	0.04	-43.79	10.12	-274.81	101.75	-77724.00	21052.55	-9179226.00	2426549.00
Mranimal	-0.02	0.00	-0.02	0.00	-7.00	0.89	-94.31	8.95	-12348.20	1850.79	-2415835.00	213324.90
Nrcrops	-0.04	0.01	-0.06	0.01	-11.01	3.47	-224.16	34.87	-14587.80	7214.20	-5832576.00	831519.50
Cashcrop	-0.26	0.05	-0.19	0.08	-117.36	20.80	-892.37	209.22	-222821.00	43288.44	-25350000.00	4989490.00
Bantrnr	-0.00	0.00	-0.00	0.00	-0.13	0.04	-2.69	0.44	-238.06	90.87	-67502.00	10474.06
d2009	-0.43	0.04	-0.09	0.06	-182.33	15.77	-1204.06	158.65	-336037.00	32824.88	-39650000.00	3783445.00
d2012	0.05	0.04	-0.11	0.05	-32.84	14.53	131.72	146.11	-132718.00	30231.54	4748735.00	3484532.00
Scale	-	-	-	-	583.21	3.39	5866.04	34.09	1213726.00	7053.19	139900000.00	812961.40

Table 5.B. Probit and Tobit estimation of determinants of headcount, poverty gap and poverty severity.

	Probit	Probit	Probit	Tobit	Tobit	Tobit	Tobit
	Poor1	Poor1x	Poor2	Pgap1	Pgap2	Pgap1s	Pgap2s
Parameter	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Intercept	1.4808a	1.1511a	-0.3394b	101.898b	7391.433a	157783.00b	118990000a
Rural	-0.7066a	-0.8283a	-0.7668a	184.005a	5892.334a	272988.50a	127150000a
Semiurb	-0.6895a	-0.7689a	-0.6779a	175.110a	5617.385a	243532.30a	120090000a
Distroad	0.0000b	0.0000a	0.0000b	0.004b	0.085a	6.61b	2063a
Distmark	-0.0003	-0.0006a	-0.0028a	0.139	6.008a	294.78c	127046a
Agehead	-0.0038a	-0.0015	0.0045a	2.264a	-3.936	4097.05a	91830
Lithead	0.2886a	0.3677a	0.5746a	-114.480a	-2400.180a	-181801.00a	-57070000a
Mshead	0.0173	-0.1466b	-0.2087b	-21.768	844.660a	-45389.30	16782314b
Dfemale	-0.1139	-0.2992a	-0.3025a	36.651	1547.484a	48382.37	35800756a
Hhsize	-0.0412a	-0.0650a	-0.0873a	14.575a	384.591a	20244.29a	9170200a
Nrincome	0.2353a	0.2370a	0.3011a	-92.211a	-1480.640a	-143969.00a	-36180000
Credd	-0.0849	0.0469	0.0816	56.987	-426.994	112654.40	-13600000a
FLand	-0.7891a	-0.8669a	-0.7723a	271.295a	5370.623a	394751.50a	129030000a
Vegetd	0.1960a	0.2111a	0.1396a	-94.629a	-794.300a	-159806.00a	-23810000a
Nrcrops	0.1132a	0.0684a	-0.0270	-54.625a	-210.613b	-88330.80a	-8770799
Scale	..	..	..	530.996	6138.447	913641.80	148640000
0	5,521	3,514	790	5,521	790	5,521	790
1 or # 0	1,977	3,984	6,708	1,977	6,708	1,977	6,708
Obs	7,498	7,498	7,498	7,498	7,498	7,498	7,498

Notes: poor1=relative poverty line based on 0.50 of median, poor1x=relative poverty line based on 0.50 of mean, poor2=absolute poverty line based on \$1.25 per day, pgap1=poverty gap based on poor1, pgap1x=poverty gap based on poor2; pgap1s=poverty severity based on pgap1; pgap2s=poverty severity based on pgap2. Significant at less than 1% (a), 1-5% (b), 6-10% (c), not significant ().

Figure 1.A Mean consumption poverty among districts in Rwanda, Rwf in 2012.

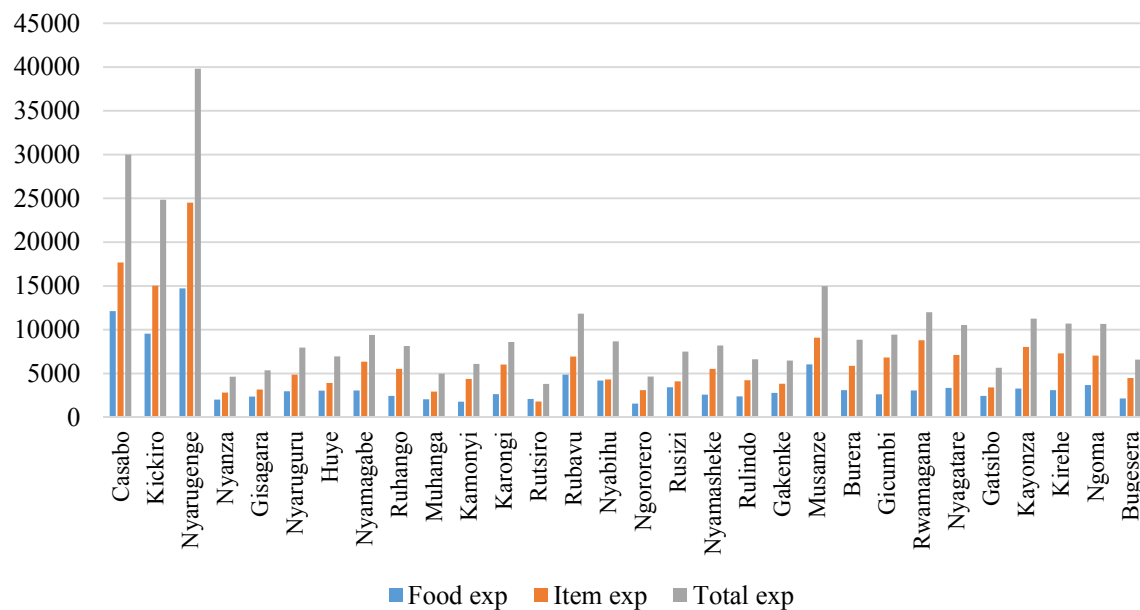


Figure 1.B Mean consumption poverty among provinces and areas in Rwanda, Rwf 2012.

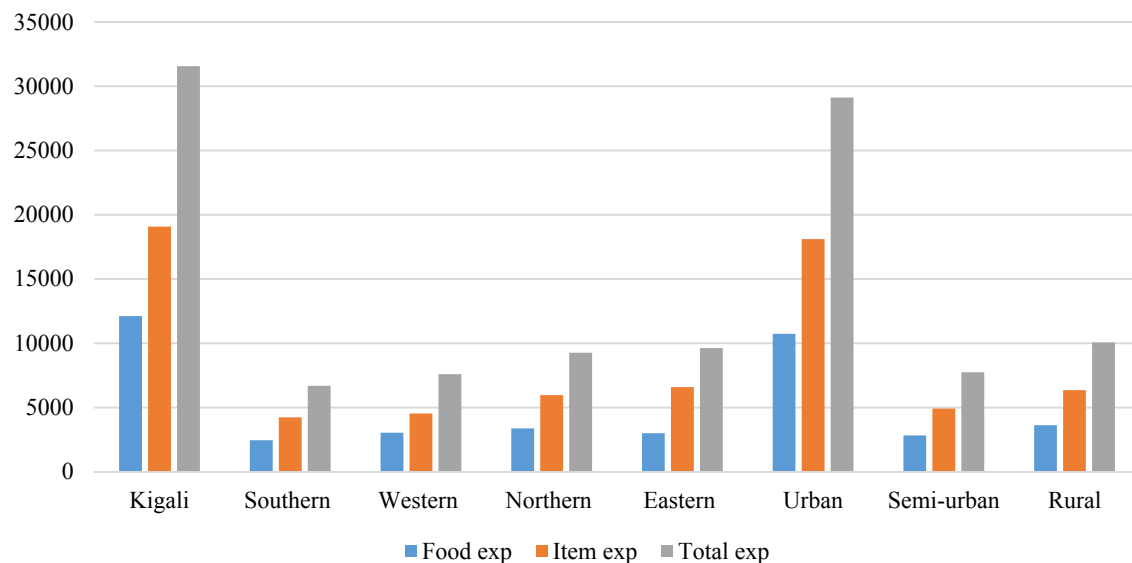


Figure 2.A. Incidence of consumption poverty among districts in Rwanda, % in 2012

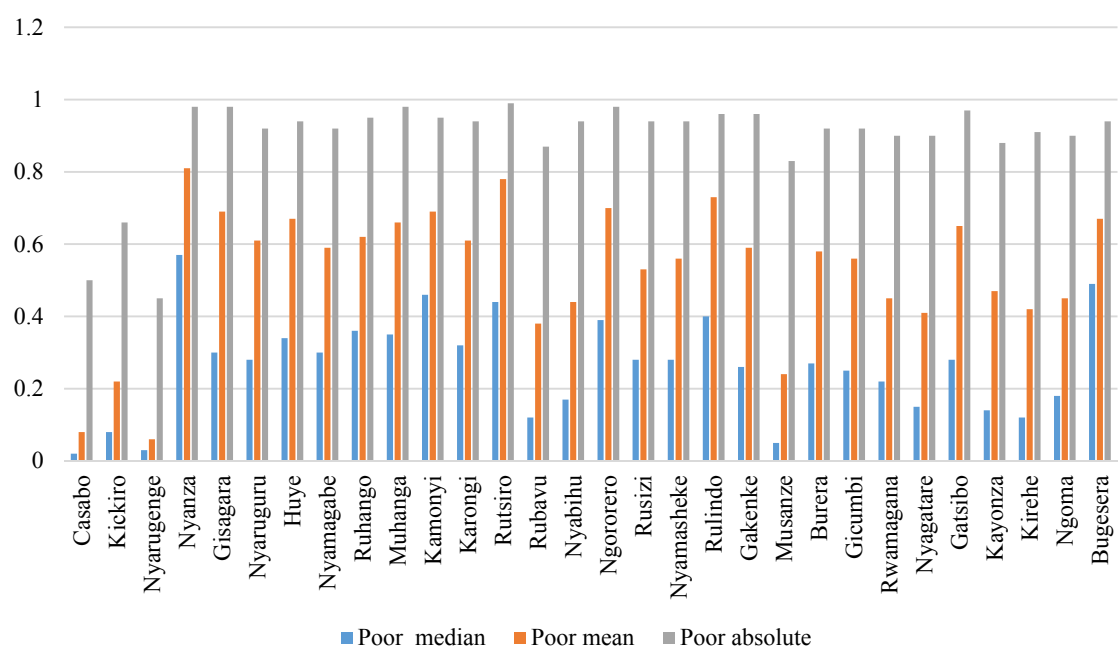


Figure 2.B Incidence of consumption poverty among provinces and areas in Rwanda, % in 2012.

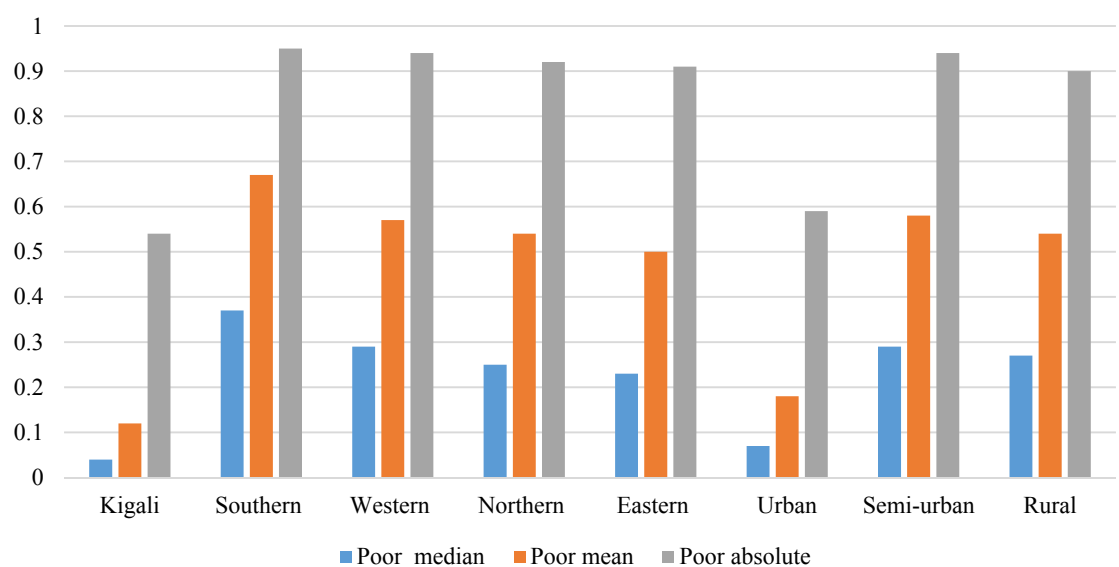


Figure 3.A Consumption poverty gap among districts in Rwanda, Rwf in 2012.

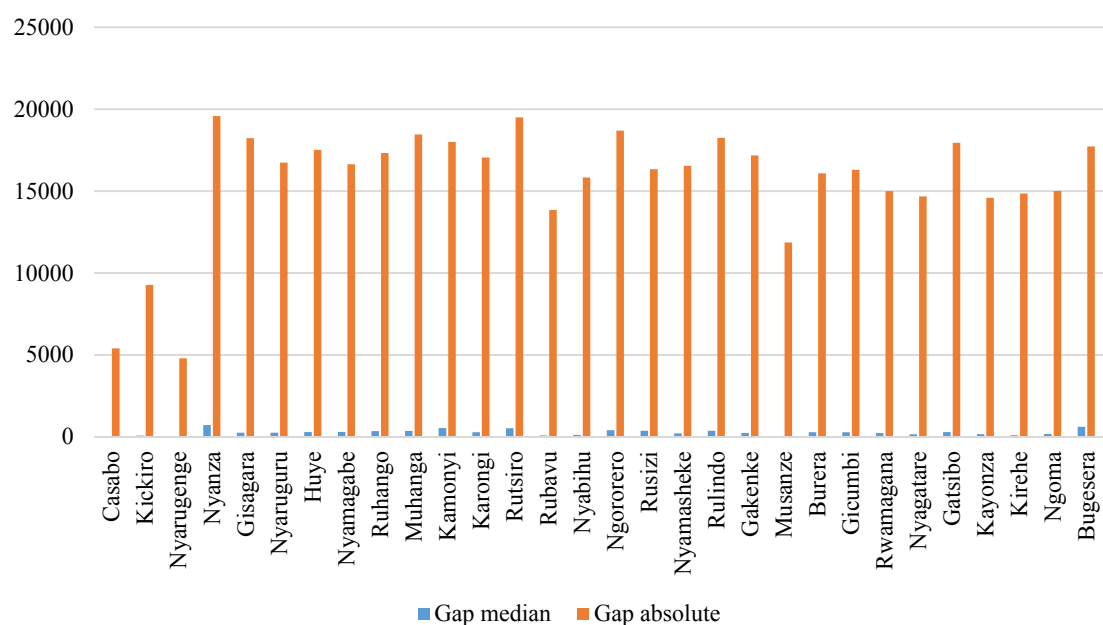
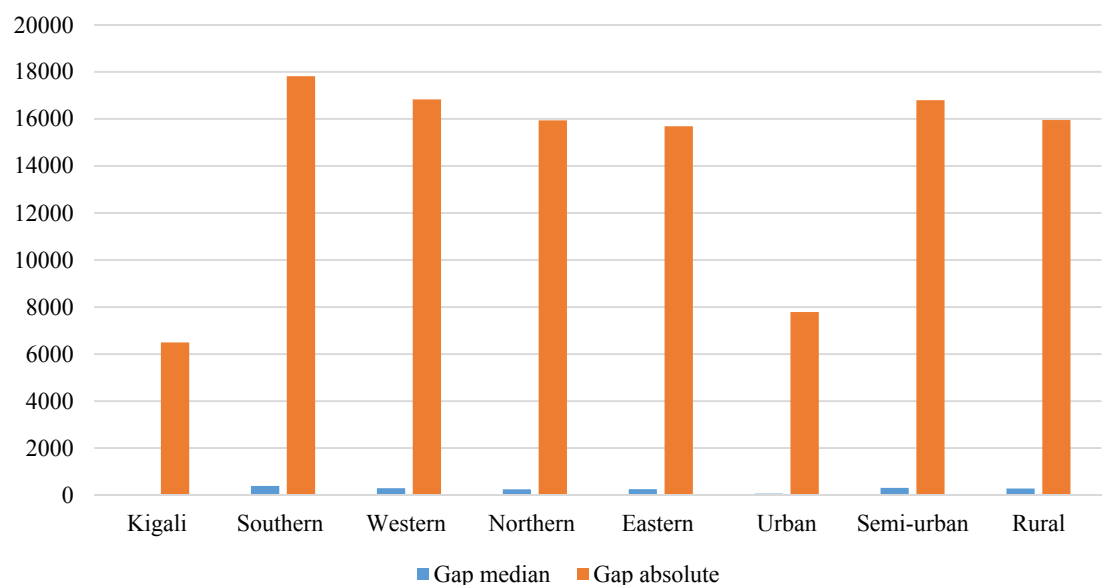


Figure 3.B Consumption poverty gap among provinces and areas in Rwanda, Rwf in 2012.



Chapter Nine

Measurement and Analysis of Multidimensional Well-being in Rwanda

Almas Heshmati¹, Masoomesh Rashidghalam² and Pia Nilsson³

¹ Corresponding author:

Department of Economics, Sogang University, Seoul, Korea,
E-mail: heshmati@sogang.ac.kr

² Department of Agricultural Economics, University of Tabriz, Tabriz, Iran,
E-mail: maso.azar@gmail.com

³ Jönköping International Business School (JIBS), Jönköping University, Jönköping, Sweden, E-mail: Pia.Nilsson@ju.se

Abstract

The well-being of families and their children is given high priority in development goals. Children's well-being in Africa is important since the growing number of children is the greatest resource of this continent. Rwanda was one of the first countries that ratified the Convention on the Rights of the Child. The country, despite its very low GDP per capita, also has one of the best child well-being indicators in Africa. In the recent past the country has also had two important achievements: protection of children by establishing the National Commission for Children and launching a Strategy for National Child Care Reform. The measures aim to protect children's rights and integrate children into families that are supported to provide needed care to them. These achievements are largely the result of strong laws and policies many of which have been developed with support from UNICEF. Investments in children's well-being will help in addressing many persistent difficulties that society may have to face in the future. What happens during the early years is of crucial importance for every child's development. This period offers great opportunities, but children are also vulnerable to negative influences. The objective of this research is to estimate multidimensional well-being of children and their families in Rwanda. The aim is to compute an overall well-being index decomposed into its underlying main components. The households are ranked by the level of well-being and by various household and community characteristics. The results shed light on the state and changes in the well-being of children and their families in Rwanda indicating which provinces and districts offer relatively better conditions for them. This can serve as a model for public policies aimed at improving general well-being in the country.

Keywords: Well-being; multidimensional index; sustainable development; Rwanda;

JEL Classification Codes: D13; D63; H53; I131; I138; J13;

1. Introduction

Many children around the world do not have natural human rights due to various reasons including families' income status, the political situation, lack of safety nets, war, religion, ethnicity, gender discrimination and disabilities (Peters and Mullis, 1997; Santos Pais 1999; Ridge, 2002; Gregg et al., 2005; Mayhew, 2005; Sobolewski and Amato, 2005). They do not receive enough food, care and opportunities to attend school and learn new skills. As a result they do not reach their full human potential (Sen, 2000; Attree, 2004). Family support, good nutrition, consistent care and encouragement to learn in the early years of life help children perform better in school, be healthier, have an active and productive participation in society, be more creative and have higher earnings in the future (Duncan and Brooks-Gunn, 2000; Bradshaw, 2002; Kamerman et al., 2003; Bargain and Donni, 2007). This issue is even more important for children in poverty. The number of children under the age of 5 who die of hunger is increasing; 7.6 million of them die each year, while others who survive (over 200 million children) usually do not reach their full potential. As a result, their societies have problems of low labor productivity, development and welfare. The early years of a child's development are of crucial importance since this is a period of growth and also of vulnerability to adverse conditions (UNICEF, 2013).

In Africa, children's well-being is of great importance since children are the greatest resource of this continent. According to key statistics provided by the United Nations Children's Fund (UNICEF, 2014), by 2050, one in every three births and almost one in every three children under 18 will be African. The number of stunted children has increased by one-third in Africa, while other regions have halved the number of stunted children. Although mortality rates among children under-5 have decreased by 45 per cent, still half of the world's 6.6 million under-5 annual deaths occur in Africa. Statistics confirm that Africa has over 300 million out of school children. They fail to complete full primary education and hence fail to master basic literacy and numeracy skills. Between 2010 and 2025, the child population in sub-Saharan Africa will increase by 130 million. This region will also be the single region with the greatest number of children under 18 from around 2030 (UNICEF, 2014). Africa's population is estimated to quadruple by 2100 (United Nations, 2015). Kayizzi-Mugerwa et al. (2017) suggest inclusive growth in Africa to cope with poverty.

Rwanda is one of the first countries that ratified the Convention on the Rights of the Child (CRC). The country, despite its very low gross domestic product (GDP) per capita, has one of the best child well-being indicators on the continent. Recently Rwanda also had two important achievements in the area of children's protection. First, it established the National Commission for Children which protects children's rights. Second, it launched a Strategy for National Child Care Reform, which aims to integrate children into families that are supported to provide needed care to these children. These successes are largely the result of strong laws and policies many of which have been developed with support from UNICEF. UNICEF is among the Government of Rwanda's key partners in preventing and responding to violence, abuse, exploitation and neglect, with a particular focus on the most vulnerable, including children without parental care and children with different forms of disabilities.

This cooperation helps Rwanda and its vulnerable population to create an environment to protect children's rights, provide them opportunities for normal growth and for developing their potential.

Despite the progress made by the government and other stakeholders in improving children's living standards in Rwanda, serious challenges still remain. One of the most important problems is the low rate of primary school completion. Further, students who complete primary school often do not have the skills that they need for successful employment in the future. According to a mini survey conducted by 'Rwanda Today' in Kigali, many children still beg on the streets because they have been abandoned. Many Rwandan children are struggling to deal with the effects of war and genocide, especially those born during the 1994 mayhem. In addition, many children face poverty in families while domestic violence has denied others a chance to be raised in proper homes. Some parents have neglected their children for various reasons. These children are now orphans and as part of the daily struggle many of them end up in petty crimes and drug and substance abuse.

These problems in Rwanda will lead to loss in adult productivity and persistent difficulties in the future. What happens during the early years is of crucial importance for every child's development. It is a period of great opportunity, but also of vulnerability to negative influences. On the other hand, the need to promote children's well-being is widely accepted as a moral imperative. Hence, the objective of this research is to estimate the multidimensional well-being of children and their families in Rwanda. Its aim is to compute an overall well-being index and decompose it into its underlying main components. The families are ranked by level of well-being across household, district and community characteristics. The results shed light on the state and changes in children's well-being in Rwanda indicating which provinces and districts have relatively better conditions for them. This can serve as a model for the general development of the well-being of children and their families in Rwanda.

The rest of this study is organized as follows. Section 2 provides a literature review which is followed by an introduction to the method of measurement in Section 3. The area of study, Rwanda, and the data are presented in Section 4. Section 5 discusses the empirical results and Section 6 gives a conclusion.

2. Literature Review

Literature on well-being in general and on related areas of economic research including capabilities, human development, freedom, poverty, happiness, sustainability, income distribution and social status and their direct association with well-being in income theory and practice has developed rapidly. The literature is divided into subjective and objective aspects (Alatartseva and Barysheva, 2015) referring to internal and external levels of well-being. Each level consists of 4 key contextual attributes that together constitute well-being. They include: (i) one's existence in accordance with their natural essence, (ii) an innate understanding of what is good for oneself, and the presence of the ability and willingness to achieve it, (iii) one's the ability to realize their human potential and plan for life, and (iv) the

creation of a society and empowering people to fulfill the above stated positions, and increase activity and awareness. This study covers many dimensions of objective well-being in general and those of children in particular. This section covers a review of literature found in journals, handbooks and other academic books (see, for example, Bronfenbrenner and Morris, 1998; Sen, 1985, 1999; Ridge, 2002; Kakwani and Silber, 2006, 2007; Senik, 2010; Truys, 2010; MacKerron, 2012; Alartseva and Barysheva, 2015; Arndt and Tarp, 2016; Qasim, 2016).

Literature on children's well-being has also developed very fast and as a result of theories, methods and their applications using increasingly available detailed household level data, numerous studies address this important issue. Research examples include Attree (2004) who provides a systematic review of the quantitative evidence on growing up in disadvantageous conditions. Bargain and Donni (2007) emphasize the theory of targeting children to influence their productivity and well-being, while Gregg et al. (2005) investigate the effects of mothers' decisions of returning to work on child development. The issues of measurement, decomposition of well-being and the underlying indicators are investigated by Brooks and Hanafin (2005). Kamerman et al. (2003) discuss social policies, family types and child outcomes. Land (2007) studies the foundation for child development. Stevens et al. (2005) focus on reinforcing the importance of family for successful child outcomes.

Most studies dealing with a measurement and analysis of child well-being use data from developed countries. Heshmati et al. (2008) investigated child well-being in middle and high income countries. Sarriera et al. (2015) examined the relationship between children's perceptions of available material resources and their subjective well-being in eight developed and developing countries. Sachs (2016) discusses subjective well-being over life. Brandolini (2007) computed multidimensional well-being indices focusing on income and health inequalities in the four advanced and largest European economies. Stiglitz et al. (2009) in viewing that well-being is a multi-dimensional phenomenon based on key dimensions that should be simultaneously taken into account. The dimension include: material living standards, health, education, personal activities including work, political voice and governance, social connections and relationships, environment and uncertainty. Maasoumi and Hu (2015) derive weights and substitution degree in multidimensional well-being of social groups in China. The well-being dimensions include: income, assets, house, health and education. Bradshaw (2002) estimated the relationship between child poverty and child outcomes and Bradshaw et al. (1993, 2006, and 2007) computed the index of child well-being in OECD and in the European Union. Jäntti and Bradbury (1999) studied child poverty in industrialized nations. Kamerman et al. (2003) studied the effects of social policies and family types on child outcomes in OECD countries.

Finally, UNICEF (2007) provides an overview of child well-being in 'rich' countries. Individual country case studies of child well-being include Beresford et al. (2005), Gregg et al. (2005) and Mayhew (2005) in the case of UK, Lippman (2004) and Berger et al. (2005) in the case of USA and Hanafin and Brooks (2005) in the case of Ireland.

Heshmati et al. (2008) analyzed the UNICEF Innocenti database and present three composite indices (two parametric and one non-parametric) of children's well-being in middle and high

income countries. These indices are composed of six well-being components including material, health and safety; educational; family and peer relationships; behaviors and risks; and subjective well-being. Each of the components is generated from a number of well-being indicators. They conclude that the Scandinavian countries performed quite well in comparison to other regions in and outside Europe. Their empirical results show that the UK performed extremely poorly in child well-being and the Russian Federation occupied the lowest rank in all the three indices. In addition, the authors provide guidelines on how to empirically link well-being to factors such as inequalities, poverty and growth.

Despite an urgent need for comprehensive child well-being studies covering developing countries only a few such studies have been done. Limited data availability and advanced research capacity explain the poor research in this field. However, the initiation of the millennium development goals and systematic data collection by the World Bank have led to changed conditions in the last two decades. Some cross-country studies have been done since then, while other single country studies too have been carried out. Among the few general studies are those by Ben-Arieh (1997) and Ben-Arieh and Wintersberger (2007) who study indicators of children's well-being to measure and monitor the state of children. Roelen et al. (2017) investigate the role of social protection in improving child well-being and childcare in sub-Saharan Africa. Sarriera et al. (2015) examine the relationship between children's perceptions of available material resources and their subjective well-being in eight developed and developing countries. Other studies focusing on developing countries include Akresh et al. (2011), Caserta et al. (2016), Ssewamala et al. (2010) and UNICEF (2013 and 2014). These are discussed in more detail later.

With regard to developing countries Roelen et al. (2017) studied the impact of social protection on loss of parental care and quality of care and well-being in sub-Saharan Africa. They investigated large-scale nationally implemented cash transfer and public works programs in South Africa, Ghana and Rwanda. According to the results of their study social protection will prevent the loss of parental care thereby providing much needed financial support to kinship or foster care providers. They also found that social protection could improve the quality of care and child well-being for all children in the studied societies.

A few studies have also been done on children's living conditions in Rwanda. In a study based on Rwandan data, Akresh et al. (2011) examined the impact of Rwanda's distinct shocks (defined as localized crop failure and armed conflict) on children's health status. According to their study, in both poor and non-poor households the boys and girls who were born during the conflict in regions experiencing fighting were negatively affected. On the other hand, only girls were negatively affected by crop failure and this impact was even worse for girls in poor households.

Caserta et al. (2016) studied the effects of various living environments for children (including child-headed households, orphanages, street children and foster homes), the quality of care and demographic factors on orphan children's psychosocial well-being in Rwanda. They conclude that children in orphanages exhibited higher levels of emotional well-being and lower levels of mental distress and risk-taking behavior than other non-orphan children. Decision-making abilities were the highest among child-headed households, while they were the lowest among those in orphanages. Demographic factors

(such as age and sex) along with the quality of care (such as meal availability and length of time spent in a particular living environment) were also important predictors of psychosocial well-being among the studied children.

Ssewamala et al. (2010) examined the effect of economic assets on sexual risk-taking intentions among school-going AIDS-orphaned adolescents in rural Uganda. According to the results of this study, in Uganda which is a country devastated by poverty and disease (including HIV/AIDS), having access to economic assets played an important role in influencing adolescents' sexual risk-taking intentions. The findings of this study have implications for the care and support of orphaned adolescents, especially in poor African countries devastated by poverty and sexually transmitted diseases.

Other studies indicate that Africa has become a better place for children as compared to five years ago. Despite its relatively low GDP per capita, the Child Friendliness Index ranked Rwanda at number six among Africa's 52 countries, having moved up five places from its 11th position in 2008. Rwanda has an impressive achievement – it has achieved most of the millennium development goals' (MDGS) targets by the 2015 deadline. Improving access to education is one of the biggest successes of the country. Rwanda has the highest primary school enrollment rates in Africa.

Sarriera et al. (2014) examined the relationship between children's perceptions of their available material resources and their subjective well-being. They found that children in Uganda had limited access to material resources and the lowest average of well-being among children from the sample countries studied.¹ Together with Algeria and South Africa, Uganda also had the strongest associations between well-being and access to material resources. Even with access to all the material resources evaluated, well-being scores were lower in South Korea. Children from Israel, Brazil, Spain and England had similar levels of satisfaction and well-being in looking at material resources and children's subjective well-being in eight countries. The preliminary results underscore the importance of assessing material well-being in children and highlighting the role that material resources play in influencing children's subjective well-being, especially in cases of children experiencing severe resource deprivation.

3. Measurement of the Well-being Index

A principal component analysis (PCA) is a variable dimension reduction method. PCA tries to identify the patterns of the data. It also directs the data by highlighting similarities and differences between related variables. It is used when researchers need to determine the minimum number of factors that will explain the maximum variance in the data. The indicators that form the principal components are highly correlated within a component, but they are not correlated across the components. The method helps reduce the dimensions in the data thereby limiting the many alternative ways to rank the units of observation.

¹ The sample countries include: Algeria, Brazil, England, Israel, Spain, South Africa, South Korea, and Uganda.

Classical PCA originated in Pearson (1901) and was further developed in Hotelling (1933); this is widely used in political economy, macroeconomics, finance and many other fields. It is useful when one has obtained data on a number of variables and believes that there is some redundancy in these variables. In this case, redundancy means that some of the variables are correlated with one another, possibly because they measure the same construct. Hence, it should be possible to reduce the observed variables into a smaller number of principal components (artificial variables) that will account for most of the variances in the observed variables (Jolliffe, 2002). Estimation of the eigenvalues of the sample covariance matrix is the key step towards PCA to reduce the dimensions of the data.

The method is described in Xiao et al. (2017) as (using their notations): Assume that the m -dimensional output Y is represented as $Y=g(X)$, where X is a vector of n -dimensional inputs. The inputs are assumed to be independent of each other and are characterized by the probability density function $f(x)$. PCA is a multivariate statistical method that can be performed through the eigenvalue decomposition of the covariance matrix of outputs Y . PCA transforms the original variables into a set of new orthogonal variables, the first few of which with the largest variance contain the most information.

The procedure involves a number of steps. First, outputs Y are centered by subtracting the mean vector and denote the centered outputs (Y^C) as:

$$(1) \quad Y^C = Y - \mu_Y$$

Second, perform the eigenvalue decomposition of the covariance matrix as:

$$(2) \quad \Sigma_Y = \Gamma \Lambda \Gamma^T$$

where Λ is the diagonal eigenvalue matrix and Γ is a matrix of normalized eigenvectors associated with the eigenvalues.

Third, the centered outputs Y^C are transformed into independent variables H through:

$$(3) \quad H = Y^C \Gamma$$

where H contains the principal components which are orthogonal to each other. Y^C can also be expressed as:

$$(4) \quad Y^C = H \Gamma'$$

Thus, the original outputs Y can be expanded by the mutually orthogonal principal components in H by:

$$(5) \quad Y = \mu_Y + H \Gamma'$$

Usually, the first of the K principals contain the most variance if the original outputs are selected, then Y can approximately be expressed as:

$$(6) \quad Y = \mu_Y + H_K \Gamma_K'$$

where H_K and Γ_K contain the first K principal components of H and the first K eigenvectors of Γ .

Well-being indices are computed non-parametrically assuming the components' weights used in their aggregation on an ad-hoc basis or parametrically where the weights are estimated. Each approach has their benefits in the form of not assuming the weights rather than estimating them and limitations in the form of an assumption of a functional form and choice of computation method. The performance of the two composite indices' approaches are compared by Heshmati et al. (2008) in the context of child well-being and in Heshmati and Oh (2006) in the context of the development strategy.

Kang (2002) conducted a sensitivity analysis of the composite environmental index while Decancq and Lugo (2008) discuss how to set weights in multidimensional indices of well-being. The robustness of composite indicators in the context of national science and technology policy were investigated by Grupp and Moge (2004). Noorbakhsh (1998) also investigates alternative development indices.

These studies together shed light on the strengths and weaknesses of the indices and on how to improve upon their performance in measuring children's well-being. Xiao et al. (2017) propose new kinds of sensitivity indices based on PCA to measure the effects of input variables on multivariate outputs. Existing sensitivity indices focus on the variance of principal components representing a magnitude of uncertainty in the corresponding coordinate axes. Our research employs a weighted average of the principal components with eigenvalues greater than 1 where the share of the variance explained by the components is used as weights in the aggregation.

4. Data

The data used in our study consists of household surveys in Rwanda. Rwanda is located in Central/Eastern Africa and is bordered by the Democratic Republic of the Congo to the west, Uganda to the north, Tanzania to the east and Burundi to the south. With an area of 26,338 square kilometers, Rwanda is the world's 149th largest country and the fourth smallest on the African mainland. The country has five provinces -- Kigali City, Southern, Western, Northern and Eastern provinces which were ascertained by borders in 2006. The Eastern Province and Kigali with an area of 9,458 km² and 730 km² are the largest and smallest provinces respectively. The five provinces of Rwanda are divided into 30 districts.² These 30 districts are further sub-divided into 418 administrative sectors. Different administrative sectors are sub-divided into cells, which in turn are divided into villages.³

A 3-year period population growth in Rwanda according to the National Institute of Statistics of Rwanda (NISR) was about 7.0 per cent in 2015 (11.3 million persons in 2015 as compared to 10.5 million persons in 2012). A majority of the people live in rural areas and the population is young, with a density among the highest in Africa. NISR (2014) recorded that

² The districts are Nyarugenge, Gasabo, Kicukiro, Nyanza, Gisagara, Nyaruguru, Huye, Nyamagabe, Ruhango, Muhanga, Kamonyi, Karongi, Rutsiro, Rubavu, Nyabihu, Ngororero, Rusizi, Rulindo, Gakenke, Musanze, Burera, Gicumbi, Rwamagana, Nyagatare, Gatsibo, Kayonza, Kirehe, Ngoma, Bugeser and Nyamasheke.

³ Central Intelligence Agency (CIA) provides a country profile of Rwanda covering various socioeconomic characteristics of the country. at: <https://www.cia.gov/library/publications/the-world-factbook/geos/rw.html>.

in 2012, 43.3 per cent of the population was aged 15 years and under and 53.4 per cent was aged between 16 and 64 years. Therefore, Rwanda is considered a young country in Africa. Rwanda's population density is amongst the highest in Africa at 445 inhabitants per square kilometer. Meanwhile the Southern and Western provinces are the most populated provinces in the country.

The data for the household surveys covered 14,810 household observations in Rwanda in 2006, 2009 and 2012. There were 2,711, 5,351 and 6,748 yearly observations respectively. In our study the overall family well-being index is composed of seven well-being components: household, community, education, housing, nutrition, farming and economics. Each of these components is in turn generated from a number of well-being indicators. The farming and economics components are a part of the family well-being index while the remaining five components are related to children's well-being. Data availability and previous studies such as those by Stevens et al. (2005), Bradshaw et al. (2007), Heshmati et al. (2008), Ssewamala et al. (2010), Akresh et al. (2011), Sattiera et al. (2015), Caserta et al. (2016) and Roelen et al. (2017) influenced the modeling and determined the composition of the index. Summary statistics of data grouped component-wise is presented in Table 1.

Insert Table 1 about here

The first index component represents households; this consists of four indicators: gender, age, and marital state of the household head and the number of spouses. Household represents how optimal the environment is for a child to grow up in. The second index component is labeled as community and is constructed using six indicators including the number of inhabitants per square kilometer; urban, rural and semi-urban areas; and population structures in 2002 and 2012. Community and its provision of services and safety is an extension of the household environment. The third component is associated with education consisting of six indicators among others: literacy, education in years, primary and secondary education of the head, number of children in the household attending school and distance to the road. This component captures availability and facilitation of education. Education and its access and quality are drivers of well-being that define the education component.

The next component is related to housing and is built by using nine indicators covering material for the roof and floor, number of rooms, number of people in the household, source of lighting, main source of drinking water, payment for drinking water and distance to the main water source. High quality and standard of housing increase children's well-being. Nutrition is the fifth index component that is composed of five nutrition-related indicators among others: owning a vegetable garden, number of animals, number of crops, number of banana trees owned by the household and number of banana trees used for making beer owned by the household. The latter has an indirect income effect. Nutrition affects students' growth, health and educational outcomes.

The sixth component captures farming and is composed of four indicators: percentage of farmland cultivated on marshland in a district, altitude, number of animals and number of crops. Farming provides conditions for children's improved welfare and well-being. It may also imply engagement of children in farming activities as child labor. Economics is the last

index component that captures the number of income generating activities undertaken by the household, total income from all income generating activities, producing cash crops, distance to the market, distance to the road, members of the extended family sending back money and having access to credit. Farming and economics influence the welfare of children in a very similar way. The overall composite index of well-being includes 41 indicators forming these seven index components.

5. An Analysis of the Results

5.1 Principal Component Analysis

The principal component analysis of different well-being components and the overall composite index estimated for children and their families are presented in Table 2. Only the eigenvalues which are bigger than 1 were used in computing the different components of the index. The different components were estimated separately and their principal components with eigenvalues exceeding 1 were aggregated using the share of variance that they explain. Traditional researchers rank units only by the first principal component. Our approach is superior as it allowed us to fully utilize information from all principal components with eigenvalues larger than 1. This applies to the overall composite children and family indices as well where full information from various indicators was used for estimating and drawing inferences about the multidimensionality of well-being. As an example the household weighted index was computed using two principal components and the share of the variance that they explained was obtained.⁴ The weighted index was normalized, where the households with minimum and maximum values attained index values of 0 and 1.⁵

Insert Table 2 about here

In order to explain the index components in more detail, we first consider the household component; only two of the principal components are bigger than 1. Number of eigenvalues bigger than 1 and share of variance explained by these principal components are: households (2, 0.60), community (2, 0.73), education (2, 0.49), housing (4, 0.60), nutrition (2, 0.53), farming (2, 0.51) and economic (3, 0.51). In the case of the overall well-being index 14 principal components are bigger than 1 and together they explain 57 per cent of the total variations (14, 0.57). The corresponding figures for children's well-being are (10, 0.55). In the case of family well-being, the contribution of the principal components to the explanation of the variance is reduced from 8 per cent by the first component and 3 per cent by the last component. The corresponding figures for the children's well-being are 10 per cent and 4 per cent respectively.

Now we explain the differences and relationships between the different index components and the composite indices for children and their families. The correlation matrix for the seven well-being components, year, composite children and family indices and income per capita are reported in Table 3. With the exception of a few cases all pair-wise relations are

⁴ The household weighted index is obtained as: $H = (PC1 \times 0.38 + PC2 \times 0.22) / 0.60$.

⁵ The normalized index is obtained as: $H_n = (H_{obs} - H_{min}) / (H_{max} - H_{min})$. The H variables are observed, minimum and maximum in sample values.

statistically significant at the 1 per cent level of significance. Concerning year and other components, only education and household are positively correlated with year while other components are negatively correlated with time. In general, we expected a positive improvement in well-being over time. The negative correlation indicates a declining level of the well-being component over time. A high negative association is found among housing and year (-0.738), between economics and year (-0.589) and between farming and year (-0.458). Farming and nutrition are highly and positively correlated (0.612). The correlation between household and housing (-0.132), community and education (-0.021) and also between education and housing (-0.111) are significant and negative. The correlation between economics and other components is statistically significant and positive, but low. The relationship between household and farming shows that these two components are positively and significantly correlated (0.257).

Insert Table 3 about here

With the exception of farming (-0.046), there are positive correlations between the children and family well-being indices and their individual components. The size of the correlation coefficient varies in the range of 0.01 and 0.527. It approximately reflects individual component's contribution share to the overall well-being index. The correlation coefficient between children and family well-being indices is 0.455. The two indices differ by economics and farming components. Unlike expectations, the income per capita variable is negatively (-0.246) correlated with time suggesting a deterioration of income per capita over time. Income is positively correlated with child well-being (0.038) but negatively correlated (-0.224) with family well-being. Again the negative relationship is unexpected. A measurement error might explain this pattern. It should be noted that these correlation coefficients are pair-wise correlations and as such unconditional on other components. Conditional correlations in the form of a regression analysis are presented later.

5.2 Variations in levels of well-being indices by characteristics

Variations in the levels of different well-being components and the overall composite indices can be analyzed by household and environmental characteristics. In this section we analyze heterogeneity by comparing the average levels of the well-being components of different districts, provinces and areas over time. In Part A of Table 4, Nyagatare has the highest family index value while Ngoma has the highest children's index and income per capita. Ruizi enjoys the highest housing standards and Nyabihu the highest nutrition component of well-being. The highest farming index level belongs to Rubavu. Gicumbi performs well in community and education. In total the five highest ranked districts are Nyagatare, Kayonza, Kirebe, Gatsibo and Nyanza, while the five lowest districts are Gicumbi, Rusizi, Nyaruguru, Burera and Nyahibu.

Insert Table 4 about here

According to Part B of Table 4 the highest/lowest contributing components to a province's rank in different well-being indices are: household (Northern/Eastern), community (Eastern/Northern), education (Southern/Eastern), housing standard (Eastern/Southern),

nutrition (Eastern/Western), farming (Southern/Western) and finally the economics component (Eastern/Southern). In sum, the Eastern Province enjoys the highest family well-being, while the Northern Province has the lowest level of family well-being. The highest and lowest children's well-being are assigned to Western and Southern provinces.

The districts are classified into three groups by different areas as urban, semi-urban and rural. According to Table 4 Part C, in urban areas, education, housing and the overall composite indices are the highest. Also the highest income index belongs to urban areas. On the other hand, the lowest numbers of household, community, nutrition and farming indices belong to urban areas. In rural areas, household, community, nutrition, farming and economics indices are the highest and housing and overall composite indices are the lowest. The lowest education, economic and income indices belongs to semi-urban areas. The largest difference is in the children's well-being index where urban areas enjoy the highest level, while rural areas the lowest level.

Part D of Table 4 presents different indices by the periods of study. The three periods differ by three years each. According to this table the number of community, housing, nutrition and economics indices decreased over time. Only household, education and farming indices increased in 2009 as compared to 2006 and then these indices decreased again in 2012. The maximum amount of income index (0.155) was in 2009 while the minimum value (0.021) is associated with 2012. The aggregate family index fluctuated over time. It decreased from 0.253 in 2006 to 0.136 in 2009 and then increased to 0.280 in 2012. The children's index had an increasing trend from 0.208 to 0.267 and 0.274. In sum, the development in children's well-being from 2006 to 2012 was positive but the development in family well-being index was not smooth. In mid-period, 2009, the development in the family index tended to be negative.

Part E of Table 4 shows the sample mean and the dispersion around mean of the indices and their components. The largest variations relative to mean values are those attributed to housing and economics and the lowest to household and community components. Dispersion in child well-being was smaller than the corresponding dispersion for family well-being.

Figure 1 shows the levels of different components and aggregate family well-being. The housing and community components are the main sources of variations in family well-being among districts. Figure 2 shows the different components and their aggregate well-being of children by districts. Again housing and community are the main contributors to the differences in children's well-being among the districts. Contributions of education and the housing standard components are very similar across districts.

Insert Figure 1 and 2 about here

5.3 Change in indices and their components by characteristics

A correlation matrix of the percentage annual changes in different index components, the overall composite indices and income are presented in Table 5. A large number of the pair-wise correlation coefficients are positive and significantly different from zero. The largest pair-wise correlations are those between changes in household and nutrition (0.188),

household and education (0.154), nutrition and education (0.105), and in particular in changes between nutrition and education (0.591) over time.

Insert Table 5 about here

Table 5 further shows that education, nutrition, farming and economics are the main contributors to changes in family well-being. The corresponding segments for changes in children's well-being over time are household, education, housing and nutrition. As expected the changes in the children and family well-being indices are highly correlated (0.556).

Table 6 presents percentage changes per annum in different index components. According to this table average percentage changes in all indices are positive and they vary between 0.001 (community index) to 0.400 (income index). The percentage change in the nutrition index is 0.123 with minimum of -0.329 and maximum of censored extreme observation of 2.000. Censoring is conducted to eliminate the influence of a few outlier observations as a way to avoid distortions in the distribution of households. Changes in housing and education indices are almost the same. Maximum changes in all the indices (except for income) are the censored value 2.000. Maximum amount of dispersion belongs to the income index (0.074) and minimum to the community index (0.002) indicating that this index did not change much.

Like Table 4 which shows the levels of the indices, changes in the indices in Table 6 are composed of four parts, representing percentage yearly changes in all indices by district, province, area and survey years. Part A of Table 6 shows that the districts differ in performance or percentage changes in respective well-being index components. The range of changes in individual components and well-being indices also differ across districts. The largest percentage changes are those of nutrition and farming. These greatly influence the ranks of Musanze, Nyagatare, Ruizi, Nyabihu and Burera to have the five highest changes in family well-being, while Nyanza, Kirebe, Gicumbi, Rutsiro and Nyamasheke are among the districts with five lowest family well-being indices. The ranks of the districts are not very closely related to changes in income per capita of the families.

Part B of Table 6 shows large variations in percentage changes in the nutrition and farming components as well as in income per capita, while the corresponding variations for the remaining components are low. Like levels, the Eastern Province enjoyed a high change rate or growth in well-being over time. The Northern Province had the highest changes in community and education indices and the lowest changes in housing and nutrition indices. The community index did not change much in different provinces.

Part C of Table 6 indicates that urban districts are superior to semi-urban and rural areas in case of income per capita and family well-being. The same applies to the main contributing well-being components of nutrition and farming, but it does not necessarily apply to other individual well-being components. It is worth mentioning here that heterogeneity in both the indices and their components is very large by location area. We did not find a clear one-to-one relationship between the well-being indices and their underlying components.

Part D of Table 6 shows low changes in 2009 in the indices as compared to 2012. It suggests that the high levels of indices and their components are associated with low annual

percentage changes in the well-being indices – that is a negative relationship between level and percentage changes. We note that most of the changes in the different indices (household, housing, nutrition and farming) happened in 2012. As other parts of this table indicate, the community component did not change much over time. Unlike the two well-being indices, changes in the per capita income index increased over time. This suggests that income is not the main contributor to well-being when well-being is defined multidimensionally.

Figure 3 shows the annual percentage changes in different components and aggregate changes in family well-being. Among the districts, growth in nutrition and farming were the main sources of variations in family well-being. Figure 4 shows changes in the different components and the aggregate well-being of children by districts. Again housing and community are the main contributors to the differences in changes in children's well-being among the districts. The contribution of education is very similar across districts.

Insert Figure 3 and 4 about here

5.4 Determinants of income and well-being

Using the principal component analysis we identified various indicators that contributed to well-being in Rwanda. The well-being index was further decomposed into its underlying main components. In addition we distinguished between well-being of children and their families. We investigated the differences in both levels and percentage changes over time in well-being indices and their components amongst different districts, provinces and location areas in Rwanda and their temporal patterns over time. This included income per capita which is a common uni-dimensional measure of well-being. The income measure was compared with the previous well-being measures which are multidimensional.

PCA helped us reduce the dimensionality of well-being to a few specific components and composite indices of children and their families. In this section we estimate models of income and well-being using a regression analysis to identify their determinants and estimate the effects on levels of per capita income and well-being. The estimation results from the ordinary least squares regression of income per capita on different components of well-being and other determinants such as provincial location, area and time periods are reported in Table 7A. Since there might be a two-way causal relationship between income and well-being, family and children's well-being are also regressed on income and other determinants. Alternatively, an estimation of the income and well-being index as a system of two equations accounts for endogeneity and simultaneity issues. The two sets of well-being models differ by economic and farming components of well-being.

The estimation results in Table 7A are heteroscedasticity consistent following the White test method. In each case four models were specified, estimated and tested. The model specifications differed by generalization of the basic model with the overall index as the determinant, different well-being components and added control variables including time, location, area and province characteristics. The decomposition of the overall index into

underlying components was used to study the impact of various indices on Rwanda's family and children's well-being.

Insert Table 7A about here

In Model A1 which is our basic model in the per capita income, family well-being was the only determinant of level of income. An increase in well-being led to an increased income. This is consistent with the fact that families with higher well-being are more educated and healthier and as such are more productive in terms of their earning capacity. A disaggregation of family well-being in Model A2 led to both positive and negative effects on the level of income. The housing and farming components were negative, while the others were positively related to income. A disaggregation of well-being increased R^2 performance of the model from 0.009 to 0.136. Adding control variables to each of two models labeled as Models A3 and A4 further increased R^2 performance of the income model from 0.047 to 0.160. A specification test suggested that the most general Model A4 was the accepted model specification. All included explanatory variables were statistically significant at less than the 1 per cent level of significance with the exception of one province dummy (Eastern) which was not significantly different from the Southern Province that served as the reference province.

The estimation results from models with determinants of family well-being are reported in Table 7B. The models were estimated by OLS with heteroscedastic consistent standard errors. In Model B1 which is our basic family well-being model, per capita income was the only determinant of level of family well-being. An increase in income increased family well-being. This is consistent with our expectation that a higher income increases a family's welfare and well-being. Adding the control variables representing time, province and area locations to Model B2 suggests they had very positive effects on the performance of the model. R^2 increased from 0.009 to 0.370. Inclusion of the components of the family well-being (Model B3) showed their contributions to well-being. Housing and farming negatively affected family well-being. However, the effect of the housing component was not significant. Finally a generalization of family well-being to include income and well-being components and control variables (Model B4) led to improved performance of the model where R^2 increased to 0.793. A specification test of the models suggested that the most general Model B4 was the accepted model specification. With the exception of two variables, income and the Eastern Province dummy, the remaining explanatory variables were statistically significant at the less than 1 per cent level of significance. Income effect was only weakly significant.

Insert Table 7B about here

Estimation results from models with determinants of children's well-being are reported in Table 7C. The key difference between Models 7B and 7C is that in Model 7C child well-being was primarily effected by only child related components. The models were again estimated by OLS with heteroscedastic consistent standard errors. In the simplest Model C1 which is the basic model per capita income served as the only determinant of the level of children's well-being. An increase in income increased children's well-being. This is consistent with our expectation that a higher income will increase children's well-being.

Similar to the family well-being model's specifications we added the different control variables to Model C2 which showed very positive effects on the performance of the model. R^2 increased from 0.002 to 0.124. Again, inclusion of the children's well-being indicators (Model C3) showed evidence of their positive contributions to children's well-being. The effects of the household and education components were the highest. Finally a generalization of the model to include the control variables in Model C4 led to further improvements in the fit of the model. The performance of the model measured in R^2 increased to 0.662. A specification test of the models suggested that the most general Model C4 was the accepted model specification. All included explanatory variables were statistically significant at less than the 1 per cent level of significance.

Insert Table 7C about here

According to Models 7B and 7C the different well-being components' effects on well-being were positive and significant. The time effect differed among the two models suggesting different development of children and family well-being. On the other hand, farming had a negative effect on the well-being of families. Results from Models 7B and 7C suggest that 2009 had negative effects on family well-being, but 2012 had positive effects. This is interpreted to mean that family well-being has progressed over time in Rwanda. The area and province effects in Models B4 and C4 showed similar positive effects on children and family well-being.

6. Summary and Conclusion

Rwanda is a low income country even by African standards. Despite its limited resources the Government of Rwanda in cooperation with NGOs has been able to give high priority to well-being of families and their children. The country, despite its very low GDP per capita, has succeeded in having one of the best child well-being indicators in Africa. Recently Rwanda fulfilled two important achievements in the protection of children. These reform measures aim to protect children's rights and integrate children into families that provide needed care to them. The success in child welfare is positively influenced by policies developed with support from UNICEF.

This research aimed to estimate multidimensional well-being of children and their families in Rwanda. Composite indices of well-being decomposed into their underlying components were estimated using the principal component analysis method and stratified household surveys. The households were then ranked by level of well-being and by various household, district and community characteristics. The results shed light on both the level and changes in well-being of children and their families. They allow identification of provinces and districts with relatively better living condition for children and families. This can serve as a model for public policies aimed at improving the general development of well-being and its specific components in Rwanda.

In this research we identified various indicators contributing to the well-being of households in Rwanda. A composite index of well-being was also constructed. The aggregate well-being index was further decomposed into several main components including household,

community, education, housing standard, nutrition, farming and economics. A grouping of the components allowed us to distinguish between well-being of children and their families. The measure of well-being is household specific and as such it allowed us to investigate the differences in both levels and percentage changes in well-being indices and their components amongst different districts, provinces and areas in Rwanda and their development over time. The two well-being indices are multidimensional and were compared with the commonly used unidimensional measure defined as income per capita.

The principal component analysis helps reduce the dimensionality of well-being to a few specific components. In computing the index for individual households the different principal components with eigenvalues larger than 1 were aggregated using the share of the total variance in the data explained by the different components. This method allowed us to use all information in computing the composite indices of children and their families. The two indices differed by economics and farming components. The selection of well-being components and aggregate indices were determined by data availability and maximum use of data from an economics point of view. Thus, there is room for significant improvements in the indices' definitions and their measurements.

Variations in the levels and percentage annual changes in different well-being components and composite indices were analyzed by location characteristics of households such as district, province and area over time. The analysis showed evidence of significant heterogeneity in various components and by different dimensions of household characteristics. There is clear evidence that some provinces, districts and areas remained high or low ranked. The index components' levels and changes over time were found to be different by characteristics. Different districts and provinces were found to be endowed with different conditions to promote the well-being of residing households. Any public policy measure to enhance well-being must account for both common and unique locality conditions of households.

In addition to the principal component analysis-based estimated indices to rank households by various characteristics as a complement we also estimated several models of income and well-being using a regression analysis. The objective was to identify their determinants and estimate their effects on levels of per capita income and well-being. This approach helped us establish the correlation or the best causality between the indices and their determinants. The estimation results from ordinary least squares regression of the income per capita on different components of well-being and other determinants such as provincial location, area and time periods were reported. Since there might be a two-way causal relationship between income and well-being, family and children's well-being were also regressed on income and other determinants. The two sets of well-being models differed by the economics and farming components of well-being.

The estimation result from a regression of income per capita as a unidimensional measure of well-being and the principal component analysis based multidimensional indices of children and their families' well-being regressed on various control variables helped identify important characteristics and their effects on well-being. The basic model's specifications were generalized and tested to identify and use the finally accepted model specification in the analysis of the factors influencing well-being in Rwanda. The results show evidence of

heterogeneity in effects and the necessity of designing public policies that are adapted to local conditions.

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Table 6. Summary statistics of means of data (N=14,810)

Variable	Description		Mean	Std Dev	Minimum	Maximum
<u>A. household</u>						
dfemale	Equals 1 if the head is female		0.231	0.421	0	1
agehead	Age of hh head		44.381	14.811	15	103
mshead	Marital state of head, equals 1 if the head is married		0.589	0.492	0	1
spousnr	Number of spouses		1.042	0.270	0	5
<u>B. community</u>						
popdens	Number of inhabitants per square kilometer		634.070	762.026	1.9	13,009
urban	Dummy urban area		0.048	0.213	0	1
rural	Dummy rural area		0.872	0.334	0	1
semiurb	Semi-urban area		0.080	0.271	0	1
pop2002	Population in 2002		20,383.050	5,353.609	9,225	51,461
pop2012	Population in 2012		26,564.180	8,446.499	10,384	58,847
<u>C. Education</u>						
lithead	Hh head can read and write a simple message		0.826	0.783	0	9
eduhead	Head's education in years		3.187	1.802	0	10
eduha	Equals one if head has completed primary		0.266	0.442	0	1
eduhb	Equals one if head has completed secondary		0.015	0.122	0	1
schoola	Number of children in hh that are attending school		1.197	1.214	0	7
distroad	Distance to road		3,760.419	3,524.973	0	21,925
<u>D. Housing</u>						
mroof	Metal shree 1; Clay tiles 2; Other spe 3; Straw/That 4; Wood/bambo 5;		3.294	2.291	0	8
mfloor	Earth/Mud 1; Cement con 2; bricks 3; Other spe 4; Hardened 5; Clay tiles 6,		1.601	0.658	0	8
rooms	Numbers of rooms		2.491	2.158	0	99

hhsizer	Number of people in the hh		2.440	1.283	0	12
electra	Equals 1 if the source of lightning is electricity base is kerosene, candles, battery or no lightning		0.051	0.220	0	1
electrb	Equals one if the fuel used for cooking is gas or electricity base is wood, charcoal, kerosene or other fuel		0.006	0.080	0	1
watera	Equals 1 if the main source of drinking water is public tap base is pond, lake, borehole, rain water or spring		0.491	0.500	0	1
waterb	Equals 1 if the hh pays for water		0.232	0.422	0	1
waterc	Distance to main water source in minutes		28.822	126.887	0	6,000
<u>E. Nutrition</u>						
vegetd	Equals 1 if hh owns a vegetable garden		0.564	0.496	0	1
nranimal	Number of animals		2.994	5.688	0	203
nrcrops	Number of crops		3.373	1.730	0	10
bantrnr	Number of banana trees owned by the hh		22.056	112.847	0	3,500
bantrbnr	Number of banana trees used for making beer owned by the hh		31.237	116.929	0	4,000
<u>F. Farming</u>						
marshlan	Percentage of farmland cultivated on marshlands in district		0.530	0.499	0	1
altitude	Altitude in meters		1,747.481	281.373	955	2,739
nranimal	Number of animals		2.994	5.688	0	203
nrcrops	Number of crops		3.373	1.730	0	10

	<u>G. Economics</u>					
nrincome	Number of income generating activities undertaken by hh		1.766	0.685	0	10
tincome	Total income from all income generating (four primary) activities		179,793.200	236,125.300	0	7,200,000
cashcrop	Equals one if the hh is a producer of cash crops (Tea, Coffee, Sugar)		0.059	0.236	0	1
distmark	Distance to market		77.226	61.950	0	1,200
distroad	Distance to road		3,760.419	3,524.973	0	21,925
worksend	Equals one if the extended family member sends back money		0.052	0.222	0	1
credd	Equals one if the hh has access to credit		0.264	0.440	0	1

Note: household (hh)

Table 2. Principal component analysis (individual components, children and family composite indices), n=14,810 obs

Variable	Eigenvalue	Proportion	Cumulative	Variable	Eigenvalue	Proportion	Cumulative
I. Individual index components:				II. Overall composite index:			
<u>A. Household</u>				<u>Composite family wellbeing index</u>			
PC1	1.90	0.38		PC1	3.38	0.08	
PC2	1.12	0.22	0.60	PC2	2.85	0.07	
<u>B. Community</u>				PC3	2.13	0.05	
PC1	1.90	0.47		PC4	1.89	0.05	
PC2	1.03	0.25	0.73	PC5	1.77	0.04	
<u>C. Education</u>				PC6	1.60	0.04	
PC1	1.94	0.32		PC7	1.37	0.03	
PC2	1.04	0.17	0.49	PC8	1.28	0.03	
<u>D. Housing</u>				PC9	1.24	0.03	
PC1	1.68	0.19		PC10	1.20	0.03	
PC2	1.49	0.17		PC11	1.13	0.03	
PC3	1.25	0.14		PC12	1.05	0.03	
PC4	1.01	0.11	0.60	PC13	1.04	0.03	
<u>E. Nutrition</u>				PC14	1.03	0.03	0.57
PC1	1.57	0.31		<u>Composite children wellbeing index</u>			
PC2	1.12	0.22	0.53	PC1	2.70	0.10	
<u>F. Farming</u>				PC2	2.36	0.08	
PC1	1.59	0.26		PC3	1.95	0.07	
PC2	1.48	0.25	0.51	PC4	1.51	0.05	
<u>G. Economic</u>				PC5	1.36	0.05	
PC1	1.36	0.19		PC6	1.27	0.04	
PC2	1.19	0.17		PC7	1.13	0.04	
PC3	1.01	0.14	0.51	PC8	1.09	0.04	
				PC9	1.05	0.04	
				PC10	1.01	0.04	0.55

Table 3. Correlation matrix among index components, n=14,810 obs

	Year	Household	Community	Education	Housing	Nutrition	Farming	Economic	Family	Children	Income
Year	1.000										
Household	0.041	1.000									
	0.001										
Community	-0.144	-0.010	1.000								
	0.001	0.227									
Education	0.132	0.228	-0.021	1.000							
	0.001	0.001	0.009								
Housing	-0.738	-0.132	0.183	-0.111	1.000						
	0.001	0.001	0.001	0.001							
Nutrition	-0.286	0.196	0.049	0.059	0.148	1.000					
	0.001	0.001	0.001	0.001	0.001						
Farming	-0.458	0.257	-0.011	0.036	0.052	0.612	1.000				
	0.001	0.001	0.175	0.001	0.001	0.001					
Economic	-0.589	0.084	0.096	0.020	0.371	0.327	0.463	1.000			
	0.001	0.001	0.001	0.014	0.001	0.001	0.001				
Family wellbeing	0.235	0.049	0.271	0.220	0.106	0.391	-0.191	0.010	1.000		
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.236			
Children wellbeing	0.197	0.527	0.094	0.384	0.062	0.214	-0.046	0.000	0.455	1.000	
	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.952	0.001		
Income	-0.246	0.088	0.055	0.149	-0.031	0.193	0.425	0.481	-0.224	0.038	1.000
	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001	

Table 4. Summary of all indices by district, province, area and year, sorted by family index, sorted by change in family index, n=14,810 obs

	House hold	Comm unity	Educ ation	Housi ng	Nutriti on	Farmi ng	Econo mic	Famil y wb	Childr en wb	Incom e
A. District										
Musanze	0.063	0.002	0.061	0.081	0.178	0.195	0.057	0.069	0.047	0.376
Nyagatare	0.051	0.004	0.082	0.093	0.172	0.133	0.038	0.067	0.058	0.422
Rusizi	0.050	0.001	0.069	0.117	0.190	0.149	0.048	0.063	0.053	0.387
Nyabihu	0.057	0.000	0.061	0.073	0.200	0.212	0.043	0.062	0.056	0.258
Burera	0.051	0.003	0.065	0.068	0.111	0.086	0.044	0.060	0.056	0.418
Rubavu	0.056	0.002	0.068	0.078	0.189	0.230	0.054	0.055	0.029	0.311
Ngoma	0.060	0.000	0.066	0.094	0.132	0.117	0.071	0.055	0.081	0.522
Karongi	0.059	0.001	0.066	0.060	0.129	0.053	0.062	0.052	0.053	0.394
Rwamagana	0.056	0.001	0.053	0.074	0.139	0.100	0.044	0.050	0.054	0.468
Bugesera	0.056	0.001	0.060	0.076	0.143	0.091	0.054	0.049	0.068	0.496
Nyaruguru	0.050	0.001	0.067	0.070	0.101	0.048	0.058	0.043	0.049	0.351
Huye	0.059	0.001	0.058	0.078	0.129	0.053	0.064	0.043	0.064	0.379
Nyamagabe	0.054	0.002	0.081	0.066	0.111	0.061	0.058	0.042	0.053	0.503
Gakenke	0.052	0.000	0.083	0.061	0.079	0.009	0.059	0.041	0.047	0.470
Kamonyi	0.051	0.001	0.055	0.072	0.100	0.068	0.081	0.038	0.054	0.493
Ngororero	0.064	0.000	0.088	0.042	0.107	0.053	0.045	0.038	0.052	0.473
Rulindo	0.059	0.000	0.089	0.066	0.093	0.047	0.046	0.037	0.042	0.398
Ruhango	0.060	0.001	0.063	0.075	0.128	0.056	0.054	0.035	0.072	0.352
Gisagara	0.065	0.001	0.066	0.071	0.120	0.058	0.027	0.033	0.058	0.342
Gatsibo	0.057	0.003	0.078	0.091	0.100	0.057	0.059	0.033	0.055	0.477
Muhanga	0.055	0.000	0.062	0.076	0.071	0.023	0.064	0.032	0.043	0.401
Kayonza	0.065	0.000	0.079	0.078	0.094	0.101	0.047	0.032	0.053	0.429
Nyanza	0.052	0.002	0.065	0.051	0.127	0.145	0.049	0.031	0.057	0.240
Kirehe	0.064	0.000	0.074	0.063	0.095	0.081	0.026	0.031	0.051	0.314
Gicumbi	0.047	0.010	0.103	0.066	0.086	0.037	0.046	0.029	0.044	0.326
Rutsiro	0.048	0.000	0.099	0.056	0.110	0.042	0.059	0.028	0.043	0.373
Nyamasheke	0.061	0.000	0.063	0.090	0.075	0.048	0.048	0.027	0.039	0.414
B. Province										
Southern	0.400	0.321	0.356	0.219	0.128	0.424	0.223	0.219	0.241	0.064
Western	0.411	0.328	0.350	0.267	0.114	0.388	0.234	0.212	0.273	0.072
Northern	0.415	0.281	0.346	0.227	0.118	0.398	0.236	0.199	0.272	0.073
Eastern	0.385	0.396	0.333	0.311	0.138	0.402	0.254	0.254	0.257	0.068
C. Area										
Urban	0.380	0.299	0.373	0.342	0.106	0.313	0.216	0.249	0.357	0.075
Semi-urban	0.391	0.327	0.339	0.267	0.123	0.388	0.211	0.235	0.280	0.061
Rural	0.404	0.338	0.346	0.253	0.126	0.410	0.240	0.220	0.252	0.069
D. Year										
2006	0.331	0.366	0.283	0.603	0.154	0.421	0.339	0.253	0.208	0.043
2009	0.461	0.338	0.370	0.207	0.138	0.538	0.298	0.136	0.267	0.150
2012	0.383	0.321	0.353	0.161	0.103	0.290	0.147	0.280	0.274	0.015
E. Sample										
Mean	0.402	0.335	0.346	0.259	0.125	0.404	0.237	0.223	0.259	0.069
Std Dev	0.148	0.111	0.149	0.194	0.072	0.160	0.134	0.115	0.109	0.106

Table 5. Correlation matrix of changes in index components, n=14,810 obs

	Household	Community	Education	housing	Nutrition	Farming	Economic	Family	Children	Income
Household	1.000									
Community	0.012	1.000								
	0.172									
Education	0.154	0.016	1.000							
	0.001	0.072								
Housing	0.101	0.033	0.036	1.000						
	0.001	0.000	0.001							
Nutrition	0.188	-0.003	0.105	0.001	1.000					
	0.001	0.731	0.001	0.922						
Farming	0.123	-0.009	0.036	-0.004	0.591	1.000				
	0.001	0.341	0.001	0.674	0.001					
Economic	0.031	0.011	0.069	0.049	0.097	0.091	1.000			
	0.001	0.222	0.001	0.001	0.001	0.001				
Family wellbeing	0.244	0.065	0.385	0.081	0.581	0.392	0.342	1.000		
	0.001	0.001	0.001	0.001	0.001	0.001	0.001			
Child wellbeing	0.492	0.010	0.332	0.266	0.271	0.052	0.097	0.556	1.000	
	0.001	0.281	0.001	0.001	0.001	0.001	0.001	0.001		
Income	-0.133	-0.006	0.048	-0.009	0.028	0.004	0.262	0.103	-0.037	1.000
	0.001	0.478	0.001	0.325	0.002	0.623	0.001	0.001	0.001	

Table 6. Summary of percentage changes in all indices by district, province, area and year,
n=14,810 obs

	Hous ehold	Comm unity	Educa tion	Housi ng	Nutrit ion	Farmi ng	Econo mic	Famil y wb	Child wb	incom e
A. District										
Nyanza	0.052	0.002	0.065	0.051	0.127	0.145	0.049	0.031	0.057	0.240
Gisagara	0.065	0.001	0.066	0.071	0.120	0.058	0.027	0.033	0.058	0.342
Nyaruguru	0.050	0.001	0.067	0.070	0.101	0.048	0.058	0.043	0.049	0.351
Huye	0.059	0.001	0.058	0.078	0.129	0.053	0.064	0.043	0.064	0.379
Nyamagabe	0.054	0.002	0.081	0.066	0.111	0.061	0.058	0.042	0.053	0.503
Ruhango	0.060	0.001	0.063	0.075	0.128	0.056	0.054	0.035	0.072	0.352
Muhanga	0.055	0.000	0.062	0.076	0.071	0.023	0.064	0.032	0.043	0.401
Kamonyi	0.051	0.001	0.055	0.072	0.100	0.068	0.081	0.038	0.054	0.493
Karongi	0.059	0.001	0.066	0.060	0.129	0.053	0.062	0.052	0.053	0.394
Rutsiro	0.048	0.000	0.099	0.056	0.110	0.042	0.059	0.028	0.043	0.373
Rubavu	0.056	0.002	0.068	0.078	0.189	0.230	0.054	0.055	0.029	0.311
Nyabihu	0.057	0.000	0.061	0.073	0.200	0.212	0.043	0.062	0.056	0.258
Ngororero	0.064	0.000	0.088	0.042	0.107	0.053	0.045	0.038	0.052	0.473
Rusizi	0.050	0.001	0.069	0.117	0.190	0.149	0.048	0.063	0.053	0.387
Nyamasheke	0.061	0.000	0.063	0.090	0.075	0.048	0.048	0.027	0.039	0.414
Rulindo	0.059	0.000	0.089	0.066	0.093	0.047	0.046	0.037	0.042	0.398
Gakenke	0.052	0.000	0.083	0.061	0.079	0.009	0.059	0.041	0.047	0.470
Musanze	0.063	0.002	0.061	0.081	0.178	0.195	0.057	0.069	0.047	0.376
Burera	0.051	0.003	0.065	0.068	0.111	0.086	0.044	0.060	0.056	0.418
Gicumbi	0.047	0.010	0.103	0.066	0.086	0.037	0.046	0.029	0.044	0.326
Rwamagana	0.056	0.001	0.053	0.074	0.139	0.100	0.044	0.050	0.054	0.468
Nyagatare	0.051	0.004	0.082	0.093	0.172	0.133	0.038	0.067	0.058	0.422
Gatsibo	0.057	0.003	0.078	0.091	0.100	0.057	0.059	0.033	0.055	0.477
Kayanza	0.065	0.000	0.079	0.078	0.094	0.101	0.047	0.032	0.053	0.429
Kirehe	0.064	0.000	0.074	0.063	0.095	0.081	0.026	0.031	0.051	0.314
Ngoma	0.060	0.000	0.066	0.094	0.132	0.117	0.071	0.055	0.081	0.522
Bugesera	0.056	0.001	0.060	0.076	0.143	0.091	0.054	0.049	0.068	0.496
B. Province										
Southern	0.056	0.001	0.065	0.070	0.111	0.063	0.057	0.037	0.056	0.384
Western	0.056	0.001	0.073	0.074	0.142	0.110	0.051	0.046	0.047	0.375
Northern	0.054	0.003	0.080	0.068	0.109	0.075	0.051	0.047	0.047	0.397
Eastern	0.059	0.001	0.071	0.081	0.125	0.097	0.049	0.045	0.060	0.447
C. Area										
Urban	0.058	-0.003	0.066	0.082	0.216	0.205	0.065	0.052	0.045	0.452
Semi-urban	0.060	0.007	0.074	0.066	0.137	0.126	0.071	0.043	0.035	0.375
Rural	0.056	0.001	0.072	0.074	0.116	0.077	0.050	0.043	0.055	0.399
D. Year										
2009	0.039	0.002	0.093	0.070	0.104	0.056	0.053	0.051	0.060	0.385
2012	0.070	0.001	0.054	0.077	0.136	0.110	0.051	0.037	0.047	0.411
E. Sample										
Mean	0.056	0.001	0.071	0.074	0.123	0.087	0.052	0.044	0.053	0.400
Std Dev	0.005	0.002	0.013	0.015	0.036	0.057	0.012	0.013	0.010	0.074

Table 7A. Determinants of per capita income, n=14,810 obs

	Model A1		Model A2		Model A3		Model A4	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Intercept	9.727a	0.024	9.554a	0.051	9.484a	0.063	8.737a	0.101
Household			-1.562a	0.072			-1.848a	0.074
Community			0.556a	0.098			0.704a	0.100
Education			0.963a	0.066			0.735a	0.066
Housing			-0.782a	0.059			0.448a	0.097
Nutrition			1.745a	0.167			2.156a	0.192
Farming			-0.751a	0.091			-0.513a	0.126
Economic			3.367a	0.095			3.640a	0.107
d2009					0.453a	0.033	0.776a	0.050
d2012					-0.177a	0.029	0.899a	0.060
Family	1.032a	0.096			2.441a	0.114		
Suburban					-0.273a	0.060	-0.256a	0.056
Rural					-0.270a	0.050	-0.380a	0.047
Western					0.192a	0.027	0.223a	0.026
Northern					0.136a	0.031	0.141a	0.029
Eastern					0.100a	0.029	0.024	0.028
F-value	130.360		333.520		92.720		202.790	
R2 adj	0.009		0.136		0.047		0.160	

Notes: Significant at less than 1% (a) and 5% (b) levels of significance. Urban area, Southern province and 2006 are references. Standard errors are corrected for heteroscedasticity.

Table 7B. Determinants of family wellbeing, n=14,810 obs

	Model B1		Model B2		Model B3		Model B4	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Intercept	0.138a	0.008	0.133a	0.008	0.103a	0.007	-0.122a	0.007
Household					0.026a	0.005	0.063a	0.003
Community					0.234a	0.009	0.307a	0.007
Education					0.150a	0.006	0.152a	0.005
Housing					-0.004	0.004	0.075a	0.006
Nutrition					1.245a	0.017	0.794a	0.017
Farming					-0.506a	0.008	-0.032a	0.008
Economic					0.043a	0.008	0.223a	0.006
d2009			-0.113a	0.002			-0.074a	0.003
d2012			0.033a	0.003			0.140a	0.003
Income	0.008a	0.001	0.013a	0.001	0.002a	0.001	0.001b	0.000
Suburban			-0.011b	0.005			-0.023a	0.003
Rural			-0.022a	0.004			-0.047a	0.002
Western			-0.007a	0.002			0.006a	0.001
Northern			-0.014a	0.002			0.007a	0.001
Eastern			0.029a	0.002			-0.001	0.001
F-value	130.360		1088.500		2198.180		3773.350	
R2 adj	0.009		0.370		0.543		0.793	

Notes: Significant at less than 1% (a) and 5% (b) levels of significance. Urban area, Southern province and 2006 are references. Standard errors are corrected for heteroscedasticity.

Table 7C. Determinants of children wellbeing, n=14,810 obs

	Model C1		Model C2		Model C3		Model C4	
	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err	Coeff	Std Err
Intercept	0.225a	0.007	0.262a	0.008	-0.051a	0.007	-0.237a	0.009
Household					0.345a	0.005	0.309a	0.004
Community					0.073a	0.010	0.118a	0.008
Education					0.207a	0.006	0.150a	0.004
Housing					0.072a	0.005	0.429a	0.011
Nutrition					0.117a	0.015	0.371a	0.011
d2009			0.065a	0.002			0.186a	0.005
d2012			0.072a	0.002			0.256a	0.006
Income	0.003a	0.001	0.002a	0.001	0.004a	0.001	0.002a	0.000
Suburban			-0.080a	0.005			-0.062a	0.003
Rural			-0.115a	0.005			-0.100a	0.003
Western			0.041a	0.002			0.033a	0.001
Northern			0.035a	0.002			0.037a	0.002
Eastern			0.031a	0.002			0.004a	0.001
F-value	24.420		363.060		1577.300		2229.720	
R2 adj	0.002		0.124		0.390		0.662	

Notes: Significant at less than 1% (a) and 5% (b) levels of significance. Urban area, Southern province and 2006 are references. Standard errors are corrected for heteroscedasticity.

Figure 1. Family wellbeing level by districts.

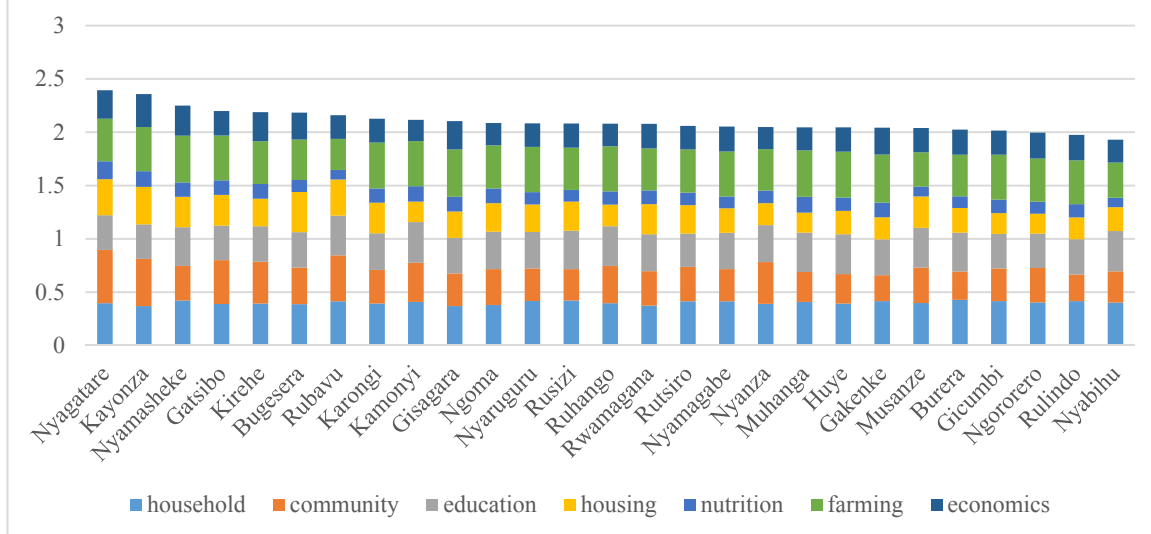


Figure 2. Children wellbeing level by districts.

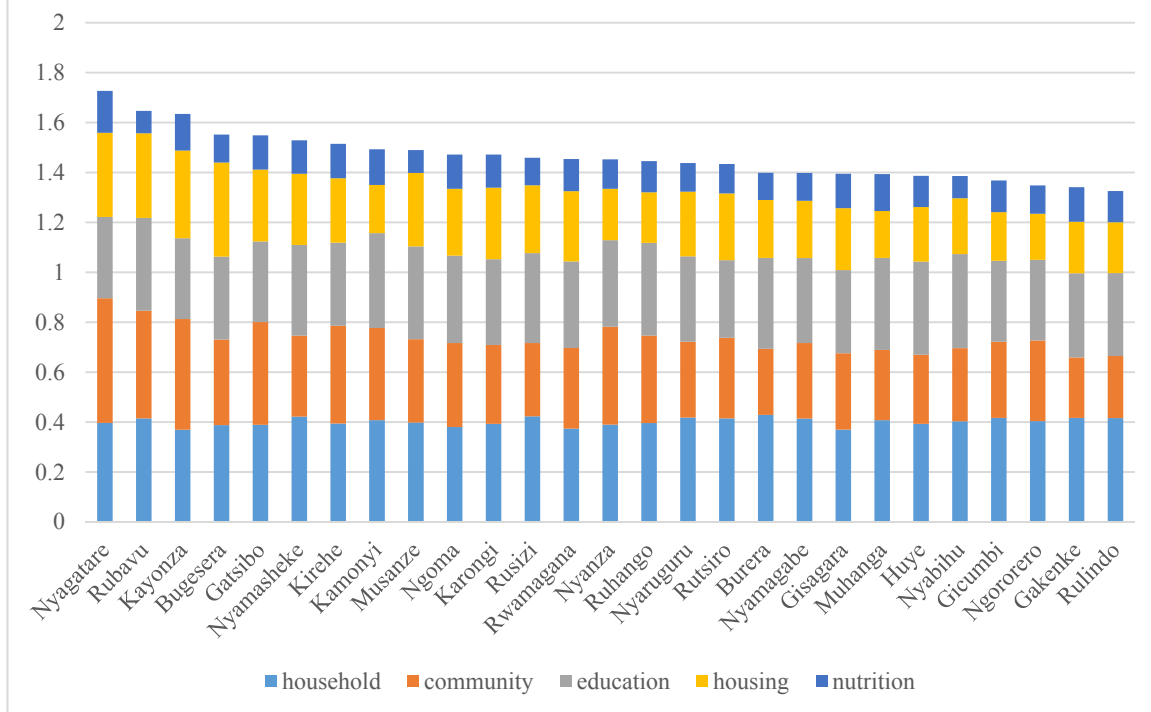


Figure 3. Sum och annual changes in family wellbeing components across districts.

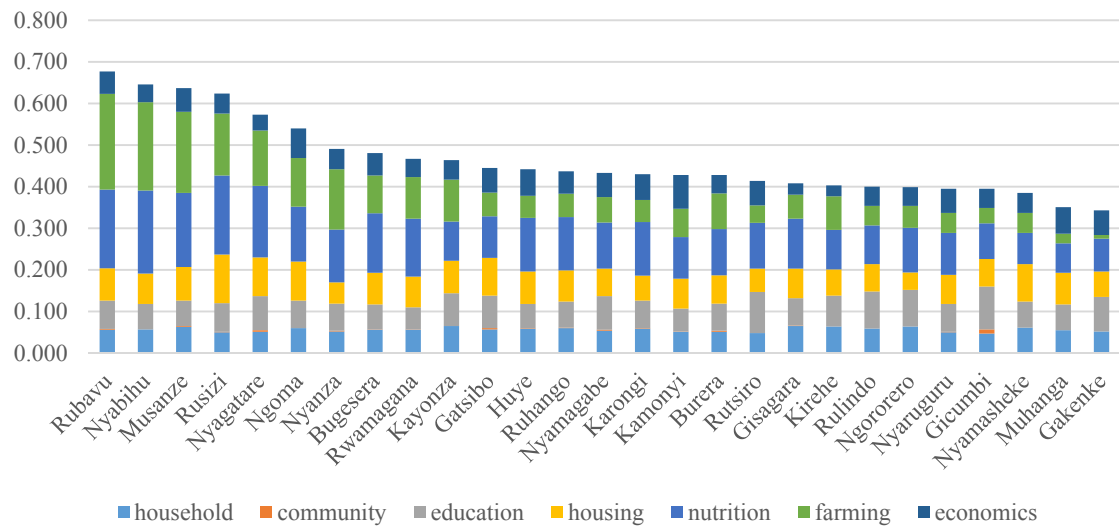
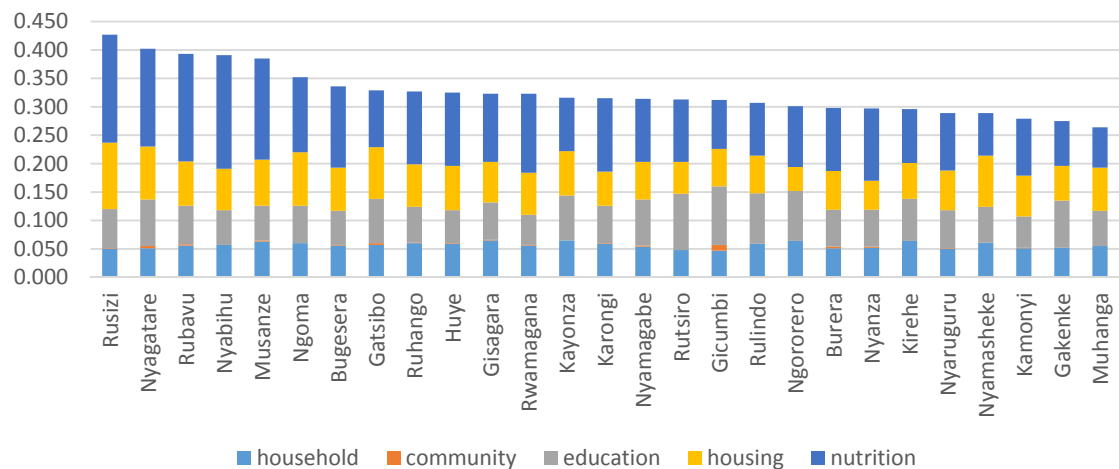


Figure 4. Sum of annual changes in childrens wellbeing components across districts.



Part Five. International Trade

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Chapter Ten

An Analysis of the Causative Factors of Trade Flows between Rwanda and its main Trading Partners

Marie Chantal Umutesi

University of Rwanda
College of Business and Economics
School of Economics
E-mail: m7chantal@gmail.com

Abstract

Trade play an important role in Rwanda's economy, influencing the level of its economic growth, balance of payments and employment. Rwanda has initiated several trade policy reforms aimed at promoting trade. Given the role of trade in the economy it is important to study the causative factors of trade in Rwanda and its main trading partners. This research examines the factors affecting Rwanda's trade using a gravity model. Using the World Bank Development Indicators dataset and data from the National Bank of Rwanda (NBR), it finds that Rwanda's GDP, its trading partners' GDP, population growth and real exchange rate had positive and significant effects on Rwanda's trade. The study also shows that Rwanda's population growth is not significant, while distance has a negative effect on Rwanda's trade. Having common borders, an official common language and the formation of EAC are not significant. Based on these results the study gives a number of recommendations for improving Rwanda's trade.

Keywords: Trade flows, gravity model, common borders, Rwanda.

1. Introduction

1.1 The background

Rwanda as a developing country located in central and East Africa has shown sustainable economic growth since 1995. The country has the highest density of population among sub-Saharan African countries and is landlocked with few natural resources and low levels of industrialization. About 79 per cent of the population is engaged mainly in subsistence agriculture (the World Bank, 2011). Rwanda is among those developing countries which have achieved high and sustainable economic growth during the last two decades and signed trade deals with countries so that their goods and services are exposed to the other countries and vice versa. The products that Rwanda sells to the global market are accounted for under exports and the products that it buys from the global market are accounted for under imports. Exports and imports are very important to stimulate economic growth in Rwanda and a combination of the two is a potential tool for developing Rwanda's economy. They can also play an important role in achieving the country's socioeconomic objectives including improving capital availability. In a country like Rwanda, exports and imports can also emerge as a significant vehicle for building physical capital, creating employment opportunities, developing production capacities and helping integrate the domestic economy with the global economy. Our study provides an assessment of the current export and import situation in Rwanda and examines their impact on the country's GDP.

After the genocide in 1994 the Rwandan economy was at a critical stage due to total destruction but after 20 years the country has re-established itself and is today considered as one of the top leading economies in East Africa. Some of the tools used for achieving this are promoting exports of local product such as coffee, tea and mining.

During recent years, there has been a downtrend in world economic growth due to different factors including an increase in geopolitical wars in some emerging economies that have led to an increase in energy prices and increasing long term interest rates. The Rwandan government has made significant efforts to put in place measures to promote exports (NBR, 2014). It created the Rwanda Development Board (RDB) to bring together all government agencies in charge of investments including agencies responsible for business registration, investment promotion, tourism and others. This structure helps foreign and local investors obtain certificates of incorporation, tax identification numbers and other documents in a few days. It is true that a country has to encourage investments inside and outside the country as the main key for development because investments provide a variety of benefits such as employment generation and payment of taxes to the government to boost its economy so that it can provide a variety of products and other opportunities (MINECOFIN, 2003).

The Rwandan economy grew by 6.5 per cent during the fiscal year 2015-16 compared to 7.3 per cent in the previous fiscal year. While agriculture continued at its long-term average growth rate of 5 per cent, both industry and services saw their growth slow down to 4 per cent respectively. The slowdown in industry, from 7 to 4 per cent, was particularly large and was mainly attributable to mining shrinking by 10 per cent continuing from the decline in the second half of fiscal year 2014-15 (MINECOFIN, 2017).

During fiscal year 2013-014, growth was mainly driven by services and industry sectors which grew by 7 and 6 per cent respectively. The main drivers in the industry sector were manufacturing and construction and both grew by 5 per cent. A good harvest in the A2014 season which followed a poor performance in season B2013 contributed to a 3 per cent growth in the agriculture sector. Available data indicates that GDP per capita stood at US \$ 701 in 2013 compared to US \$ 689 at the end of 2012 (MINECOFIN, 2014).

The economy also recorded a low performance in 2013-14 as compared to the last four fiscal years mainly due to low production in the agriculture and industry sectors. Despite the ongoing implementation of the crop intensification program, weather conditions contributed to a poor harvest in 2013-14 as compared to the two previous fiscal years. The industry sector's growth rate decreased mainly due to manufacturing and construction sub-sectors, which performed badly (MINEFOFIN, 2015).

The industrial sector grew by 6 per cent during 2013-14, compared to 12 per cent in 2012-13. Mining led the sector's performance with a 15 per cent expansion, followed by construction and manufacturing with 5 per cent growth and beverages which grew at a rate of 3 per cent. The growth in mining was a result of previous large investments in the sector along with high mineral prices in the first half of the fiscal. However, sugar production declined as the industry stopped production for four months for maintenance purposes instead of the two months stoppage earlier. Electricity grew by 8 per cent due to new investments in the energy sector. During the same period, the production of cement increased by 5 per cent and modern beer by 4 per cent due to stability in electricity supply. For the manufacturing sector, the following products recorded negative growth: soaps (-6 per cent), paints (-22 per cent), textiles (-18 per cent), sugar (-18 per cent) and flour production (-9 per cent). The share of industry sector to GDP was 15 per cent (MINECOFIN, 2014).

According to MINECOFIN (2016), services remained the largest share of GDP at 47 per cent and grew by around 7 per cent. This performance was mainly driven by trade and transport which grew by 8 per cent, followed by real estate at 5 per cent. In addition to general trade and real estate, activities in administrative and support services, hotels and restaurants and information and communication remained the largest contributors to GDP.

The overall balance of payments deficit increased by 5.2 per cent to US\$ 62.6 million at the end of FY 2015-16. This was due to mineral exports declining in output for six quarters in a row by the end of the fiscal year as prices continued to decline, the other segments of services sector declined due to the need for expertise for Rwandair and because secondary incomes (budgetary grants) did not grow during this period (MINECOFIN, 2017).

The decrease in mineral exports affected the volume of exports of goods in 2015 negatively; this decrease was followed by a decrease in imports of goods due to an increase in energy imports which led to a surplus in the current account.

Imports from EAC countries increased by 10 per cent in 2013-14 because of a reduction in import tariffs, reduced non-tariff barriers and more efficient border controls. However, exports to EAC declined significantly to 44 per cent. This is related to low competition in

the region. Major exports to EAC included tea and coffee (Mombasa auction), hides and skins and iron and steel (MINECOFIN, 2014).

As a landlocked country Rwanda's level of imports is higher than its level of exports because of its focus on priority expenditure assisted by grant financing from donors. Despite its trade deficit, Rwanda is driven by a stable macroeconomic framework (the World Bank, 2011). The inadequacy of infrastructure and limited knowledge of the labor force have become crucial limitations in boosting trade, investments and economic growth.

Our study analyzes the causative factors of trade between Rwanda and its main trading partners using the gravity model. Literature on the gravity model's application in Rwanda is limited even though there is growing interest in this subject among researchers and policymakers.

Geographically, our study covers Rwanda and the EAC (East African Community) territory's two main trading partners because these hold all the information regarding imports and exports of different items. This is a key factor in an analysis of the variations in trade in different years. Our study covers the period 2000-15; this was a period in which the EAC revived itself and worked among its member countries.

Our study is limited to independent variables, the dependent variable and factor and dummy variables for finding the effects of economic growth which is done by GDP, population, exchange rate and distance to Rwanda.

Trade and economic growth are two concepts that go together because international trade contributes to the growth of a country's economy in several ways. This is affected by the distance between countries which are trading with each other, the level of population growth, the variability of their currencies and the trade agreements that they sign with each other.

Like other developing countries with rapidly growing economies, Rwanda imports more than it exports leading to a trade deficit where Rwanda's participation in trade is still low. Rwanda needs to have specific solutions to resolve these issues. Our study analyzes the causative factors of trade flows between Rwanda and its main trading partners by including variables which influence trade such as growth in population, distance between the two trading partners, exchange rate and the trade agreements signed. It also looks at the effect of having common borders and languages.

Most of the empirical studies on Rwandan trade emphasize only on exports, imports, being a member of a trade union and exchange rate but do not emphasize other factors that affect trade such as distance, common borders and a common language. Our study fills this gap.

2. Literature Review

2.1 Overview of Trade theories

To understand how modern global trade has changed, it is crucial to understand how countries have traded with one another historically. Over time, economists have come up with theories to explain the mechanisms of global trade. The key historical theories are called classical theories which are done from the perspective of a country or are country-

based. In the mid-20th century, theories began to change to explain trade from a firm rather than a country perspective. These theories are referred to as modern theories and are firm-based or company-based. Both these categories, classical and modern, consist of several international theories (Robert and John, 2004).

Trade between countries is possible because they benefit from it. There may be other motivations for trade between two countries but the main motivation is gain for the participants. In most cases the benefits from international trade are like benefits from all trades. The benefits increase because specialization allows resources to be allocated to their most productive uses in each trading country (Robert and John, 2004). It is well-known that it is unwise for a town or a province to be self-sufficient and not recognize that specialization and the division of labor also exist in international trade. Political boundaries that divide geographic areas into nations do not change the nature of trade nor do they remove its benefits. The truth about this was developed by classical economists in the late 18th and 19th centuries. The advantage of Adam Smith's original statement on trade, contained in his *The Wealth of Nations* (1776), was understood in terms of absolute cost differences between countries. Smith assumed that each nation could produce one or more items at a lower real cost than its trading partners. It then follows that each country will benefit from specialization in those commodities in which it has an absolute advantage (that is, it can produce them at a lower real cost than another country), exporting them and importing other items that it produces at a higher real cost than another country. Real cost, for Smith, meant the amount of labor time required to produce an item (Robert and John, 2004).

Smith's analysis mainly relied on the labor theory of value, which considers labor as the only factor of production and holds that commodities are exchanged for one another in proportion to the number of hours needed for their production. To make it simple, the classical economists' assumption is that labor is completely immobile between countries. If labor requirements differ across countries, then in the absence of trade, the prices of goods will differ across countries. In brief, Adam Smith did not consider the way an equilibrium price might be reached between trading nations. He showed the proposition that a nation gained from trade in which it exported the commodities that it produced at a lower real cost than other countries and imported those commodities that it produced at a higher real cost than other countries.

Smith demonstrated that a possible way of gaining from specialization was not only by assigning tasks within a firm but also by trading with other countries. A country has to export products in which it is more productive than other countries because it will have an absolute advantage for goods for which it can produce more output per unit of input than others. A country should import goods where it is less productive than other countries and has an absolute disadvantage. Trade makes it possible for world output to increase even though individuals are working no harder than before the trade took place (Robert and John, 2004).

Ricardo (1987) explains that absolute cost advantages are not a necessary condition for two nations to gain from trade with each other. Instead, trade will benefit both nations provided their relative costs, that is, the ratios of their real costs in terms of labor inputs, are different for two or more commodities. In brief, trade relies on differences in comparative advantages

and one nation can profitably trade with another even though its real costs are higher (or lower) in every item. One of the ways to avoid dependency on the labor theory of value is the use of the now familiar concept of opportunity cost which is the next best alternative unit of a commodity given up in order to obtain another unit of commodity (Ricardo, 1987).

Ricardo tried to extend this finding to explain that the basis for gains from trade was the existence of comparative advantage, not absolute advantage. A country that was less productive in two goods could still gain from trade by exporting the goods in which its relative disadvantages were smaller because its relative prices of these goods before trade will be lower than abroad. A country with an absolute advantage in both goods gains by specializing in the production of the goods in which its relative advantage is greater. It can gain from trade by importing the products in which its relative advantage is smaller because the foreign opportunity costs of producing them are lower (Robert and John, 2004).

Wherever pre-trade prices in two countries differ, gains from trade are possible. The larger the improvements in a nation's terms of trade the greater the gains (the ratio of its export price to its import price) relative to its autarky position.

The Heckscher-Ohlin (H-O) theory incorporates other determinants of production which were not included in the Ricardian model. Hence, labor is the only factor of production that is needed to produce goods and services and it is only differences in technology that determine international trade. According to the H-O theory a capital abundant country will export capital-intensive goods and a labor abundant country will export labor-intensive goods; complete specialization only happens when a country's factor endowments are different from the endowments of another country (Schott, 2003). Tests of the factor proportions hypothesis have shown unexpected results. Leontief found that US imports needed more capital relative to labor than US exports, even if he expected a capital-abundant country like the United States to export capital-intensive goods. More complete tests of the theory suggest that it works best in predicting trade between dissimilar countries but that some trade is not explained by differences in factor endowments (Robert and John, 2004).

Different studies have been done on factors that determine trade flows between two countries. Joachim (2007) states that more active participation in the international market by promoting exports will lead to competition and trade improvements in terms of productivity. Leamer (1984) shows that trade specialization for primary goods is highly dependent on the differences in endowments of natural resources, while the result for industrial goods is not clear. Leamer developed the idea for industrial goods at a future date in an article published in collaboration with Harry et al., (1987).

However, studies like Balassa and Bauwens (1988), find that North-South trade can be explained by differences in skill endowments (but not in capital endowments).

In the early 1990s a lot of literature on the determinants of trade patterns used differences in consumer preferences, technology or in returns to scale to explain trade patterns. According to Ricardo changes in technology were utilized unexpectedly which enhanced the prediction of trade in factor services (Davis and Weinstein, 2001; Trefler, 1995). Changes in consumer choices could relate to home bias consumption (Trefler 1995). Further, increasing returns to

scale in different sectors is also beneficial in clarifying some factors of trade flows (Antweiler and Trefler, 2002).

In addition to factor endowments, these studies applied new factors to describe why a country was a net exporter of one factor and to describe specialization in production (Harrigan, 1997).

Cumulative income determines the level of demand in the importing country and the level of supply in the exporting country. Whereas Anderson and Van's (2003) analysis found that it was cumulative income that determined demand and supply Bergstrand (1985, 1989) developed a microeconomic foundation of the gravity model. He states that a gravity model is a reduced form equation of a general equilibrium of demand and supply systems.

To understand the factors of comparative advantage it is necessary to include many countries over a long period of time in the analysis to see if these factors change over a period of time. Given the lack of reliable input-output data that is needed to calculate the net factor content of trade, one way to proceed is by studying the factors of net trade on items (that is, relying on the items version of the Heckscher-Ohlin-Vanek theorem). Lederman and Xu (2001) included these 'new' factors in item version for a panel of 57 countries over 25 years for ten product group clusters presented by Leamer (1984). Lederman and Xu used an estimate of profit to test the influence of factor endowments on net exports which is the best way to control for the absence of linear than the way used in preceding studies on items (Leamer, 1987). According to Baier and Bergstrand (2001) the main factors that explain growth in world trade are income growth, tariffs and transport cost reductions.

2.1 Economic Growth and Trade

Many researchers and economic policymakers have studied the relationship between economic growth and trade. Many economic models have been established by many researchers. However, their studies focus on the foreign sector by emphasizing the relationship between exports, imports and GDP growth. More than two centuries ago, mercantilists said that surpluses of trade were considered as the only profit for a country doing international trade. Trade flows between countries depend on a number of factors. Bilateral trade flows between two countries are assumed to be proportional to their GDP. GDP is taken into account due to the fact that higher income economies tend to be more interested in product differentiation and specialization and therefore they trade more (Edmonds and Fujimura, 2006).

Alfred (1963) also studied the positive relationship between economic growth and trade and showed a positive relationship between international trade and variations in the economy by studying this relationship between seven countries.

The idea behind these analyses have been classified into two streams where the first focuses on the role of trade in economic growth and the second deals with the causality relationship between trade and economic growth to analyze if economic growth is affected by international trade or vice versa (Rodriguez and Rodrick, 2001).

Neddy et al., (2013, citing Ulaşan, 2012 and Andersen and Babula, 2008) state that as a major factor of openness international trade has made an increasingly significant contribution to economic growth. Schneider (2004) found that imports increased competition and brought different categories of goods to domestic markets, which increased consumer welfare and improved domestic firms as they exported to enlarge their markets. International trade also increases specialization for domestic producers as they are exposed to foreign markets where they meet a number of foreign firms and where the demand is large which increases their production capacities. International trade helps domestic producers to access innovative capital inputs such as machine equipment to increase productivity. They can also avail of new chances of growth for developing countries.

It is thus difficult to talk of economic growth and development without understanding trade. Some models such as endogenous growth models (Schneider, 2004) have tried to connect different pathways of international trade with economic growth.

According to Marin (1992) countries exporting a big part of their output develop faster than countries which do not export a great part of their GDP. Growth in exports has a stimulating influence across the economy in the form of technological spillovers and other externalities.

According to Bhagwati (1988), increased trade produces more incomes and more incomes facilitate more trade. The neoclassical trade theory emphasizes the causal relationship between factors of production and the level of production which lead to exports thus resulting in a 'virtuous circle.' This type of feedback has also been noted by Grossman and Helpman (1991). In their study on Austria, Kunst and Marin (1989) give evidence of growth-driven exports.

Analyzing the relationship between exports and economic growth in Portugal, Oxley (1993) found no support that an increase in exports had an impact on economic growth. Export growth is often considered a main determinant of the production and employment growth of an economy. This so-called hypothesis of export-led growth (ELG) is substantiated by Balassa (1978) and Bhagwati (1988). First, by the foreign trade multiplier, export growth leads to an expansion of production and employment. Second, the foreign exchange made available by export growth allows import of capital goods which, in turn, increases the production potential of an economy. Third, the volume of and the competition in export markets leads to economies of scale and an acceleration in technical progress in production. Export expansion and openness to foreign markets is viewed as a key determinant of economic growth because of the positive externalities that it provides. After recognizing the importance of trade in a country's economic growth was found that countries began reducing trade barriers and controls over other economic activities for facilitating trade to increase the economy's rate of growth. Robert and John (2004) also note that any change in supply conditions interacts with demand conditions at home and abroad to determine the final effects on output, quantities of exports and imports and the terms of trade. It has also been suggested that growth in output leads to growth in exports (Jung and Peyton, 1985).

We use the gravity equation in our research. In its simplest form, the gravity equation states that bilateral trade between two countries is directly proportional to the product of the countries' GDP. Thus, larger countries tend to trade more with each other and countries that

are more similar in their relative sizes also trade more (Feenstra, 2000). This model has earlier been used for analyzing the causative factors of trade flows between Rwanda and its main trading partners. As noted by Giovanni (1998), in a gravity model the volume of trade between two countries rises with the level of their GDP and decreases with their geographical distance. Countries with larger economies tend to trade more in absolute terms, while distance represents a factor for transportation costs and it negatively affects bilateral trade.

The gravity equation states that bilateral trade between two countries is directly proportional to the product of the countries' GDPs. Thus, larger countries tend to trade more with each other and countries that are more similar in their relative sizes also trade more. This equation performs well empirically, as has been known since Tinbergen's (1962) work.

2.2 Geography, Distance and Trade

Being landlocked limits a country's trade and it becomes dependent on the transit states (Arvis et al., cited in World Trade Report, 2003) and thus the location, size and quality of transportation infrastructure to support trade are not fully under its control. Neither are the policies or regulations that apply to the transportation and logistics sectors. These have to be discussed with the transit states and the outcomes are not necessarily what the landlocked country would have chosen. Transit countries may also have political and economic incentives to impose costs on landlocked countries (Gallup et al., cited in World Trade Report, 2003)

In addition, to the determinants of trade, its impediments and frictions (trade barriers, transaction and transport costs) should be also taken into consideration. As Leamer (1984) has shown these impediments are reflected in a deviation of domestic prices from international prices. Davis and Weinstein (2001) improve the Heckscher-Ohlin-Vanek model by adding a measure of trade costs through a gravity equation.

According to Samuelson (1954), most of the trade models that consider transportation costs assume that these costs are proportional to the price of the traded good (transportation costs are the 'iceberg costs'). Transportation costs determine a wedge between origin and destination prices but they do not produce changes in the relative prices of goods. Consequently, higher transportation costs reduce the volume of trade but do not automatically change the composition of trade.

The cost of transportation is in turn affected by a wide range of essential determinants. These include countries' geographical features, the quantity and quality of the physical infrastructure that supports transportation services, the procedures and formalities used for controlling the movement of goods from one country to another, the extent of competition in the transportation sector, the pace of technological innovations in the sector and the cost of fuel (Behar and Venables, cited in the World Trade Report, 2003). The characteristics of the products being shipped also influence transportation costs.

A number of studies use the gravity model to point out the effects of geographical distance on trade like Blomqvist (2004) on Singapore and Montanari (2005) on Balkans. They state

that population, distance between trading partners and culture effect trade flows between countries. The negative relation between geographical distance and bilateral trade has been studied in most economics (Leamer and Levinsohn, 1995) but exact information which is in distance coefficients is unclear. Filippini and Molini (2003) noted that the impact of distance on trade was more than the impact of geography. They added that in the history of countries which are trading partners, culture, language and social relations too had an impact on the trade between them. This findings state that distance included in the variables explained the determinants of trade flows between countries and by Leamer (2007) in his review of Krugman's study that trade decreases severely with distance.

In addition, Krugman (1991) considers the distance between two countries to be an important determinant of geographical partners in trade. He found that trading partners located far apart from each other incur high costs in their bilateral trade which reduces trade between them. Papazoglou et al., (2006) also indicate that the longer the distance between two trading partners the lower will be the trade between them. Jacquemin and Sapir (1988) and Neven and Röller (1991) add that the volume of international trade is negatively related to the cost of transport, where an increase in transport costs reduces trade.

After a study of the effects of distance on trade, Blum and Goldfarb (2006) concluded that distance effected trade even in a free trade area. Clark et al., (2004) and Rose et al., (2000) add that if a country is far away from its trading partner, this will negatively affect bilateral trade between the two. Tinbergen (1962) studied the relationship between bilateral trade and distance using the gravity model. His results show that distance negatively affected trade between countries.

Berthelon and Freund (2008) note that it is the variations in the coefficients of the distance across industries that increases the global distance coefficient.

2.3 Population Growth and Trade

International studies on differences in population have found that this difference may be one of the factors in determining the differences in comparative advantage and trade. Some theoretical studies show that a country with a population growth rate is capital-abundant and a country with a high rate of population growth is labor-abundant over time (World Trade Report, 2003). This is similar to Lederman and Xu's (2001) findings that population growth is one of the determinants of growth in trade.

Bendjilali (2000) adds that the populations of trading partners can be included in the gravity model for expanding it and seeing the effect of population on bilateral trade flows between countries in trade. A larger population can also be interpreted as a bigger market for imports. The effect on total trade depends on which effect overcomes the other. On the other hand, higher GDP per capita means enhanced demand for differentiated products which has a tendency to increase import levels.

Economic growth may be negatively or positively affected by population growth. According to Todaro (1994), larger populations provide the required aggregate demand (the 'size' effect) to generate favorable economies of scale in production, lower production costs and

provide sufficient labor supply to achieve higher output levels. Moreover, positive effects of population growth also stem from human capital's contribution. However, population growth can have a negative impact on economic growth if the dependency of the young population lowers investments. It is possible to extend the basic gravity model by including the populations of exporting and importing countries to see the effect of population on bilateral trade flows between two countries.

Matyas (1997) found that population had a tendency to increase trade and the level of specialization by producing gains from specialization. On the other hand, Bergstrand (1989) found that there was a positive effect of GDP per capita's coefficients, which means a negative relationship between population and trade flows, suggesting that imports and exports are capital intensive in production. A higher population growth rate may have a positive impact on trade flows in the short-run since it may increase the labor force, the level of specialization and more products for export. However, in the long run a higher population has a tendency to decrease income per capita, making every individual poorer and therefore it may cause production and exports to decrease. In addition, imports reduce when a country is at the low income per capital level.

2.4 Exchange Rate and Trade

According to many theories, another variable that is supposed to affect the level of international trade is the exchange rate. Many researchers have studied the effects of exchange rate volatility on international trade following two approaches. According to the first approach, exchange rate uncertainty or volatility does not affect trade while according to the second approach it affects trade. Hooper and Kohlhagen (1978) analyze the impact of exchange rate uncertainty on the volume of the US-German trade and Gotur (1985) studied the volume of trade among US, Germany, France, Japan and the UK. Both the studies reveal that the exchange rate did not have any economic meaning. A similar result was found by where it noted that a big part of the research done on the relationship between a change in exchange rate and the volume of trade supported the previous argument even if this did not mean that the relationship did not exist. This view was supported recently by Bacchetta and Eric (2000) who found that exchange rate uncertainty did not affect trade significantly.

Ethier (1973) notes that any doubts about the future exchange rate has a negative impact on the volume of trade. Cushman's (1983) study of 14 bilateral trade flows between high industrialized countries found a significant negative effect of exchange rate on trade. Akhtar and Hilton (1984) also found a negative relationship between trade and exchange rate.

Studies are conducted to find out whether trading partners being across each other was affected by a change in exchange rate otherwise, as well as analysis of the effects of change in real exchange rates on the level of trade and concluded that an increase in exchange rates reduced the volume of trade. De Grauwe and De Bellefroid (1986) in their study on trade in the European Economic Community's countries for 1960-1969 and 1973-1984 found a negative relationship between exchange rate and bilateral trade. Further, Lanea and Milesi-Ferretti (2002) analyzed the effects of variability of exchange rates on trade and concluded

that there was a positive impact of real exchange rate on trade if there was a decrease in the real exchange rate.

2.5 Trade Agreements and Trade Policies

Trade creation and trade diversion and the effect of a custom union was first brought into limelight by Viner (1950) who pointed out that regional trade agreements could be beneficial or harmful to the participating countries depending on whether the trade arrangements led to trade creation and trade diversion. Trade diversion refers to a shift in trade from a less expensive (or a more efficient foreign producer) to less efficient producers within the trading bloc while trade creation is shifting in trade from more expensive to less expensive producers in the trade arrangement.

Regional integration can be made more interesting by the members if they enable a more competitive and complementary trade environment. The key areas that they can focus on to create an enabling environment are the large cost discrepancies in the goods that they produce; the initially high tariffs between partner states and low tariffs for the outside world; and the highly elastic demand and supply curves. If addressed well, producers and consumers can be effectively targeted based on their responses to targeted surveys. An increase in the number of regional participants can increase the benefits of such agreements, that is, the more the trading partners the larger the scope for traded goods after integration.

When one looks at these factors and how they are working in the East African Community (EAC), one cannot help but conclude that the net effect is not substantial or at the very least it is unknown. EAC economies cannot be categorized as competitive or complimentary as they stand alone and do not take any initiative to enhance trade within the bloc. Even though the number of member countries increased from three to five in 2007, the effect of this increase is not visible. Additionally, trade creation and trade diversion effects of regional integration have not yielded much. On the other hand, it is clear that there exist dynamic effects including a competitive market, reduced monopoly, economies of scale, specialization, higher levels of investment and higher incomes from factor mobility. However, our study focuses on analyzing the static effects of EAC.

Our study relies on two major theoretical backgrounds: one, of the Ricardian model of comparative advantage and the second of Viner's (1950) model of trade creation and diversion effects. Finally, it also relies on Grossman and Helpman's (1995) focus on the 'politics' of free trade agreements (FTA). In their theoretical political-economy analysis, two governments establish a FTA when there is the existence of substantial economic welfare gains for each country's average voter; this is similar to our model.

Classical international trade literature has long advocated trade liberalization and open borders, claiming that open borders help everyone if proper compensation schemes are implemented (Krugman, 1987).

Classical economists provided essential thoughts on the benefits of trade, although the economics of regional integration was still a future idea for them. Modern economic analyses emphasize complex problems of international trade and also on the maximization of trade

benefits through regional integration resulting from regional trade agreements. However, literature on this subject has produced mixed results as far as benefits for member states are concerned. Winners and losers appear to be in equal strength. Regardless of the poor performance of some regional integration schemes in Africa, efforts have been made to resuscitate EAC to promote trade between member countries. To facilitate this, the area formed a custom union in 2005 as an entry point to the regional trade agreement (RTA).

The impact of trade agreements on each country in the agreement as noted by researchers such as Vinaye (2009) is that the formation of RTAs has resulted in an increase in intra-regional trade volumes within the RTAs in general. The existence of the North American Free Trade Agreement (NAFTA), for instance, led to an increase in the intra-regional trade volume from less than 35 per cent in the late 1980s, to almost 50 per cent in 1999. Over the same period, trade among MERCOSUR members doubled from 10 to 20 per cent. However, the picture is mixed in Africa. The extent of regional integration among the Common Market for Eastern and Southern Africa (COMESA) members has been relatively static over the past two decades. In contrast, the share of intra-regional trade has increased substantially for the Economic Community of West African States (ECOWAS) since the early 1980s and for the Southern African Development Community (SADC) since the late 1980s. Robert (2004) notes that a trade agreement between countries for the mutual, reciprocal reduction of tariffs will be beneficial for both the countries.

Cernat (2003) did a preliminary analysis of the Framework Agreement on Trade Preferential System (FATPS) between the OIC member countries and his findings show that FATPS had an effect on overall trade expansion and increasing potential intra-regional trade among its members. Regional integration is considered a major policy tool that countries can use to ensure industrialization and economic growth for attaining better social welfare for their citizens. This belief has accelerated RTAs in the world trading system in recent years. According to the World Trade Organization (WTO), there were more than 350 RTAs in force, several fully operational while others were under on-going negotiations and it had received 200 notifications from RTAs.

Since the 1990s, a number of countries in Africa have worked hard to open up their economies to external competition through trade liberalization. Many RTAs have been signed to achieve this. According to WTO, the African continent had 30 RTAs. Trade agreements are projected to nurture trade and investment relations between member countries by removing tariffs and other barriers to intra-regional trade flows. The success of these arrangements in fostering inter-regional trade has been diverse with the Southern African Development Community (SADC), the Economic Community of West African States (ECOWAS) and the Common Market for Eastern and Southern Africa (COMESA) cross-border initiative and UEMOA being more successful.

Economic integration under RTAs opens trade by changing the prices of goods from member states as tariffs are phased out. This makes goods and services cheaper as compared to imports from the rest of the world leading to a change in demand patterns resulting in adjustments in trade flows and output flows. RTAs' welfare impact depends on its effect on trade, that is, whether it will create trade or divert trade between the member states (Viner 1950). Consequently, membership to a RTA has both positive and negative effects for the

economy, hence it is the net impact that determines the overall effect. However, there are indecisive welfare effects of RTAs to both the member states and the world at large (Jayasinghe and Sarker, 2007). Bhagwati (1988) shows that there are two sets of views on RTAs. Additionally, there are regional or locational factors that can skew the effects. Time and further studies will make this clearer.

Finally, opening the borders and reducing trade barriers changes most of the small countries into internationally large markets where they may become decision makers for their prices. Consumers are able to buy not only domestically, but they can expand their interest and exploit the opportunities to travel abroad and buy from foreign firms. Domestic producers can sell not only to domestic consumers but may also gain from competitors in foreign markets. But as domestic producers move from the domestic market to foreign markets they may lose their existing clients because of this market expansion (Yochanan, 2004).

3. Methodology

3.1 Study Design

We used balanced panel data of 96 observations to determine the causal factors of trade flows between Rwanda and its main trading partners. A balanced panel has the same number of time-series and observations for each cross-sectional unit. We used the panel data framework because panel data methods increase the power of the test. The use of a panel data framework is also important because it helps address two problems: controlling cross-sectional dependence across the members of the panel because a shock affecting one country may also affect another through the high degree of globalization and international trade and financial integration.

Hsiao (1986) highlighted the importance of panel datasets when he argued that panel data provided much larger datasets with more variability and less collinearity among the variables compared to typical cross-section or time series data alone. In addition, he showed other important aspects of panel data including the fact that it is more informative and useful for controlling individual heterogeneity. Controlling for individual heterogeneity is necessary because it leads to biased estimates.

The gravity model suggest that the level of GDP influences trade positively but trade is influenced negatively by the distance between trading partners.

This is displayed as:

$$(1) \quad T_{ij} = C \times \frac{GDP_i \times GDP_j}{D_{ij}}$$

where, C is a constant term, T_{ij} is the volume of trade flows between the importing country i and the exporting country j , where GDP_i and GDP_j are the levels of the trading partners' economic size and D_{ij} is the distance between them (Krugman and Obstfeld, 2006). According to the gravity model, large economies spend more on imports and exports. Therefore, higher GDP means more trade for a country. After the introduction of this basic gravity model, we extended it to catch the effects of distance, market size, level of exchange

rate, having a common language and a common border or signing a trade agreement between trading partners. We use being a member of EAC or not in our study. The proposed model explains the causal factors of trade flows between Rwanda and its main trading partners as:

$$(2) \quad \text{LnTRADE}_{Rpt} = \alpha + \beta_1 \text{LnDIST}_{RP} + \beta_2 \text{LnGDP}_{Rt} + \beta_3 \text{LnGDP}_{Pt} + \beta_4 \text{LnPOP}_{Rt} + \beta_5 \text{LnPOP}_{Pt} + \beta_6 \text{LnEXR}_{Rpt} + \beta_7 \text{LnGDP}_{Pt} \text{##} \text{LnDIST}_{RP} + \beta_8 T + \beta_9 \text{EAC} + \beta_{10} \text{CB} + \beta_{11} \text{CL} + \varepsilon_{Rpt}.$$

$$(3) \quad \text{LnTRADE}_{Rpt} = \alpha + \beta_1 \text{LnD}_{RP} + \beta_2 \text{LnGDP}_{Rt} + \beta_3 \text{LnGDP}_{Pt} + \beta_4 \text{LnPOP}_{Rt} + \beta_5 \text{LnPOP}_{Pt} + \beta_6 \text{LnEXR}_{Rpt} + \beta_7 \text{LnGDP}_{Pt} \text{##} \text{LnDIST}_{RP} + \beta_8 T + \beta_9 \text{LnGDP}_{R^2t} + \beta_{10} \text{LnGDP}_{P^2t} + \beta_{11} \text{LnPOP}_{R^2t} + \beta_{12} \text{LnPOP}_{P^2t} + \beta_{13} T^2 + \beta_{14} \text{EAC} + \beta_{15} \text{CB} + \beta_{16} \text{CL} + \varepsilon_{Rpt}.$$

3. 2 Data

Our data source is the National Bank of Rwanda (BNR), the World Bank Development Indicators' database and the Rwandan Ministry of Finance and Economic Planning (MINECOFIN). The data used covers the period 2000-15, the dataset consists of 96 observations between five EAC countries and two countries which are Rwanda's main trading partners (Rwanda, Burundi, Tanzania, Kenya, Uganda, China and Belgium). Data for estimating the causative factors of trade flows between Rwanda and its main trading partners comprise of:

Dependent Variables

The dependent variable that we use is trade in USD (LTRADE) defined as the sum of exports and imports between Rwanda and its main trading partners.

Independent Variables

We use the independent variables Rwanda's real GDP represented by (LnGDP_{Rt}), real GDP of Rwanda's main trading partners represented by (LnGDP_{Pt}), real exchange rate represented by (LnEXR_{Rpt}), Rwanda's population growth represented by (LnPOP_{Rt}) and that of Rwanda's trading partners represented by (LnPOP_{Pt}), the factor variable is represented by (LnGDP_{Pt} , LnDIST_{RP}) and the trend variable by (T). If the coefficient of trend variable turns out be significant, then it will mean that trade does change with respect to time and dummy variables represented by (EAC, CB, CL). The EAC dummy variable has been coded 1 for a EAC country member and 0 for an EAC non-member. The common border (CB) dummy variable is coded 1 for a country that has a common border with Rwanda and 0 indicates the opposite. The common language (CL) dummy variable is coded 1 for a country that speaks a common language with Rwanda and 0 indicates the opposite. During the analysis we used the squared variables ($\beta_9 \text{LnGDP}_{R^2t}$), (LnGDP_{P^2t}), (LnPOP_{R^2t}), (LnPOP_{P^2t}), (T^2) to see if the effect of these variables on trade will be the same for the continuous growth of these variables in the short and long term.

4. Empirical Results

We used the test of functional form to see how the data is scattered from the mean. This test is based on the residual sum of squares. Based on the residual sum of squares in the model

and the p-value for the F-test of overall significance for both models we conclude that both models provide a better fit than the intercept-only model as the probability for both models is significant. According to our results of this test, Model 2 was the accepted and preferred model specification with reasonable explanatory power in explaining trade flows between Rwanda and its main trading partners (see Table 1). The F-value also confirms that the second model is a better fit than the first model as the F-value of Model 1 is greater than the F-value of Model 2, where Model 1 was the restricted and Model 2 was a more generalized specification model; hence we use Model 2 in our research.

Insert Table 1 about here

We then applied the Hausman test to check whether the fixed effects model was more efficient than the random effects model. This would be true if the null hypothesis of no correlation between the individual effects and the regressors was rejected (Park, 2015). According to our results, the Hausman test statistic shows that the null hypothesis was accepted, suggesting that the random effects regression was more efficient than the fixed effects regression. According to the test results, we do not reject the null hypothesis in favor of the random effects model.

Insert Table 2 about here

Table 2 provides summary statistics of the main variables used in our study, where the average trade between Rwanda and its main trading partners was US\$ 933 million where a standard deviation of US\$ 101 million each year meant a dispersion of 0.1 times the mean each year. Rwanda's average real GDP was US\$ 4,470 billion with a standard deviation of US\$ 2,230 billion each year where the average of real GDP of Rwanda's trading partners was US\$ 908 million with a standard deviation of US\$ 2.29 trillion. The average exchange rate was 131.541 in relation to the US is with a standard deviation of 265.302. The average population for Rwanda was 10,400,000 million with a standard deviation of 1,329,050 million which means a dispersion of 0.1 times the mean each year. The mean population of Rwanda's trade partners' was 248 million with a standard deviation of 285 million. The distance between Rwanda and its main trading partners had a mean and standard deviation of 2,893.590 km and 3,372.087 km respectively.

The minimum trade that Rwanda had with its main trade partners' was US\$ 452,677 million while the highest was US\$ 456 million. The minimum real GDP that Rwanda had was US\$ 1,670,000,000 and the maximum was US\$ 8,100,000,000. For its main trading partners the minimum and the maximum real GDP was US\$ 785 million and US\$ 11 trillion respectively.

The minimum and maximum exchange rate was 0.241 and 907.503; for Rwanda's population it was a minimum of 8,398,413 and a maximum of 12,700,000. The minimum population was 6,767,073 while the maximum was 1,370,000,000 for Rwanda's main trading partners. The nearest country was 159.390 km and the farthest was 8,730.450 km.

Insert Table 3 about here

The correlation coefficients among the nine variables are given in Table 3. Variables such as GDPR and GDPP had positive effects on trade as expected but most of the variables such as PPOR, EAC, CB and CL did not have the expected trade sign. The trend variable had a

high correlation between PPOR, POPP, GDPR and GDPP variables which may lead to a spurious regression and that is why we removed this variable in our further analysis. The remaining pairs were low correlated with each other and did not show any signs of serious multicollinearity (see Table 4).

Insert Table 4 about here

The variables which influenced Rwanda's trade were its economic size (GDP_R) and its trading partners' economic size (GDP_P), population size (POP_P), distance (D_{RP}) and exchange rate (EXR_{RP}). The other variables had no impact on Rwanda's trade because of insignificant coefficients.

The effect of Rwanda and its trading partners' GDP was positive and statistically significant at the 5 and 1 per cent levels respectively. This is in line with theoretical expectations. The population of trading partners, distance and exchange rate variables were statistically significant at 1 per cent. This result suggests that Rwanda's GDP was a key determinant of its capacity to export. A higher GDP means a higher production capacity which in turn translates into an economy's ability to export more (supply side). This is consistent with theory and most of the findings of previous researchers such as Edmonds and Fujimura (2006). These studies argue that GDP is taken into account because higher income economies tend to be more interested in product differentiation and specialization and thus they trade more.

Rwanda's GDP growth and also the GDP growth of its trading partners will help increase the total trade value. The estimated coefficients of these variables are statistically significant and show a positive influence which is in line with expectations. An increase of 1 per cent in Rwanda and its trading partners' GDP will enhance the trade value by 35.5 per cent and 5.5 per cent respectively but this positive effect will turn negative for an intensive increase in Rwanda's GDP as Rwanda's economic growth will negatively affect the volume of trade (as shown by the coefficients of $GDPR^2$ and $GDPP^2$) where an increase of 1 per cent will decrease trade by 0.77 per cent and 0.06 per cent approximately. This may be explained by the fact that most of the domestic goods produced will be domestically consumed *ceteris paribus*. While Rwanda's trading partners' market size will be statistically significant with positive effects. If the population of a trading partner country increases by 1 per cent, Rwanda's trade value will step up by roughly 15.5 per cent but this effect will be the opposite when the trading partner's population continues to grow at this high level as this continuous growth will reduce Rwanda's trade by 0.4 per cent. Therefore, hypothesis 1 – a positive effect of the economy and market size on Rwanda's trade -- is strongly supported for Rwanda and its trading partners' economic size and market size but it is not supported for Rwanda's market size as this variable is not statistically significant which means that this coefficient does not have economic meaning in our study.

Geographical distance is statistically significant and impairs trade between Rwanda and its partners, where a 1 per cent increase in distance leads to a 0.4 per cent decrease in trade, on average. Therefore, hypothesis 2 – negative effect of geographical distance on Rwanda's trade – is strongly supported.

An increase in exchange rate means that Rwanda's currency is devalued as a result of which imports will be more expensive and exports will become cheaper; Rwanda was more of an import-based country during 2000-15. Hence, the exchange rate variable is expected to have a positive effect on trade between Rwanda and its partners.

A change of 1 per cent in the exchange rate will increase Rwanda's trade by 0.7 per cent. The exchange rate policy in Rwanda during the period under study had an influence on increasing the competitiveness of exports as a change in the exchange rates of Rwanda's currency significantly supported commercial activities.

Therefore, hypothesis 3 is strongly supported. In addition, variables having a common border and being a member of EAC are not statistically significant, which means that these variables did not have economic meaning during the period of the study.

The EAC variable was not significant, which means that many things still need to be done like increasing industries so that Rwanda is able to increase its exports to regional countries. This is consistent with some of the findings of previous researchers such as Duncan (2016). His findings on EAC members' regionalism showed that regionalism had no significant effect on agricultural exports of Burundi, Rwanda and Uganda, while Kenya and Tanzania reported a significant effect of regionalism on their agricultural exports as these two countries enhanced this regionalization more than the other three countries.

The EAC variable cannot affect Rwanda's trade value and a possible explanation for this is the signing of partnership trade agreements which was strengthened during 2000-15, though this was not efficient. If Rwanda has more trading partners, then its resources should be distributed and it would be hard to focus on investments that promote important economic and political relationships. Another reason for the insignificance of this variable is that during the study period, Rwanda was still investing in infrastructure development when it needed materials that were available in other EAC countries.

This also confirms what MINICOM (2010) said when it indicated that only FTAs are not enough to help trade and economic growth in developing countries. Accumulation of resources including labor, human capital, physical capital, land and natural resources; improvements in technologies for converting those resources into goods and services; investments in efficient public infrastructure; and innovation of new goods and services are extremely important complementary economic development factors that need to be coherently developed to make trade an effective engine for economic development and poverty reduction. The fundamentals for long-term growth are human resources, physical infrastructure, macroeconomic measures and the rule of law.

Insert Table 5 about here

The effect of each trading partner on Rwanda's trade flows (Table 5) shows that most of the variables were not statistically significant except for China where some variables such as GDP_R , POP_P , EX_{RP} , T were statistically significant. An explanation for this is that even if these countries are Rwanda's main trading partners, a single country alone cannot help the growth of trade flows to Rwanda.

This also means that Rwanda needs to have more trading partners to achieve a high level of trade growth.

Some of the results for the variables which are statistically significant are not in line with theory, like considering if Rwanda is trading only with China an increase in GDP_R by 1 per cent will reduce trade by 142 per cent, but this effect will become negative as GDP continues to increase where an increase in GDP_R by 1 per cent will increase trade by 3.5 per cent which is in line with theory.

The effect of EX_{RP} is also not in line with theory, as the devaluation of Rwanda's currency should encourage exports but in our case an increase of 1 per cent in the exchange rate reduced trade by 6.08 per cent.

China's population growth positively affected Rwanda's trade, where according to our findings an increase of 1 per cent in China's population positively affected Rwanda's trade by 30.56 per cent.

Insert Table 6 about here

Table 6 gives the influence of the variables used and the results are similar to the ones got before. Total elasticity shows that the effect of Rwanda's GDP on both Rwanda and its trading partners was positive and statistically significant at the 5 per cent level, where a growth in Rwanda's GDP will boost trade value. An increase of 1 per cent in Rwanda's GDP will enhance trade value by approximately 31.9 per cent and an increase of 1 per cent in Rwanda's trading partners' GDP will enhance trade value by approximately 5 per cent but this positive effect may turn negative if there is an intensive increase in Rwanda's GDP as in this case the coefficients of GDP_R^2 are not statistically significant while Rwanda's trading partners' market size is statistically significant with positive effects. If the population of a partner country increases by 1 per cent, Rwanda's trade value will step up by roughly 13.4 per cent but this effect will be the opposite when the trading partner's population continues to grow at a high level and this will reduce trade by 0.3 per cent.

Geographical distance is statistically significant and effects trade between Rwanda and its partners, where an increase of 1 per cent in the distance reduces the trade value by 4.1 per cent on average (see Table 7).

The other variables did not have any economic meaning.

Insert Table 7 about here

The effects of trading partners' on Rwanda's trade varied over time. In 2003, 2005, 2006, 2007, 2010 and 2013 they had an economic meaning for the trade flows as their coefficients are statistically significant. In 2003 there was a reduction in trade between Rwanda and its trading partners of 0.3 per cent; this was 0.26 per cent in 2010; and 0.18 per cent in 2011 and 2013.

During the study period trade flows between Rwanda and its trading partners had an increment of 0.59 per cent in 2005, 0.51 per cent in 2006 and 0.3 per cent in 2007.

5. Summary and Conclusion

The main purpose of this study was determining the causative factors which affected trade flows between Rwanda and its main trading partners and reviewing the potential for trade growth between Rwanda and these countries. It estimated the gravity model with data from six countries for 2000-15. The estimated results showed that trade flows between Rwanda and its main trading partners were mainly affected by Rwanda and its trading partners' economic size, population growth in Rwanda's trading partners, real exchange rate and geographical distance. Growth in Rwanda's economic size had a positive impact on trade flows with its trading partners. Besides, an increase in Rwanda's trading partners' economic and population positively affected the total trade value; but a continuous increase in these variables negatively affected Rwanda's trade growth. The negative effect of a continuous increase in population growth can be explained as a larger younger generation does not trade as much as the adults. Geographical distance negatively affected trade flows between Rwanda and its main trading partners. Being a member of EAC, having common borders and having a common language did not have economic meaning for Rwanda's trade flows as they were not statistically significant.

Our study has some limitations. It is limited in the data that it uses as some aspects observed in the rest of the world have not been included in the research. Hence, studies with large-scale data in space and time should be conducted as this will give universal results with fewer errors.

However, our research does provide an interesting result and may help policymakers get a clearer view of how to improve Rwanda's trade trends to ensure that its trade potential is met. Policymakers can learn from our results and assess what is lacking in the trade agreements that Rwanda has signed. Our results will also help in implementing other internal trade policies which should be monitored and evaluated on a timely basis during their implementation. Rwanda's current weak trade performance is largely attributable to its weak supply side capacity. It is therefore clear that the government needs to undertake more work on strengthening productive capacity as according to our results Rwandan economic growth has positive effects on its trade.

An insignificant number of Rwandans are involved in trade and this does not impact its trade. This should be a lesson for policymakers to support the Made in Rwanda campaign in terms of quality improvements so that it attracts buyers and sellers and hence leads to trade development.

The negative impact of distance between Rwanda and its main trading partners should also be taken into consideration when working out trade and infrastructure policies to reduce transport costs.

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Table 1. Result of Test of Function form for Model 1 (N=96)

	(Model 1) Coefficients	Standard Error	(Model 2) Coefficients	Standard Error
_cons	1489.425*	588.441	1690.361	2206.527
LG DPR	2.162***	0.509	50.031	37.004
LG DPP	5.009***	0.623	0.000	0.000
LDIST	5.194***	1.149	0.000	0.000
C.LGDPP#C.	-0.384***	0.069	-2.081**	0.621
LDIST				
LEXC	0.511*	0.248	0.685*	0.279
LPOPP	-0.113	0.221	-13.855	15.367
LPOPR	-101.021**	37.108	-179.661	220.567
T	2.477*	1.009	1.873	1.829
EAC	-0.298	0.437	-0.675	0.569
CB	0.058	0.589	0.314	0.677
CL	0.000	0.000	0.000	0.000
LG DPP2			0.142	0.109
LG DPR2			-0.799	0.886
LPOPP2			0.378	0.420
LPOPR2			3.078	6.516
T2			0.005	0.009
LDIST2			1.956**	0.660
F-value	84.53		58.27	
R ² Adj	0.908		0.906	

Note: Significant at lesser than * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ levels of significance.

Table 2. Summary Statistics of Variables (NT= 96)

Variable	Mean	Std. Dev.	Min	Max	VC
TRADE	93,300,000	10,100,000	452,677	456,000,000	0.108
GDPR	4,470,000,000	2,380,000,000	1,670,000,000	8,100,000,000	0.532
GDPP	9,080,000,000,000	2,290,000,000,000	785,000,000	11,000,000,000,000	0.252
EXC	131.541	265.302	0.241	907.503	2.017
POPR	10,400,000	1,329,050	8,398,413	12,700,000	0.128
POPP	242,000,000	485,000,000	6,767,073	1,370,000,000	2.004
DIST	2,893.590	3,372.087	159.390	8,730.450	1.165

Table 3. Correlation Matrix of variables (N= 96)

	LTRADE	GDPR	GDPP	POPP	POPR	DIST	EXC	T	CB	CL	EAC
LTRADE	1										
GDPR	0.6587	1									
GDPP	0.3242	0.2533	1								
POPP	0.1691	0.0168	0.8077	1							
POPR	0.6493	0.9876	0.2520	0.0171	1						
DIST	0.2409	0.0000	0.6574	0.7699	0.0000	1					
EXC	0.1701	0.0948	0.0153	-0.0982	0.0997	0.5364	1				
T	0.6565	0.9820	0.2491	0.0172	0.9982	-0.0000	0.1020	1			
CB	-0.4081	-0.1139	-0.3601	-0.4058	-0.1129	-0.6577	-0.4571	-0.1088	1		
CL	-0.1810	-0.0919	-0.4916	-0.5507	-0.0833	-0.8624	-0.6191	-0.0766	0.7284	1	
EAC	-0.1810	-0.0919	-0.4916	-0.5507	-0.0833	-0.8624	-0.6191	-0.0766	0.7284	1.0000	1

Table 4. Robust Estimated Results

	LTRADE	Robust Standard Error
LGDPP	5.522***	1.231
LGDPP2	-0.065**	0.022
LG DPR2	-0.775*	0.360
LG DPR	35.474*	15.698
LEXC	0.742**	0.278
LPOPP	15.556***	4.255
LPOPP2	-0.424***	0.111
LPOPR	-289.077	175.868
LPOPR2	8.680	5.437
LDIST	-4.644***	0.739
EAC	-0.744	0.509
CB	0.682	0.641
CL	0.000	0
_cons	1810.968	1319.546
$\bar{N}$	96	
R^2	0.913	

Note: Significant at lesser than * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ levels of significance.

Table 5. Trading Partners' Estimated Results per Country

	(BELGIUM)	(BURUNDI)	(CHINA)	(KENYA)	(TANZANIA)	(UGANDA)
	LTRADE	LTRADE	LTRADE	LTRADE	LTRADE	LTRADE
LGDP	-65.231 (158.040)	25.783 (178.890)	57.185 (56.984)	41.057 (352.657)	210.129 (486.476)	-17.196 (132.955)
LGDP2	1.182 (2.932)	-0.602 (4.252)	-0.902 (0.991)	-0.926 (7.342)	-4.330 (10.141)	0.332 (2.825)
LGDP2	-2.095 (2.048)	-7.459 (4.939)	3.253* (1.130)	-3.810 (5.706)	-0.252 (6.573)	-3.730 (4.324)
LGDP	92.914 (89.230)	332.081 (215.394)	-142.734* (49.670)	175.816 (249.026)	10.393 (295.001)	168.621 (193.285)
LEXC	3.092 (4.031)	-1.014 (9.164)	-6.086* (1.819)	2.080 (4.709)	-0.620 (7.781)	-0.486 (1.613)
LPOP	182.945 (393.462)	-216.658 (727.061)	160.594 (158.415)	502.648 (771.886)	77.293 (715.972)	-205.597 (357.688)
LPOP2	-2.708 (12.165)	2.928 (23.454)	30.566* (10.689)	15.451 (20.468)	6.158 (31.409)	-2.371 (34.617)
LPOP	-742.526 (411.677)	472.580 (911.237)	15.758 (148.977)	291.107 (858.701)	-365.054 (788.385)	-363.336 (465.217)
LPOP2	19.716 (11.494)	-6.967 (23.571)	7.992 (4.112)	-14.881 (26.103)	9.756 (26.543)	12.721 (12.015)
LDIST	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
LDIST2	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
T	2.321 (3.097)	-4.098 (7.729)	-17.094* (5.456)	-23.597 (17.674)	-7.345 (15.915)	8.184 (27.129)
T2	-0.007 (0.015)	0.068 (0.060)	0.085* (0.024)	0.052 (0.071)	-0.023 (0.155)	0.002 (0.039)
EAC	0.000 (.)	-1.548 (0.847)	0.000 (.)	3.449 (1.670)	0.000 (.)	0.000 (.)
CB	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
CL	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)	0.000 (.)
_cons	4445.487 (5388.724)	-7025.436 (12153.246)	-18343.520* (6229.631)	-16561.459 (16828.047)	-2478.778 (13464.468)	5060.964 (6017.433)
N	16	16	16	16	16	16
R ²	0.927	0.984	0.998	0.972	0.959	0.993

Note: Standard errors in parenthesis.

Significant at lesser than * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ levels of significance.

Table 6. Trading Partners' Estimated results per year

	LTRADE	Standard Error
LGDP	3.138	2.724
LGDP2	-0.020	0.051
LGDP2	0.541	0.280
LGDP	-21.653	12.219
LEXC	0.727*	0.296
LPOP	36.141	23.252
LPOP2	-0.985	0.633
LPOP	0.000	0.000
LPOP2	-0.381***	0.080
LDIST	-14.230	10.977
LDIST2	0.717	0.823
EAC	-0.096	0.820
CB	0.260	0.820
CL	0.000	0.000
2000.year	0.000	0.000
2001.year	0.187	0.159
2002.year	-0.173	0.183
2003.year	-0.373*	0.167
2004.year	0.060	0.142
2005.year	0.592***	0.109
2006.year	0.518***	0.105
2007.year	0.301**	0.110
2008.year	0.144	0.113
2009.year	-0.003	0.107
2010.year	-0.255**	0.083
2011.year	-0.188*	0.076
2012.year	0.000	0.000
2013.year	-0.179**	0.062
2014.year	0.000	0.000
2015.year	0.000	0.000
_cons	0.000	0.000
$\bar{N}$	96	
R^2		

Note: Significant at lesser than * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ levels of significance.

Table 7. Total Elasticities results

	LTRADE	Standard Error
LGDPP	5.081***	1.288
LGDPP2	-0.057*	0.023
LGDPR2	-0.688	0.376
LGDPR	31.903	16.416
LEXC	0.544	0.291
LPOPP	13.452**	4.449
LPOPP2	-0.371**	0.117
LPOPR	-292.232	183.912
LPOPR2	8.746	5.686
LDIST	-4.154***	0.773
EAC	-0.266	0.532
CB	0.033	0.670
CL	0.000	0.000
_cons	1904.233	1379.904
$\bar{N}$	96	

Note: Significant at lesser than * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ levels of significance.

Chapter Ten

An Analysis of Causality between Tea Exports and its Determinants in Rwanda

P. Uwimana¹, C. Mugemangango², Mary Kipsat³, Timothy Sulo⁴, S. Nsabimana⁵

1. UR-CAVM (Rwanda), 2. UR-CST (Rwanda), 3. Professor in Maseno University (Kenya), 4. Moi University (Kenya), 5. UR-CAVM

¹ Corresponding author:

Department of Rural Development and Agricultural Economics
University of Rwanda, Kigali, Rwanda, E-mail: uwipla@gmail.com

² Department of Mathematics, University of Rwanda, Kigali, Rwanda
E-mail: mucypro2@yahoo.fr

³ Maseno University, Kisumu, Kenya, E-mail: mjkipsat@yahoo.com

⁴ Moi University, Eldoret, Kenya

⁵ Department of Rural Development and Agricultural Economics
University of Rwanda, Kigali, Rwanda, E-mail: uwipla@gmail.com

Abstract

Tea growing in Rwanda started in 1952 and by 2002 tea had become the country's largest export item. However, an increase in tea farm land has been constrained by population growth, impacting the quantity of tea that the country produces. Tea exports are volatile and are influenced by the real effective exchange rate, incomes of major trading patterns, total investments as a proportion of GDP, tea world market prices and coffee world market prices. There is little recent empirical research on factors affecting Rwandan tea exports. This study assesses the causality between tea exports and their determinants in Rwanda. The study applies a causal research design and uses time series data collected from different sources. It uses the Granger causality test to test for predictability between exports and their factors. The research concludes that non-causality in the long term was possible because before the late 1980s Rwanda had an economy that was based on a pre-structural adjustment program when exports were under total control. Short-run causality was possible because after the 1980s, a decline in world tea prices may have led to an increase in exports as demand increased in the short run. What is needed now are more investments in tea factories, diversification of commodities that are exported, prioritizing forward selling or contracting and widening niche markets for tea products.

Key words: GDP, exports, economic analysis, Granger causality test, time series.

JEL Classification Codes: F11; O13; Q13; Q17;

1. Introduction

Tea has been cultivated and consumed in China for more than 2,000 years. Today it is the most widely consumed caffeine containing beverage in the world. Its worldwide consumption is second only to water. Tea arrived in London for the first time in 1652 (Kurian et al., 2007).

In Africa, many tea companies took the strategic decision to develop new sources of tea production in perceived 'safer' countries. Kenya, Uganda, Tanzania and Malawi already had some tea estates, conditions for growing tea were fundamentally good and they were expected to remain British colonies and protectorates for many decades. Substantial investments began in the tea cultivation on the continent in the 1950s. Kenya in particular had excellent growing conditions and good transport infrastructure for exports via Mombasa (Tyler, 2013).

Tea growing in Rwanda started in 1952. Two principal varieties of tea are grown in Rwanda: the China plant (*C. sinensis sinensis*) and the clonal Assam plant (*C. sinensis assamica*). Growing tea requires a large area. In 1999 the total area under tea cultivation in Rwanda was 12,541 ha which went up to 14,394 ha in 2008 with 1,407 ha that had not been exploited (Mupenzi et al., 2011). Since its introduction, tea production has increased steadily, from 60 tons of black tea in 1958, to 17,800 tons in 2001. Although Rwanda had made modest attempts to grow tea since the Second World War, it was only in the 1960s that the industrial cultivation of tea was established (Alinda and Abbot, 2012).

By 2002 tea had become Rwanda's largest export, with export earnings from tea reaching US\$ 18 million or 15,000 tons of dried tea. Existing foreign investments were concentrated in commercial establishments, mining, tea, coffee and tourism (Global Tenders, 2014).

However, there was the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. These were issues of efficiency and could be addressed by reducing waste within the system which would have led to gains without directly affecting crop yields. There were some factories that either had to work at over-capacity or refuse crops because of lack of capacity. This reduced both the quality and quantity of tea production (Alinda and Abbot, 2012).

Our study investigates how tea exports fared over the period 1982-2012. Our study is centered on a dynamic time series procedure to test the validity of hypotheses of exports and variables which affected them in Rwanda.

The Government of Rwanda set a strategy for tea with a two-fold objective: increasing production and improving quality. Production was to be increased by expanding and consolidating land dedicated to tea farming and re-investments were to be made in factories to increase production capacity. However, this strategy was constrained by some challenges mainly the dual issue of low capacity of tea processing factories and poor pruning and plucking practices. Targeting each tea farmer to farm 0.5 ha for tea was also constrained by population growth in Rwanda that was estimated to be growing by 3.6 per cent per year. There were also some factories that either had to work at over-capacity or refuse crops because of lack of capacity. This reduced both the quality and quantity of tea production and

brought challenges to tea exports. Further, the black tea market was saturated and this pushed down prices. The impact of this was that Rwanda's tea export earnings and volumes changed over time (Nuwangira, 2013).

Although tea exports play a big role in Rwanda's economic growth thereby contributing to its achieving its 2020 Vision, there are very few recent empirical studies that investigate the factors which are leading to both volatility in exports and prices of tea over the long term. Taking into consideration these issues, it is important to investigate the factors that affected tea exports in Rwanda in 1982-2012. Finding the factors that affected tea exports may throw light on the real causes of volatility in both the quantity of tea exported and its prices. Hence, the research question of our study is: Is there a causal linkage between the quantity of tea exported and what are its determinants?

The overall objective of our study is to test for a causal linkage between the quantity of tea exported and the real effective exchange rate, incomes of major trading partners, total investments as a proportion of GDP, tea prices in the world market and coffee prices in the world market.

We started with the hypothesis that the real effective exchange rate, incomes of major trading partners, total investments as a proportion of GDP, tea prices in the world market and coffee prices in the world market did not have a statistically significant effect on the quantity of tea exported by Rwanda.

Both coffee and tea production declined by 18 per cent and 6 per cent respectively and coffee prices fell by 4 per cent; however coffee and tea exports in 2010 reached US\$56.1 million and US\$55.7 million respectively (GoR, 2011). Although the export sector is growing, Rwanda lags behind other African nations in terms of exports as a percentage of GDP (GoR, 2011). This shows how much Rwanda's exports are influenced by factors like world prices, exchange rate especially for tea which is an important cash crop and the main source of foreign currency for the country (GoR, 2010). Since very few studies have looked at the linkage between tea exports and these factors over the period 1982-2012 our study helps in filling this gap so that strategies can be worked out to improve tea exports. The findings of our study will also help improve tea trade in Rwanda thus leading to a sustainable achievement of economic growth.

Our study uses secondary data collected from the NAEB headquarters, FAOSTAT and the World Bank website. We also use investments in the tea sector as a proportion of GDP for our study. However, data on this was not available so we had to use data on the general investments as a proportion of GDP. As most of the economic models on exports include capital and labor among the independent variables, we wanted to consider the population that has been involved in the tea sector for the period under study. However, data on this was not available. Some missing data like REER for 2012 was obtained by the extrapolation method using SPSS but the obtained data might not correspond to the actual figures.

2. Literature Review

According to Markusen et al., (1995) international trade is the exchange across national borders of goods, services and factors and the impact of this trade on domestic and global economies. International trade is a result of the interactions between individuals in one nation with persons in other nations. According to Seyoum (2009), the factors which affect exports include currency exchange control/risks, taxation, tariffs and inflation which originate outside a business enterprise. Such variations require managers who are aware of global threats and opportunities. Hence, firms must consider the following factors: the success of the product in domestic markets, participation in overseas trade shows, advertising and market data. Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in the estimation of export supply functions in general (Alemayehu, 1999; Balassa et al., 1989; Branchi et al., 1999; Klaassen 1999; McKay et al., 1998; Ndung'u and Ngugi, 1999; Ogun 1998; Whitley, 1994; in Were et al., 2002). In their study on tea exports Were et al., (2002) focus on the following explanatory variables: real exchange rate (RER\$K), real foreign income (income of major trading partners (YTRADI)) and total investments as a proportion of GDP (INV/GDP). The inclusion of income and real exchange rate is standard in trade models. The additional variable—investments to GDP ratio—is a proxy for capital formation to capture supply constraints (Were et al., 2002).

Abdulai and Jaquet (2002) in Sinoha (2006) tested the ELG hypothesis for Côte- D'Ivoire for the period 1961-97. The authors examined the short-run and long-run relationship between economic growth, exports, real investments and labor force. The time series techniques that they used were co-integration and ECM (Error Correction Model). The authors found evidence of one long-run equilibrium relationship among all variables. They also found causality, both in the short-run and in the long-run, flowing from exports to economic growth. Further, they also found bidirectional causation between the variables. They concluded that Côte d'Ivoire's recent trade reforms (promoting domestic investments and recovering international competitiveness) had contributed to export expansion, diversification and potentially future economic growth in the nation. According to Faridi (2012) a group of researchers like Jung and Marshall (1985); Darrat (1987); Chow (1987); Kunst and Marin (1989); Sung-Shen et al., (1990); Bahmani-Oskooee et al., (1991); Ahmad and Kwan (1991); Serletis (1992); Khan and Saqib (1993); Dodaro (1993); Jin and Yu (1995); and Holman and Graves (1995) have examined the causality relationship between growth in exports and economic growth using the Granger causality test. The studies concluded that there existed some evidence of a causality relationship between exports and growth.

The main problem with the causality test is that it is not useful when the original time series is not co-integrated. Some recent studies have investigated the impact of exports on growth by applying the technique of co-integration and ECM.

Were et al., (2002) found that the immediate price effect (depreciation of the real exchange rate) was statistically insignificant while the same variable lagged one-period was significant but negative. This could be explained by the fact that adjustments to price response in the short run are not likely to be considerable. Nonetheless, improvements in investments as a

proportion of GDP (both current and lagged) had a positive influence on the volume of tea exports in the short run. Surprisingly, the incomes of trading partners had a negative sign. This can be explained by shifting markets for Kenyan commodities, especially with economic integration and a decline in exports to the European Union.

According to Alam (2010) devaluation or no devaluation, floating or no floating have been a tug-of-war between fund banks and intellectuals for a long time with a conservative disposition in third-world countries. One of the merits that the advocates of depreciation of a local currency commonly put forward is its contribution to increased export earnings. In fact in an era of devaluation Bangladesh, like many other third world countries, placed exports as one of the foremost reasons for devaluing their local currencies against the US\$. One study shows that there was no causality run from depreciation of the real exchange rate of the taka to Bangladesh's export earnings. This result is in line with the findings of CPD and many other Bangladeshi researchers over the years (Hussain, 2000) who found Bangladesh's export price inelastic and that the depreciation of the taka did not have much impact on exports. So, for Bangladesh's exports to be price elastic, policies that help increase the share of domestic goods that can be exported by the expansion of the production base are needed. This will also help in the diversification of export items. However, the impact of exchange rate depreciation might not have been the same for all sub-sectors of exports. This is why the relationship between exchange rate and various sub-sectors of exports need to be considered and analyzed separately. Nabli and Marie-Ange (2002) in Alam (2010) show that exchange rate over-valuation caused huge losses in exports of MENA (Middle Eastern and North African) countries by decreasing their export competitiveness: 'For the MENA region as a whole, exchange rate policy explains losses in competitiveness and in manufactured exports. RER overvaluation has reduced on average the ratio of manufactured exports to GDP by 18 percent a year. Manufactured exports which averaged 4.4 percent of GDP from 1970 to 1999 could have reached 5.2 percent of GDP if no overvaluation had taken place. These losses were more concentrated in the 1970s and 1980s than in 1990s due to the higher overvaluation of the currencies during those two sub-periods.'

According to Ferris (2005) the quantity exported by a given nation is the dependent variable which has the following independent variables: price in exporting country, prices in competing exporting countries, prices in importing countries, world market prices, population, purchasing power, production in importing nations, demands for inventory, consumption maintenance, (price inelastic) demand, border protection policies, export subsidies from competing exporting nations, transportation costs and livestock numbers (for feed demand). Our study used the quantity of tea exported as the explained variable and the following different explanatory variables which affect tea exports: the real exchange rate, incomes of major trading partners, total investments as a proportion of GDP, world market tea prices and world market coffee prices.

3. Methodology

Our study applied a causal (explanatory) research design to explain the cause-effect relationship between the variables. Since our study conducted a time series data analysis,

secondary data was collected from different sources like WITS, the World Bank, FAOSTAT and NAEB websites. The study investigated relationships between tea exports as the explained variable and the following different explanatory variables which affect tea exports: the real exchange rate, incomes of major trading partners, total investments as a proportion of GDP, world market prices for both tea and coffee. The real effective exchange rate was deflated to 2007 constant Rwandan franc (2007=100); the GDP deflator used was for 2005 constant Rwandan franc (2005=100). To analyze the data statistical packages E-views, PcGive and SPSS were used.

The international trade theory that we used (neo-classical trade theory) is based on David Ricardo's principle of comparative advantage which states that a country has a comparative advantage in producing a good if the opportunity cost of producing that good in terms of another good is lower in that country than it is in the other countries. The neo-classical trade theory assumes two factors of production (labor and capital), equal technology in all countries, perfect competition, constant returns to scale and factor mobility between sectors but not between countries (Appleyard et al., 2001). In the neo-classical trade theory, trade can take place due to a comparative advantage which is explained through differences in relative factor endowments-factor abundance (Heckscher-Ohlin theorem-HO).

The Heckscher-Ohlin theorem states that a country will produce and export a good whose production makes intensive use of the relatively abundant factors of production before trade. This country should limit the production and increase the imports of the good whose production makes intensive use of expensive factors of production before trade (Appleyard et al., 2001 in Were et al., 2002).

We evaluate the neo-classical trade theory in a neo-classical production function framework incorporating an additional factor of production (exports) into the production function. Exports are incorporated into the production function to capture their relationship with aggregate output. The augmented neo-classical production function is specified as:

$$(1) \quad Y = F(K, L, EXP)$$

where, Y= aggregate output (real GDP), K is capital, L is labor force and EXP is total real exports of goods and services.

Because of their importance in production, economic theory says that both capital and labor have positive effects on overall output. Because of its positive externalities, the ELG hypothesis says that exports must have a positive effect on aggregate output.

Conventional commodity models usually incorporate the real foreign income (of trading partners) and real exchange rate (proxy for relative prices) as explanatory variables in estimating the export supply functions in general (Alemayehu, 1999; Balassa et al., 1989; Branchi et al., 1999; Klaassen 1999; McKay et al., 1998; Ndung'u and Ngugi, 1999; Ogun 1998; Whitley, 1994; in Were et al., 2002). Our study adopted a similar approach with the following explanatory variables: the real effective exchange rate (REER\$FRws), foreign incomes (incomes of major trading partners (inc)), total investments as a proportion of GDP (invGDP), coffee prices, tea prices and dummies to capture structural change variables with 1 standing for the presence of structural change and 0 otherwise.

The inclusion of income and real exchange rate is standard in trade models. The additional variables are investments to GDP ratio as a proxy for capital formation to capture supply constraints and dummies for structural change variables.

Granger Causality Equation

According to Kónya et al., (2004) the concept of Granger causality is based on the idea that a cause cannot come after its effect. More precisely, variable X is said to Granger-cause another variable, Y , if the current value of $Y(y_t)$ is conditional on the past values of $X(x_{t-1}, x_{t-2}, \dots, x_0)$ and thus the history of X is likely to help predict Y . Note that this is causality for one-period ahead.

To test the hypothesis H_0 , the following Granger causality model was used:

$$(2) \quad \Delta Y_t = a_1 + \sum_{j=1}^n \beta_{1t} \Delta Y_{t-j} + \sum_{j=1}^n \gamma_{1t} \Delta X_{t-j} + \varepsilon_{1t}$$

$$(3) \quad \Delta X_t = a_2 + \sum_{j=1}^n \beta_{2t} \Delta Y_{t-j} + \sum_{j=1}^n \gamma_{2t} \Delta X_{t-j} + \varepsilon_{2t}$$

ΔY_{t-1} is the lagged difference of the dependent variable at time t

ΔX_{t-1} is lagged difference of the independent variable at time t

The null hypothesis was $\gamma_j = 0$ for all j versus the alternative hypothesis that $\gamma_j \neq 0$ for at least some j . If the coefficients γ_s were statistically significant, then X caused Y .

Data Analysis

Our study used both descriptive and inferential statistics in the analysis. Software packages such as PcGive, SPSS and E-views were used as tools for computation. The first stage of data processing and analysis was concerned with a descriptive analysis of data to present the main characteristics of Rwanda's tea exports and their determinants. While dealing with time series data it has to be ensured that the individual time series are either stationary or that they are co-integrated otherwise the regression analysis will not be correct (Gujarati, 1999). Two or more time series are said to be co-integrated if they have a common stochastic trend (Stock and Watson, 2007). We used the two-step method put forward by Engle and Granger (1987) to test the mutual long term causalities of relevant indices; if it was proved that long term causality existed then their short term causalities were tested using the Wald test. The final stage of data analysis was to test for predictability between exports and factors of exports using both model and the Granger causality test (F-test). Causality testing involved examining whether the lags of one variable could be included in another equation. To test for the direction of causation between exports and factors of exports, the F-statistics testing of the hypothesis that the coefficients on all the values of one of the variables in the Granger causality model (for example, the coefficients on $X_{1t-1}, X_{1t-2}, \dots, X_{1t-q1}$) were zero. This null hypothesis implies that these regressors had no predictive content for Y_t beyond that contained in the other regressors and the test of this null hypothesis is called the Granger causality test (Stock and Watson, 2007). According to Granger (1988) in Alam (2010), the Granger causality test is used to examine whether the past value of a variable series X will

help predict the value of another variable series at present, Y , taking into account the past value of the Y (Granger, 1988).

In our study, Granger causality from determinants of tea exports to the quantities of tea exported was established when the coefficients of the lagged differences of the dependent variables were found to be jointly statistically significant and helped explain and predict the quantities of tea exported over and above what the lagged differences of quantities of tea exported could predict. Our study also carried out diagnostic tests in order to validate the results.

4. Results and Discussion

The unit root test and the co-integration test were done as pre-tests and depending on the outcomes, testing for causality was done using the VAR model.

Unit Root Tests

Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests are used to test for stationarity of the data. Both the tests were done to check the order of integration of these variables. The results are given in Table 1. Based on the PP test statistics, it was seen that all variables had a unit root (non-stationary) at level and stationarity after first difference (integrated of order one). However, the standard Augmented Dickey-Fuller (ADF) showed that out of six variables, five had a unit root meaning that $\lnreer$ $I(1)$, $\lnp$ $I(1)$, $\lninvdp$ $I(1)$, $\lncoffprice$ $I(1)$ and $\lninc$ $I(2)$, while $\lnexp$ was $I(0)$ variable. Noticeably, with a mixture of $I(0)$, $I(1)$ and $I(2)$ variables in the ADF unit root test it would not have been possible to perform the Johansen procedure of co-integration. This should have given a good justification for using the bounds test approach, or the ARDL model proposed by Pesaran et al. (2001). However the correlogram test was carried out to check if variables having different levels of integration in ADF behaved the same way in the correlogram test. Both the PP and correlogram tests confirmed that all variables were stationary at first difference $I(1)$ allowing us to do the Johansen co-integration test. We also allowed for a linear deterministic trend for variables.

Table 1: Results of Augmented Dickey- Fuller and Phillips-Perron Tests

variables	ADF	I(d)	PP	I(d)
$\lnexp$	-17.95 (-2.99)	$I(0)$	-5.14 (-2.97)	$I(1)$
$\lncoffprice$	-5.94(-2.97)	$I(1)$	- 5.96 (-2.97)	$I(1)$
$\lnp$	-7.95 (-2.97)	$I(1)$	-7.99 (-2.97)	$I(1)$
$\lnreer$	-4.98 (-2.97)	$I(1)$	-5.69 (-2.97)	$I(1)$
$\lninvdp$	-7.82 (-2.97)	$I(1)$	-8.42 (-2.97)	$I(1)$
$\lninc$	-3.87 (-2.99)	$I(2)$	-4.68 (-2.97)	$I(1)$

Source: Authors' computations using secondary data (2014).

Note: Dummies were not included in the unit root analysis.

The Johansen Co-integration Test

The Johansen co-integration test was carried out to find out whether there was a long-run relationship among the variables; all variables had to be at level form. Other preconditions for performing this test were that the variables had to be non-stationary at level but when converted into first difference they had to become stationary and integrated of the same order. The PP test allowed running the co-integration test.

The null hypothesis in the Johansen co-integration test was that there was no co-integrating equation against the alternative hypothesis (H_1) stipulating that there was at most one co-integrating equation. Both trace and maximum eigenvalue showed that there were three co-integrating equations because the Max-eigen statistics of 17.26 is less than 21.13 and trace statistic of 3.31 is less than 3.84 (the critical value at 5 per cent) with p-values greater than 0.05. Therefore, co-integration relationships reflected the long term balanced relationship between relevant variables (they moved together in the long run). Consequently, a restricted VAR (Vector Error Correction) model was run to test for the short-run relationship. If the variables were not co-integrated, the unrestricted VAR model would been run (Engle and Granger, 1987 in Alam, 2010). Table 2 gives the results of the co-integration test.

Table 2: Results of the Co-integration Test

Hypothesized n of CEs	Eigen value	Trace test			Hypothesized n of CEs	Max-Eigen test		
		Trace Statistic	Critical values 5%	Prob**		Max- Eigen Statistic	Critical values 5%	Prob**
$r=0^*$	0.969	236.888	95.75	0.000	$r=0^*$	97.376	40.078	0.000
$r\leq 1^*$	0.896	139.511	69.819	0.000	$r\leq 1^*$	63.391	33.877	0.000
$r\leq 2^*$	0.781	76.120	47.856	0.000	$r\leq 2^*$	42.490	27.584	0.000
$r\leq 3^*$	0.461	33.629	29.797	0.017	$r\leq 3$	17.266	21.132	0.160
$r\leq 4^*$	0.373	16.364	15.495	0.037	$r\leq 4$	13.0575	14.264	0.077
$r\leq 5$	0.111	3.306	3.841	0.069	$r\leq 5$	3.306	3.841	0.069

Note: Trace test indicated 5 co-integrating equation(s) and the Max-eigenvalue test indicated 3 co-integrating equation(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level and ** are MacKinnon-Haug-Michelis (1999) p-values. N of CEs denotes number of co-integrating equations.

Long -Run Elasticities in the Co-integrating Equation

Three steps were involved in VECM: Lag order selection, the Johansen test of co-integration and VECM. The optimal number of lags to be included in the model was found to be two.

Table 3 gives the following results: if the price of coffee increased by 1 per cent in the long run, then the quantity of tea exported went up by 10.44 per cent. These results match economic theory because tea and coffee are substitutes. Farris et al., (1987) have shown that two goods are substitutes if as the price of one goes up, more of the other is purchased, *ceteris paribus*.

If the incomes of major trading partners went up by 1 per cent, the quantity of tea exported increased by 5.89 per cent corresponding to the economic theory of consumption stipulating that if income goes up consumption also goes up. Given that tea is a perennial crop, these results are true for the long run.

In case there was a 1 per cent increase in investments as a proportion of GDP in Rwanda, the long run response was that the quantity of tea exported increased by 35.30 per cent.

A 1 per cent increase in the world prices of tea led to a 56.24 per cent decrease in the quantity of tea exported.

The same increase in the real exchange rate (depreciation of 1 per cent of REER) resulted in a 0.82 per cent increase in the quantity of tea exported. Although it is statistically insignificant with a t-value of 0.59, this view is in agreement with the findings of De Broeck et al., (2001) who concluded that there was clear evidence of productivity-based exchange rate movement (the Balassa-Samuelson effect).

Table 3: Long -Run Elasticities in the Co-integrating Equation

Variables	Coefficients	Standard Error	t-statistic
Ln of Quantity of Tea Exported	1.00		
Ln of Income of Major Trading Partners	5.89	0.45	13.01
Ln of Investment as Proportion of GDP	35.30	2.55	13.85
Ln of Tea World Price	-56.24	2.73	-20.56
Ln of Real Effective Exchange Rate	0.82	1.38	0.59
Ln of Coffee World Price	10.44	0.80	13.02
Constant	-231.51		

Source: Data analysis used in the study (2014).

Quantity of Tea Exported by Rwanda 1982-2012

Figure 1 gives the quantity of tea exported by Rwanda. It shows that from 1988 to 1989 Rwandan tea exports increased. This corresponded with an increase in incomes of its major trading partners. The figure also shows that from 1993 to 1995 there was a decrease in the quantity of tea exported; this can be explained by the fact that during this period there was war and the Tutsi genocide and economic activities were paralyzed. The figure also shows that since 1998 the quantity of tea exported has followed an increasing trend; this confirms what has been found previously that in 1998 the quantity exported increased compared to previous years due to the relative political stability in the northern part of Rwanda. Political

instability in major trading partners too can influence demand and that was the case in 1998 because Pakistan had a foreign currency shortage due to a World Bank embargo and could not import tea (NAEB, 1998).

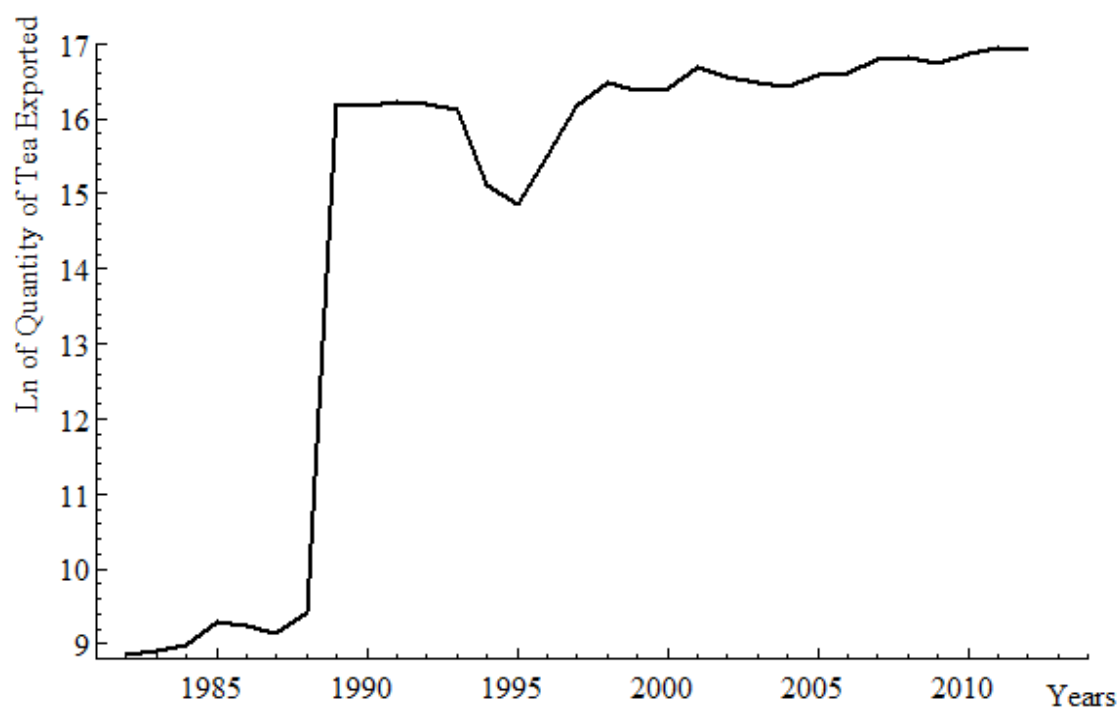


Figure 1: Quantity of Tea Exported by Rwanda (1982-2012)

Source: Data Analysis done in this study (2014).

OLS Model: Econometric Estimation Results and Discussion

Results of the OLS model regression are given in Table 4. These indicate that from the statistical point of view the R^2 of 0.54 is statistically significant, since the computed F value of about 3.30 is significant as its p-value is almost zero (0.01). As Gujarati (2004) says, the F statistic tests the hypothesis that all the slope coefficients are simultaneously zero, that is, all the explanatory values jointly have no impact on the regressand. Therefore, all independent variables in the model jointly influence the dependent variable. The model estimation shows that only the real effective exchange rate was significant among the six variables and that is a sign of existing multicollinearity in independent variables. The Durbin-Watson statistic for this regression was 0.65. This statistic was not within the acceptable range of 1.50 to 2.50, indicating that the residuals were serially correlated. However as Gujarati (2004) puts it, R^2 of less than d indicates that the estimated regression is not incorrect.

Table 4: OLS Model Estimation

Variable	Coefficient	Standard Error	t-statistic	Probability
Constant	83.19	22.37	3.72	0.00
Coffee prices	-0.39	1.42	-0.28	0.78
Incomes of major trading partners	0.19	0.22	0.88	0.39
Investments as proportion of GDP	-6.04	4.45	-1.36	0.19
Tea prices	5.02	3.66	1.37	0.18
REER	-12.30	2.98	-4.13	0.00
Dummy for 2001-04	-1.38	1.99	-0.69	0.49
Dummy for 1988-89	-1.04	2.24	-0.47	0.65
Dummy for 1992-95	0.08	1.49	0.05	0.96
R-squared	0.546	Mean dependent var		14.71
Adjusted R-squared	0.380	S.D. dependent var		3.109
S.E. of regression	2.447	Akaike info criterion		4.865
Sum squared resid	131.759	Schwarz criterion		5.282
Log likelihood	-66.415	Hannan-Quinn criter.		5.001
F-statistic	3.303	Durbin-Watson stat		0.655
Prob(F-statistic)	0.012			

Source: Authors' computation using secondary data (2014).

Wald Test Results for Short-Run Causation

The probability of Chi-square statistic was less than 5 per cent for the joint influence of tea exports lagged once and twice on current tea exports. Thus, it can be said that lag 1 and lag 2 of the quantity of tea exported jointly affected exports in the short run. The probability of Chi-square statistic was less than 10 per cent for incomes of major trading partners lagged once and twice. Thus, it can be said that lag 1 and lag 2 of incomes of major trading partners jointly affected tea exports in the short run.

Granger Causality Test of Quantity of Tea Exported on its Determinants

Tables 5 and 6 summarize the results obtained in tests of predictive content (Granger causality tests). Table 5 shows that the F-statistic testing the null hypothesis that coefficient on $\ln\text{expt-1}$ is zero in the REER equation was 5.06 and had a p-value less than 0.05 was rejected, so the quantity of tea exported was a useful predictor of changes in REER given one lag in REER. The results differ from Alam's (2010) results who found that REER lagged once was not a good predictor of exports. We proved that bidirectional Granger causality existed between the quantity of tea exported and the dummy for the period 1988-89. SAPs and a decline in coffee prices in the 1980s as substituted by the dummy contained information that was useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests for a one-year lag are presented in Table 5.

Table 5: Granger Predictability Test Results for Variables Lagged Once

Variable A	Variable B	F- statistic	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.23	0.64	yes
Lnexp	lninc	2.89	0.10	yes
lninvgdp	lnexp	0.15	0.70	yes
Lnexp	lninvgdp	1.03	0.32	yes
lncoffprice	lnexp	0.41	0.53	yes
Lnexp	lncoffprice	0.00	0.95	yes
Lnp	lnexp	0.60	0.44	yes
Lnexp	lnp	0.04	0.84	yes
lnreer	lnexp	0.00	0.98	yes
Lnexp	lnreer	(5.06)**	0.03	no
D0104	lnexp	0.00	0.94	yes
Lnexp	D0104	0.28	0.60	yes
Lnexp	D8889	(6.77)***	0.01	no
D8889	lnexp	(21.35)***	0.00	no
Lnexp	D9295	0.34	0.56	yes
D9295	lnexp	2.23	0.15	yes

Note: * significant at the 0.1 level, ** significant at the 0.05level, *** significant at the 0.01level.

Source: Analysis of secondary data (2014).

The null hypothesis (Ho) is that variable A does not Granger cause variable B. Table 6 shows that for both REER and the quantity of tea exported the F-statistic was 2.98 with p-value less than 0.1 so the quantity of tea exported was Granger causing the real exchange rate at the 10 per cent level. This contradicts Alam's (2010) findings that RER did not Granger cause exports both in the short and long run. This does not necessarily mean that a change in the quantity of tea exported in the two previous years will cause a change in the real exchange rate; rather it means that the past values of the quantity of tea exported appear to contain information that is useful for forecasting changes in the real exchange rate beyond that contained in the past values of REER (Stock et al., 2007). We proved that bidirectional Granger causality existed between the quantity of tea exported and the dummy for the period 1988-89. SAPs and a decline in coffee prices in the 1980s as substituted by the dummy contains information that is useful for forecasting changes in the quantity of tea exported and vice versa.

The Granger predictability tests of a two-year lag are presented in Table 6.

Table 6: Granger Causality Results for the Variable Lagged Twice

Variable A	Variable B	F- statistics	probability	Decision on the null hypothesis. Yes if Ho is true and no otherwise
Lninc	lnexp	0.39	0.68	Yes
Lnexp	lninc	1.97	0.16	Yes
lninvgdp	lnexp	0.04	0.96	Yes
Lnexp	lninvgdp	0.17	0.84	Yes
lncoffprice	lnexp	0.28	0.76	Yes
Lnexp	lncoffprice	0.84	0.45	Yes
Lnnp	lnexp	0.29	0.75	Yes
Lnexp	lnnp	1.97	0.16	Yes
Lnreer	lnexp	0.06	0.94	Yes
Lnexp	lnreer	(2.98)*	0.07	No
D0104	lnexp	0.00	0.99	Yes
Lnexp	D0104	0.19	0.83	Yes
Lnexp	D8889	(6.82)***	0.00	No
D8889	lnexp	(72.70)***	0.00	No
Lnexp	D9295	0.19	0.82	Yes
D9295	lnexp	0.16	0.86	Yes

Note: *significant at the 0.1level, ** significant at the 0.05level, *** significant at the 0.01level.

Source: Analysis of secondary data (2014).

The null hypothesis (Ho) is that variable A did not Granger cause variable B when the F-test was applied. The Granger causality tests in both lagged once and lagged twice variables proved that independence was suggested between the quantity of tea exported and other independent variables meaning that the coefficients were not statistically significant in both regressions. R-squared was $0.77 > 0.50$, Prob (F-statistic) of $0.087 < 0.1$ meaning that 77 per cent of the variations in the quantity of tea exported were explained by variations in independent variables included in the model. However the latter could jointly influence the dependent variable (quantity of tea exported) at the 10 per cent level of significance. R-square of 77 per cent allowed us to conclude that the model was good.

5. Conclusion

We performed the predictive content tests for estimating bidirectional causation between tea exports and its determinants. Unidirectional causation flew from the quantity of tea exported to the real effective exchange rate. It was proved that bidirectional causation existed between the quantity of tea exported and the dummy for the 1988-89 period in both one and two-year periods of time (lags). The result of non-causality in the long term among all variables may be possible because before the late-980s it was a period of a pre-SAPs economy when exports were controlled. Short run causality was possible because after the 1980s, there was a decline in world tea prices in the short run which may have led to an increase in exports as demand increased. Additionally, a bidirectional predictive content existed between the

quantity of tea exported and SAPs in the late 1980s implying that economic policies can help in predicting tea exports.

The limitations of this study include the nature of the data and the sample size used. In the variables used as determinants of tea exports, labor and production were not included in the model. Thus, the effect of tea exports' determinants should be empirically re-examined including these factors.

Investments in tea factories should be improved, there should be diversification of commodities that are exported because the quantity of tea exported influences REER: The export sector relies greatly on tea and hence ease in forward selling or contracting should be prioritized and the niche markets for tea products should be widened.

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Part Six. Agriculture and Food Prices

Chapter 12. Aristide Maniriho and Pia Nilsson, “Determinants of livelihood diversification among households in Rwanda: the role of education, ICT and urbanization”.

Chapter 13. Charles Ruranga, Martin Mugenzi and Aline Mutabazi, “Spatial price transmission analysis in beans and rice markets of Rwanda”.

Chapter 14. Sandrine Unezeza and Jean-Baptiste Habyarimana, “External economic shock and food price volatility in Rwanda: evidence from ARCH and GARCH”.

Chapter Twelve

Determinants of Livelihood Diversification among Rwandan Households: The Role of Education, ICT and Urbanization

Aristide Maniriho¹ and Pia Nilsson²

¹ Corresponding Author,
School of Economics, University of Rwanda, Kigali, Rwanda,
Email: manirihoaristide1@gmail.com

² Jönköping International Business School (JIBS),
Jönköping University, Jönköping, Sweden,
Email: Pia.Nilsson@ju.se

Abstract

Rural households in many different contexts have been found to diversify their income sources allowing them to spread their risks and to smoothen consumption. Generating diversified incomes for a majority of the rural poor is an essential component of a successful rural development strategy. This paper identifies the determinants of income diversification among Rwandan households using unique panel data obtained from the Integrated Households Living Conditions Surveys of 2011 and 2014. It applies a binary logit panel model to a representative sample of 3,839 households across Rwanda controlling for latent household specific factors. It also conducts a Hausman test the results of which show that the random effect estimates were more efficient than fixed effect estimates ($\text{Chi}^2=20.73$ and $\text{Prob}>\text{Chi}^2=0.1891$). The results reveal that education, access to ICT and urban areas were among the most important factors that influenced livelihood diversification given that $p \leq 0.05$. We also found that other measures of household specific factors were important (for example, the age and gender of the household head along with asset endowments). From these results, it is recommended that professional training, internet access through phones and wireless and urbanization should be enhanced so as to enable households to diversify their sources of income and thus improve food security for their family members.

Keywords: Non-farm income, livelihood diversification, random effects logistic regression, Rwanda

JEL Classification Codes: C23; D13; E24; I20; O18;

1. Introduction

Agriculture is a well-known and important economic sector in Rwanda. All development strategies in Rwanda recognize agriculture as a leading development sector. Rural households in many different contexts have been found to diversify their income sources allowing them to spread their risks and to smoothen consumption (Ellis, 1998, 2000a, 2000b; Reardon et al., 1992). Generating incomes for a majority of the rural poor is one of the most important reasons that led economists to stress increased agricultural productivity as an essential component of a successful rural development strategy.

In rural areas in developing countries (as also in rich countries) it is common for farmers to work part-time in other activities thereby smoothing out seasonal fluctuations in demand for agricultural labor. This might include market or non-market activities such as bicycle repairs and home construction (Gollin et al., 2012). Further, Barrett et al., (2001) report that income diversification lies at the heart of livelihood strategies in rural Africa.

Appropriate economic policies for pursuing its pace of economic growth and development are of recent interest in Rwanda. Given that non-farm activities have become an important component of livelihood strategies among rural households, farmers in the agriculture sector need to diversify their livelihood sources so as to reach food security for their households. Alternatively, strong interactions between farm and non-farm activities are necessary to leverage rural development. Another problem is the effect of the government's agricultural policies on poverty alleviation. Policymakers and planners need to know the factors that influence livelihood diversification among rural farmers. It is necessary to state the extent to which rural farmers attempt to cope with risks and uncertainties and achieve food security by adopting off-farm and non-farm activities.

It is expected that the results of this study will be used by decision makers and rural development practitioners when planning for agricultural and rural development. After learning about the main determinants of farmers' income diversification, this paper will help decision makers know where more efforts are needed to help farmers choose additional economic activities besides on-farm jobs. With regard to researchers and academicians, the results of this study will contribute to knowledge related to agricultural economics in Rwanda.

Further, the results of our study will also help development practitioners and policymakers to learn about which off-farm and non-farm economic activities to pay attention to and the infrastructure that will reduce entry barriers and facilitate easier access to these activities.

The purpose of this study is to analyze the determinants of income diversification among households in Rwanda. It specifically aims to: (1) analyze the effect of education on livelihood diversification, (2) measure the effects of ICT on livelihood diversification, and (3) analyze the effects of the rural urbanization process on livelihood diversification in Rwanda.

2. Literature Review

There is vast literature on livelihood diversification, specifically in rural areas in developing countries. Barrett et al., (2001) classified the components of rural household incomes by sector, by function or by space. By sector, they differentiate farm activities from non-farm activities: farm income is gain from production and gathering of unprocessed crops, livestock, fish or forest products from natural resources whereas non-farm income is got from other activities like processing, transport or trading of unprocessed farm, fish and forest products. By function, wage employment is differentiated from self-employment (Fields, 2010): wage employment implies that people sell their labor to employers in exchange for wages or salaries, whereas self-employed people sell their labor to themselves. Finally by space an activity can be classified as local (when it is executed at home) or as migratory (when the activity is away from home).

Abimbola and Oluwakemi (2013) prove that in Africa various studies show that while most rural households are involved in agricultural activities such as livestock, crop or fish production as their main source of livelihood, they also engage in other income generating activities to augment their main source of income. Further, Escobal (2001) highlights that ‘income diversification is the process of switching from low-income crop produce to higher value crops, livestock and non-farm activities.’

This is often necessary in agriculture based peasant economies because of risks such as variability of soil quality, household and crop diseases, price shocks and unpredictable rainfall and other weather related events which lead to low productivity, low output and invariably low income which continually trap people in a vicious cycle of poverty (Awoniyi and Salman, 2011).

According to Ellis (2000a), income diversification is mostly referred to when the range of rural activities outside the farm is expanded and it can be seen as a dynamic adaptation process created through pressures and opportunities. Ellis (1998) also notes that diversification may be deliberate or involuntary and it can be used as a safety net by the rural poor or as a means of accumulation by the rural rich.

The factors underlying the diversification of livelihood sources among rural households are classified into two sets -- push factors and pull factors. Push factors commonly include risks and seasonality (Ellis, 2005). Here diversification is used as a strategy to manage risks due to lack of social insurance and rural poor households use diversification of livelihood sources as a substitute for social insurance (Barrett et al., 2001). Pull factors are opportunities for diversification of income sources (Chamberlin and Jayne, 2012). These factors are associated with factors like commercial agriculture, improved infrastructure, proximity to urban areas and better market access.

An assessment of farmers’ income diversification as a factor of food security among small-scale farmers has been of much interest for agricultural researchers. In Ethiopia, Gecho (2016) assessed rural farm households’ income diversification in the Wolaita zone. Primary data was gathered from 300 farm households randomly selected in four districts in the zone. They specified the binary logit model and their results confirmed that sex, farm size, livestock ownership, oxen ownership, education, leadership, annual cash income and market

distance were key determinants of farmers' participation in income diversification. In Nigeria, Adepoju and Oweyole (2014) examined rural livelihood strategies and their effects on income inequalities among households in the Akinyele area of Oyo state. They analyzed primary data collected from 105 respondents selected through a multi-stage random sampling method using descriptive statistics, multinomial logit and the generalized entropy inequality indices. Their findings revealed that age and land ownership had positive effects on farmers' livelihood strategies whereas household size had negative effects.

In Kenya, Wanyama et al., (2010) analyzed the factors underlying income diversification in maize based farming systems. Their study used primary data collected in 2004 from 1,850 rural households selected through a multi-stage sampling method. They used descriptive statistics, multinomial logit and Tobit models for data analysis. Their study shows that a majority of the farmers grew cash crops that were supplemented with off-farm income generating activities.

Many other researchers have investigated the diversification of farmers' livelihoods. BIRTHAL et al., (2014) examined farm households' access to different income-generating activities and their impact on income distribution in India. Their study concluded that agriculture was the dominant source of income but the households earned close to half of their incomes from non-farm activities. Besides, the poor households diversified more towards low-paid, low-return non-farm activities. They identified small landholdings, low agricultural productivity and surplus labor as determinants of farmers' income diversification even though non-farm income sources were accessible to a small proportion of farm households and had an unequalizing effect on income distribution.

Beyene and Muche (2010) examined the determinants of household food security among rural households in the Ada Berga district in central Ethiopia. Their study discovered that experience in farming activities, off-farm and non-farm incomes, land and livestock holdings, as well as soil and water conservation practices significantly affected household food security. The results of their study imply that attaining food security in the highlands of Ethiopia required adopting mixed strategies and policies. Mamman et al., (2014) analyzed food security status for livelihood and income diversification in Jigawa state, Nigeria. Eleven livelihood activities including fishing, petty trading, tailoring, carpentry, labor on other farms and agro micro-processing were the major livelihood activities that farming households engaged in to diversify their income sources. The study recommends that farmers should be encouraged to diversify their economic activities to earn more incomes to maintain their food security status so as to be better off.

Ghimire et al., (2014) state that non-farm activities played an important role in determining rural household incomes, consumption expenditure and household food security in Nepal. Using cross-sectional data and a Probit model, their results reveal that household characteristics such as age, gender and education of the household head and family size played a significant role in non-farm work decisions. Households with larger farm sizes were less likely to participate in non-farm work than households with small farms.

Akpan et al., (2016) analyzed poverty and income inequalities and identified the determinants of poverty among rural farm households in Akwa Ibom state, Nigeria. As a

result of persistence poverty, there was a sudden upsurge in agricultural livelihood diversification and rural-urban migration resulting in a high rate of urban unemployment. They collected data from 390 rural farm household heads spread across the rural areas of the state. The authors employed a combination of sampling methods to sample cross-sectional data collected from the respondents. The study used descriptive tools and the Tobit regression analysis to analyze the collected information. The income inequality index was 0.4210 for male headed households and 0.4531 for female headed ones. The Tobit model's estimates revealed that household head's farming experience, years in a social organization, level of formal education and farm and non-farm incomes were negative drivers of rural poverty in the region, whereas household head's age, household size, structure of land ownership and gender were positive drivers of poverty among rural farming households.

Awoniyi (2011) examined some of the factors determining the adoption of non-agricultural activities in rural Nigeria. This study concluded that an increase in foreign remittances reduced the incidence, depth and severity of poverty in developing countries. Remittances were considered a source of income which could possibly reduce poverty in the rural sector of the economy. Amanze et al., (2015) analyzed the pattern of income diversification strategies among rural farmers in the Nnewi north local government area in Anambra state. Their study used a multi-stage random sampling technique to select a sample of 90 rural farm households and a pre-tested and well-structured questionnaire to collect data. Descriptive statistics and the binary Tobit likelihood method were used to analyze the data. The results of the Tobit regression analysis showed that the model was well-fit as confirmed by the pseudo R² of 69 per cent. The sample value of the log likelihood ratio of 45.20 was significant at the 1 per cent level of probability. Constraints on income diversification included high investment costs, low human capital, risk, credit constraints and lack or inadequate expertise.

Prowse (2015) examined the determinants of non-farm income diversification in rural Ethiopia for a four-wave panel of 1,240 households from the Ethiopian Rural Household Survey over the period 1994–2009. The survey makes a conceptual distinction between non-farm and off-farm incomes and uses fixed and random-effects models to control for unobserved characteristics. The results of Prowse's study show that pull factors were the main determinants of income diversification and reflected a strategy by wealthier households. Ifeanyi-Obi and Matthews-Njoku (2014) studied socioeconomic determinants of choice of livelihood activities among rural dwellers in southeast Nigeria. The ordinary least squares multiple regression estimates showed that age, years of education and monthly income were the major socioeconomic factors affecting livelihood activities and farming and trading were the main livelihood activities in the study area.

Teshome and Edriss (2013) discuss different factors affecting income diversification and assess patterns of income diversification in the Akaki district in Ethiopia using cross-sectional data from 155 farm households using a structured questionnaire and the Tobit model. Their results indicate that family size, number of extension visits per year and education levels had a positive significant effect on income diversification, whereas age of the household head, land size and average distance from the market had a negative and significant influence on a household's decision for diversification.

Schwarze and Zeller (2005) examined two aspects of income diversification -- diversification as a shift away from agricultural activities and as an increasing mix of income activities -- in the vicinity of the Lore Lindu National Park in Indonesia. They noticed that agricultural activities were the most important source of income for rural households. Using a Tobit model, their results show that access to social capital and crop failures both had a positive impact on the Shannon equitability index, whereas the socioeconomic status and the distance to a road had a negative influence.

Demissie and Legesse (2013) examined the determinants of income diversification among rural households in Ethiopia. Using cross-sectional data and a multinomial logit model, their results show that human capital related variables (gender and age of household head, number of economically active family members, education level of household head and presence of children attending school), livelihood assets (livestock holdings, size of cultivated land), livelihood diversifying strategies (crop based diversification through the number of crops grown and harvested) and infrastructure related variables (proximity to market) influenced participation in non-farm and off-farm employment activities and the level of income in the study area. Idowu et al., (2011) analyzed the determinants of household income diversification and the share of income sources to total household income among rural farm households in southwest Nigeria. They collected data from a random sample of 411 rural farm households selected through a multi-stage sampling technique. They used the Herfindal index and Tobit regressions to analyze the data. Their results indicate that the level of income diversification among rural farm households in southwest Nigeria depicted by the inverse of the Herfindal index was 2.82. Education, experience in any non-farm activity and distance to an urban center were the major determinants of income shares of different sources of non-farm activities while an increase in the size of a household, per capita landholdings and per capita animal wealth significantly increased income diversification of rural farm households. The study recommends providing an enabling environment for enhancing more non-farm self-employed jobs.

Ogbanje et al., (2014) examined off-farm diversification among small-scale farmers in north central Nigeria. They used a multistage sampling technique to select 180 respondents and used the entropy index and multiple regression to analyze the data. Their findings show that the degree of off-farm diversification among small-scale farmers in north central Nigeria was high and that the farmers were neither specialized nor completely diversified. Their results also show that farming as a primary occupation, formal education, off-farm work experience and off-farm work significantly increased the degree of diversification, whereas age, farm size, on-farm work hours, leisure, hours, farm assets' current value and crop income decreased off-farm diversification. Etim et al., (2009) conducted a study to estimate the determinants of poverty among peri-urban fluted pumpkin producers in Nigeria. Using a two-stage sampling procedure to select a sample of 70 farmers, a questionnaire to collect data and a Tobit regression analysis to estimate the determinants of poverty, their results show that except sex, age and education of household head, all other explanatory variables specified in the model (household size, farming income, farming experience and access to extension services) were significant poverty determinants.

Woldernhanna and Oskam (2004) identified the lucrative rural non-farm activities available to farmers in the Tigray region of northern Ethiopia like masonry, carpentry and petty trade. They found that the underlying factors that hindered participation in non-farm activities such as credit constraints and lack of skills may have to be addressed through the provision of credit and technical training for the poor.

Many studies use cross-sectional data while a few also use panel data. Specifically in Rwanda, few researches have been conducted as far as income diversification is concerned. These include Ansoms and McKay's (2010) study which assesses poverty and livelihood profiles in rural areas and that of Nilsson (2016) whose research targeted rural households and examined their involvement in the non-farm sector and spatial spillovers analyzing data from 2006 and 2009 using a panel econometric analysis to identify the determinants of farm, non-farm and agricultural incomes. Dabalén et al., (2004) analyzed the returns to participation in the nonfarm sector in rural Rwanda and found that this enabled high earnings and that diversified households were less likely to be poor. Households which did not participate in the market had significantly lower consumption levels than households that did.

Whereas some researchers have analyzed the effects of age and education (besides other factors) of the household head on income diversification, our study extends these variables as besides the age of the household head, the ratio of household members aged less than six years, the ratio of household members aged between seven and 16 years and the ratio of household members between 17 and 59 years are included in the analysis. In addition to the education level of the household head, our study also considers the education levels of household members (ratio of household members who have completed different education levels -- primary, secondary, university and professional). In discussing the effects of internet connectivity, our study distinguishes internet access via phones and through wireless and the Local Access Network (LAN).

3. Research Method

3.1 Data sources

The Republic of Rwanda is located in east central Africa. It is the 149th largest country in the world and the fourth smallest in Africa. It is divided into five provinces -- Kigali City, Southern, Western, Northern and Eastern provinces--30 districts and 416 administrative sectors. Administrative sectors are sub-divided into cells which in turn are divided into villages. With a size of 26,338 square kilometers, Rwanda is bordered by the Democratic Republic of the Congo to the west, Uganda to the north, Tanzania to the east and Burundi to the south. It has many hills and mountains at a high altitude where the lowest point is 950 meters above sea level. The population of Rwanda was estimated at 11,689,696 in 2012 with a population density of 415; 83.5 per cent of the population lived in rural areas and 28.6 per cent was headed by females (NISR, 2012). The projected life expectancy at birth is currently 66.6 years. With a labour force participation of 73.6 per cent, a majority of the employed population in Rwanda is self-employed in the agriculture sector (62 per cent), followed by employees (19 per cent). Out of the non-agriculture sectors, those which employ workers

are wholesale and retail trade (22 per cent), construction (15 per cent), manufacturing (12 per cent) and households (11 per cent) (NISR, 2012). With the intent of assessing livelihood diversification our study used nationwide data obtained from two surveys of the Integrated Households Living Conditions Survey in Rwanda (EICV, French acronym) during 2011 and 2014 covering 3,839 households.

3.2 Model specification and definitions of study variables

Following Cameron and Trivedi (2005), McManus (2011) and Wooldridge (2013), a binary Probit model was specified and estimated to identify the factors underlying income diversification among households in Rwanda:

$$(1) Y_{jt} = \beta_0 + \sum_{k=1}^{17} \beta_k X_{kjt} + v_{jt}$$

where, Y_{jt} is the dependent variable (income diversification, yes=1, no=0), X_s are the independent variables, B_s are the coefficients, k the number of independent variables, j represents a household, t is time and v is the stochastic error term. The study variables are described in Table 1.

Insert Table 1 about here.

3.3 Data analysis

The binary logit panel model specified in Equation 1 is estimated using the random-effects binary maximum likelihood (ML) logit technique. The choice of this approach was motivated by the fact that the dependent variable is categorical and the specification captures heterogeneities among respondents and the variables under study when cross-sectional data is analyzed (Wooldridge, 2013) using panel data. The choice of the random effects model was based on the Hausman test (McManus, 2011) whose results showed that the random effects' estimates were more efficient than fixed effects' estimates (Chi2=20.73, and Prob>Chi2=0.1891).

4. Determinants of Livelihood Diversification among Households in Rwanda

Following the results from the estimation in Equation 1, it was found that some factors had a positive effect on income diversification, whereas others had a negative effect; some were statistically significant at different significance levels while some others were not. The significant factors that had a positive effect on income diversification were household size, remittances, share of household members who had professional training, access to the internet and the location of the household in an urban area. The age of the household head, female household head, the ownership of the house, the share of household members who were doing primary education, the ratio of household members aged between seven and 16 and the household poverty category had negative effects on income diversification.

In different studies, different factors have different effects on livelihood among households. The discussion on the findings of our study also takes into consideration the findings from other studies. The results are summarized in Table 2.

Insert Table 2 about here.

Age of the household head (agehhd): the results of binary random effects panel logit regression show that age had a negative significant effect on livelihood diversification (at a significance level of 1 per cent). This is supported by the results of different studies (see Aababbo and Sawore, 2016; Abimbola and Oluwakemi, 2013; Adepoju and Oyewole, 2014; Agyeman, 2014; Amanze et al., 2015; Fufa, 2015; Ghimire et al., 2014; Lay et al., 2009; Nilsson, 2016; Ogbanje et al., 2014; Teshome and Edriss, 2013). Other authors have found that the age of the household head had a positive effect on livelihood diversification. These include Akpan et al., (2014); Gecho (2016), Irohabe and Agwu (2014); Idowu et al., (2011); Manjur et al., (2014); and Wanyama et al., (2010).

Our study considers all household members. The variables ratio_less6, ratio_btn7_16 and ratio_btn17_59 are used to measure the ratio of household members who are aged less than six years, the ratio of household members who are aged between seven and 16 years and the ratio of household members who are aged between 17 and 59 years respectively. The results of the panel logit regression reveal that ratio_less6 and ratio_btn7_16 had negative effects, whereas ratio_btn17_59 had a positive effect on income diversification. The negative effects of ratio_less6 and ratio_btn7_16 contrast with the findings of Ogbanje et al., (2014) who reported that the number of children in a household was positively correlated with income diversification. As for the positive effects of the ratio_btn17_59, our results are supported by Ogbanje et al., (2014) who show that the number of adult males in a household had a positive effect on income diversification; they also report that the number of adult females had negative effects on income diversification.

Female household head (femalehhd): estimates of binary random effects logistic regression revealed that a female household head was negatively correlated with livelihood diversification. This negative relationship between the gender of the household head and income diversification is supported by the findings of Amanze et al., (2015); Adepoju and Oyewole (2014); Beyene and Muche (2014); Fufa (2015); Gecho (2016); Manjur et al., (2014); Nilsson (2016); Ogbanje et al., (2014); Sarah (2012); Teshome and Edriss (2013). In contrast, some authors report a positive relationship between the gender of the household head and livelihood diversification (Aababbo and Sawore, 2016; Abimbola and Oluwakemi, 2013; Agyeman, 2014; Ghimire et al., 2014; Idowu et al., 2011; Irohabe and Agwu, 2014; Wanyama et al., 2010).

Household size (HHsize): the results of econometric estimations show that household size had positive effects on livelihood diversification among households. Different authors support this relationship (for example, Akpan et al., 2016; Adepoju and Oyewole, 2014; Beyene and Muche, 2010; Ghimire et al., 2014; Idowu et al. 2011; Sarah, 2012; Teshome and Edriss, 2013) whereas some others reveal a negative relationship (see Abimbola and Oluwakemi, 2013; Ahmed, 2012; Amanze et al., 2015; Irohabe and Agwu, 2014; Nilsson, 2016).

House size (SizeHouse): this variable measures the number of rooms in a house occupied by the household. The econometric estimates of a binary panel logit model show that house size was positively correlated with livelihood diversification among households in Rwanda.

House occupation of the owner (owner_occup_house): this variable was used for measuring the effects of the house occupancy status (if the house is occupied by the owner) on livelihood diversification. The results show that the owner_occup_house had negative effects on livelihood diversification. These results are supported by Idowu et al., (2011).

Education (share_primary, share_secondary, share_higher, share_higher): whereas this variable measures the formal and/or informal education level of the household head, it is included for all household members in our study. Four variables were used to measure the education levels of household members. The variable share-primary was used to measure the ratio of household members who had completed primary education; share_secondary was used to measure the ratio of household members who had completed secondary education; share_higher was used for measuring the ratio of household members who had completed university studies; and share_other was used for measuring the ratio of household members who had completed education levels other than primary, secondary or university (technical education, professional training, etc.). The estimates of the binary random effects panel logit regression reveal that share_primary, share_higher and share_other were positively correlated with livelihood diversification among households. See Figure 1 and 2. More specifically, the results reveal that professional training was a very important determinant of income diversification and thus a source of food security among households in Rwanda. Different authors in different areas support these results (for example, Aababbo and Sawore, 2016; Agyeman, 2014; Ahmed, 2012; Amanze et al., 2015; Birthal, 2014; Gecho, 2016; Ghimire et al., 2014; Irohibe and Agwu, 2014; Idowu et al., 2011; Lay et al., 2009; Nilsson, 2016; Ogbanje et al., 2014; Wanyama et al., 2010). Some researchers have reported negative effects of education on livelihood diversification (see Adepoju and Oyewole, 2014; Akpan et al., 2014; Beyene and Mucche, 2014; Fufa, 2015; Manjur et al., 2014). Specifically, Abimbola and Oluwakemi (2013) did not include all household members in their analysis but considered different education levels of the household head. They report that secondary education was positively correlated with income diversification, whereas primary and tertiary levels of education were negatively correlated with income diversification among households. Further, Fufa (2015) reported positive effects of non-farm training on income diversification.

Insert Figure 1 about here

Insert Figure 2 about here

Internet connection (internet_phone, internet other): our study measures the effects of internet connections via phones (internet_phone) and internet connections through other connectivity facilities (wireless, LAN) separately. The econometric estimations show that both internet_phone and internet_other had positive effects on livelihood diversification. However, these results are in contrast to those in Akpan et al., (2014).

Urbanization (urban): this variable is a measure of the urbanization process undertaken by the Government of Rwanda through group settlements, modern infrastructure, rural

electrification and enhancement of secondary cities other than Kigali (Huye, Muhanga, Musanze, Nyagatare Rubavu and Rusizi), among others. The results of the effects of urbanization reveal that it had positive effects on livelihood diversification. These results are supported by Idowu et al.'s (2011) research.

Poverty status (Poor): we also estimated the effects of poverty status on livelihood diversification. Our results show that poverty status was negatively correlated with income diversification among households in Rwanda. These results are supported by Awoniyi and Salman's (2011) findings.

Credit (credit): this is a measure of total household credit. The results of an econometric estimation show that credit was positively correlated with income diversification among households in Rwanda. The same results were found by Nilsson (2016), Fufa (2015), Beyene and Muche (2014), Ogbanje et al., (2014), Irohabe and Agwu (2014) and BIRTHAL (2014) when farm credit was considered and Gecho (2016) and Idowu et al., (2011). In contrast, some authors have found a negative correlation between credit and income diversification (see for example, Agyeman, 2014; Ahmed, 2012; Amanze et al., 2015; Ghimire et al., 2014; Sarah, 2012; Teshome and Edriss, 2013). BIRTHAL (2014) also found a negative effect of credit on income diversification when he considered non-farm credit specifically.

At the significance level of 0.05, the results show that the most statistically significant determinants included education, ICT, urban areas and specific characteristics of households (age of the household head, ratio of household members aged below six, ratio of household members aged between seven and 16 and occupation status of the house). Consequently, it was found that: (1) education level, specifically the share of household members who had attended other education such as professional training had a positively strong effect on livelihood diversification, (2) ICT, particularly internet access through mobile phones, was positively correlated with income diversification, and (3) the undertaken rural urbanization process had a significantly positive effect on livelihood diversification in Rwanda.

5. Conclusion and Recommendations

Agriculture is the main source of livelihood among households in Rwanda. In many different contexts, rural households have been obliged to diversify their income sources allowing them to spread their risks and smoothen consumption. Income diversification mostly refers to a situation when the range of rural activities outside the farm is expanded and can be seen as a dynamic adaptation process created through pressures and opportunities.

Theory specifies that factors underlying the diversification of livelihood sources among rural households are classified into two sets -- push factors and pull factors. Push factors commonly include risks and seasonality. In our study diversification was used as a strategy to manage risks due to lack of social insurance when rural poor households substituted social insurance with diversification of livelihood sources. Pull factors are opportunities for diversification of income sources. These factors are associated with commercial agriculture, improved infrastructure, proximity to urban areas and better market access.

Our study aimed to analyze the determinants of income diversification among households in Rwanda. It obtained data from two surveys of the Integrated Households Living Conditions Survey in Rwanda (EICV, French acronym) during 2011 and 2014 from 3,839 households for analysis. A binary panel logit model was specified and the maximum likelihood method was used to estimate the coefficients.

Our results show that some factors had positive effects on income diversification, whereas others had negative effects; some were statistically significant at different significance levels while some others were not. The significant factors that had a positive effect on income diversification were household size, the share of household members who had professional training, access to internet connections and the location of a household in an urban area. The age of the household head, female household head, occupying own house, the share of household members with primary education, the ratio of household members aged between seven and 16 and the household poverty category had a negative effect on income diversification. At a significance level of 0.05, the results show that the most significant factors for income diversification included education, access to ICT and urban areas.

Therefore, it is recommended that professional training, internet access through phones and wireless and urbanization should be enhanced so as to enable households to diversify their sources of income and thus improve food security for their family members.

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Table 1: Definitions, measurement and summary statistics of study variables

Variables	Definition	Mean (Std. Dev.) 2010	Mean (Std. Dev.) 2014
Nonfarm_logit	Income sources (Diversification=1; Otherwise=0)	0.1736705 (0.2812472)	0.1959421 (0.1959421)
agehh	Age of the HH Head (years)	44.2974 (15.72515)	44.73945 (15.96274)
femalehhd	Sex of the household head (Female = 1 Male = 0)	0.2765625 (0.4474147)	0.2652423 (0.4415772)
HHsize	Mean household size	4.786979 (2.246168)	4.621157 (2.221515)
SizeHouse	Number of rooms of the house occupied by HH	3.807292 (1.385306)	3.594059 (1.278435)
owner_occup_house	Occupancy status (by the owner=1, otherwise=0)	0.8057292 (0.3957414)	0.7576863 (0.4285948)
share_primary	Share of HH members who completed primary	0.0127491 (0.0603102)	0.1754168 (0.220211)
share_secondary	Share of HH members who completed secondary	0.017219 (0.0709232)	0.0535875 (0.1386137)
share_higher	Share of HH members who completed higher edu	0.0001042 (0.0045644)	0.0111295 (0.0718008)
share_other	Share of HH members who completed other edu	0.0133399 (0.0646364)	0.0578534 (0.1600854)
ratio_less6	Share of HH members aged less than 6	0.1954119 (0.1783858)	0.171721 (0.1809986)
ratio_btn7_16	Share of HH members between 7 and 16 years	0.2136411 (0.2038594)	0.2094548 (0.2073315)
ratio_btn17_59	Share of HH members between 17 and 59 years	0.5232459 (0.2448195)	0.5486774 (0.25384)
internet_phone	HH has internet access through mobile	0.05000 (0.2180017)	0.1130797 (0.3167728)
internet_other	HH has internet access through LAN, wireless	0.0145833 (0.1199089)	0.0328296 (0.1782368)
credit	Total credit of the household in FRW	292686.8 (3754966)	324832.1 (2421470)
Poor	Poverty status (Poor=1, Otherwise=0)	0.1864583 (0.3895776)	0.1083898 (0.3109531)
urban	Urbanization (Urban=1, Otherwise=0)	0.3053674 (0.3053674)	0.2813966 (0.4497977)

Source: Authors' calculations from EICV 3 and 4 data.

Table 2: Random Effects Logistic Regression estimates and Random Effects ML regression estimates of livelihood diversification

Variables	Random effects logistic regression estimates	Random Effects ML regression estimates
agehhd	-0.0203029***	-0.0015751***
femalehhd	-0.2179306	-0.0432825***
lnHHsize	-0.7560621***	-0.0954197***
lnSizeHouse	0.2040365	-0.0109612
owner_occup_house	-0.8892044***	-0.1217525***
share_primary	0.1409671	0.0201557
share_secondary	-1.163167**	-0.128185***
share_higher	1.082503	0.3082335***
share_other	1.807745***	0.346362***
ratio_less6	-3.147527***	-0.262995***
ratio_btn7_16	-2.984682***	0.1672226***
ratio_btn17_59	0.4700391	0.1251007***
internet_phone	0.40818080**	0.0611698***
internet_other	0.4450081	0.0977653***
loan access	6.79e-08***	7.51e-09***
Poverty status	-0.1883487	0.0088813
urban	1.007354***	0.0867764***
Constant	0.3183861	0.4278653***
/lnsg2u	-1.44147	
Wald Chi2(18) / LR Chi2(18)	343.75	1480.56
Prob (> Chi2)	0.0000	0.0000
sigma_u	0.4863947	0.553636
rho	0.0670873	0.2838152
Observations	3839	3839

Note: *** significant at 1%; **: significant at 5%; and * significant at 10%.

Source: Authors' estimations from EICV 3 and 4 data.

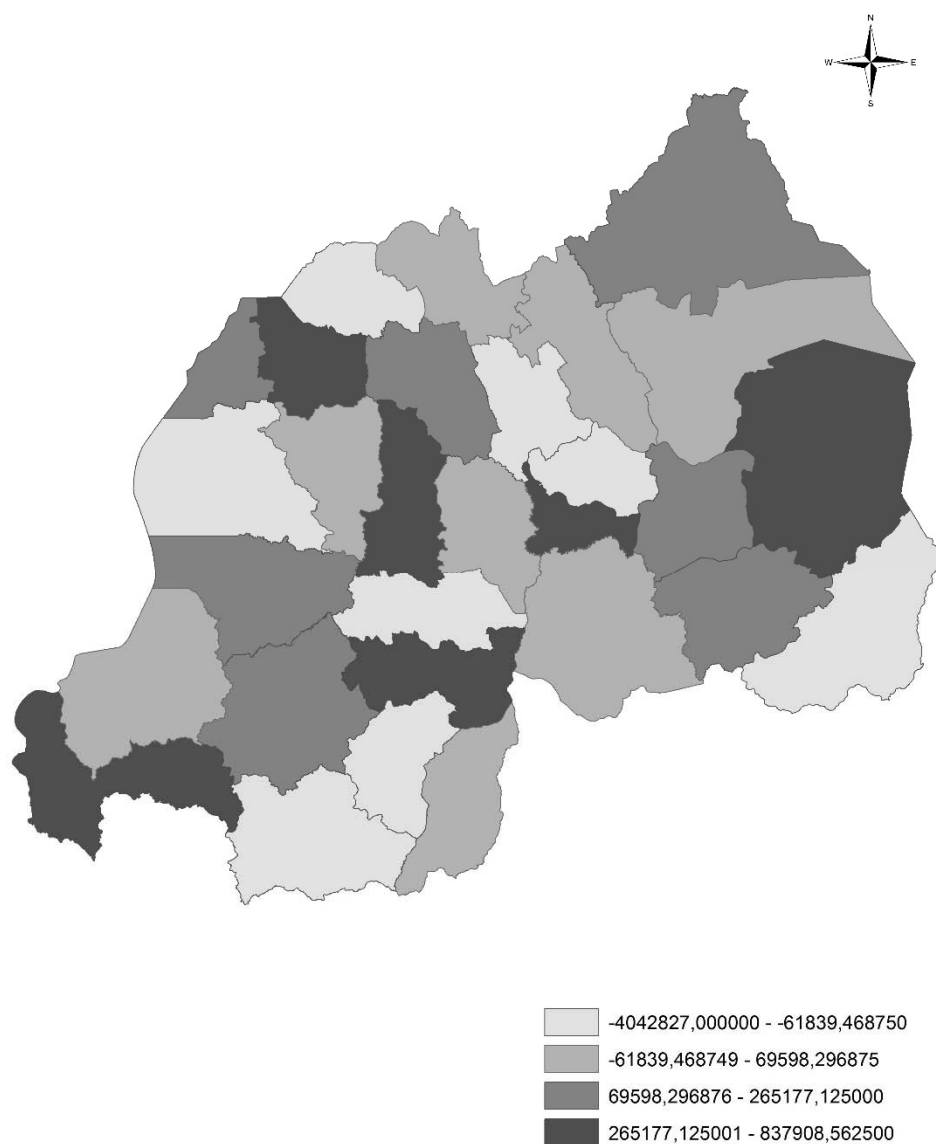


Figure 1. Differences in the level of non-farm income calculated at the district level (measured in quintiles)

Note: The darker shaded districts are those that experienced growth in non-farm income over the period 2010 to 2014 while the lighter ones experienced a decrease.

Source: Authors' estimations based on EICV3 and EICV4 survey data.

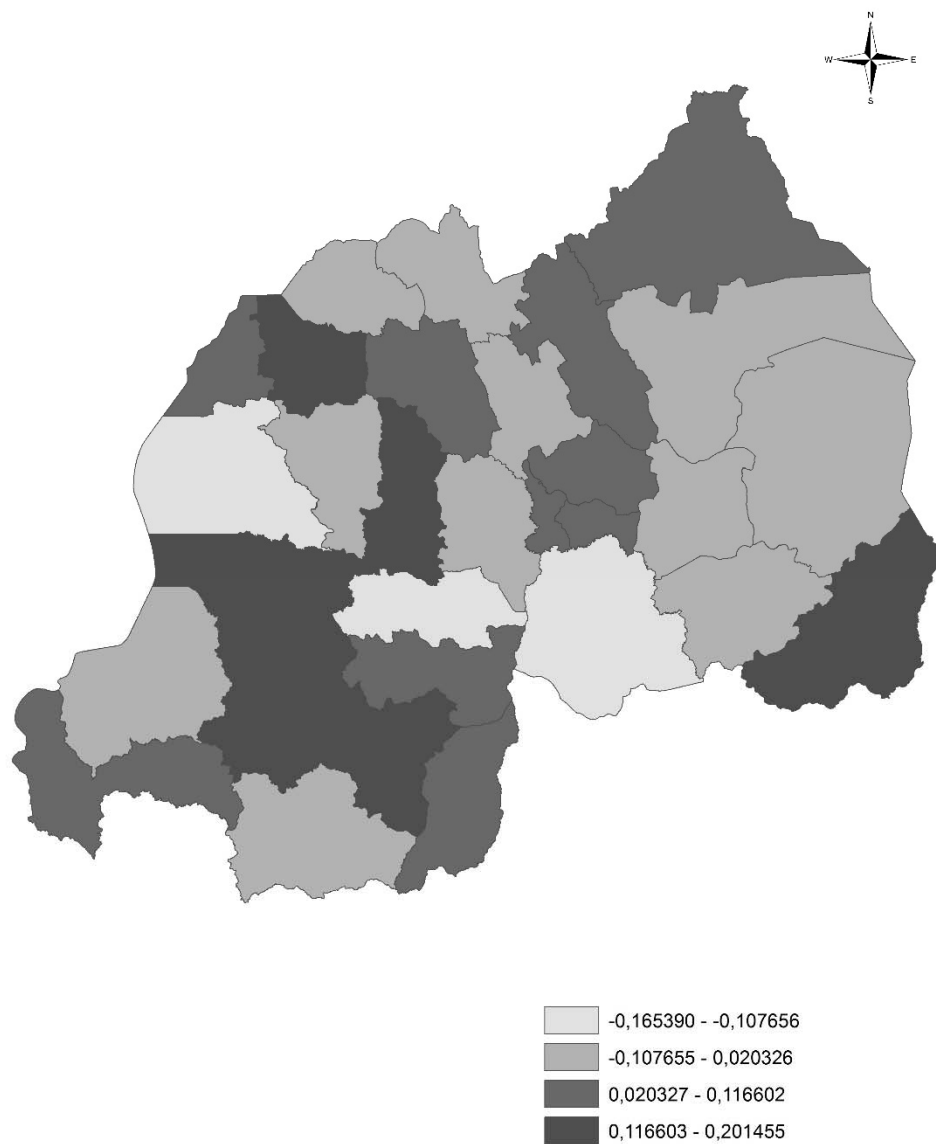


Figure 2. Differences in the share of non-farm income calculated at the district level (measured in quintiles)

Note: The darker shaded districts are those that experienced growth in the share of non-farm income over the period 2010 to 2014 and the lighter shaded are those that experienced a decrease.

Source: Authors' estimations based on EICV3 and EICV4 survey data.

Chapter Thirteen

A Spatial Price Transmission Analysis of Beans and Rice Markets in Rwanda

Charles RURANGA¹, Martin MUGENZI² and Aline MUTABAZI³

¹ Corresponding author:
School of Economics,
University of Rwanda, Kigali, Rwanda
E-mail: cruranga@ur.ac.rw

² School of Economics,
University of Rwanda, Kigali, Rwanda
E-mail: mmugenzi@ur.ac.rw

³ School of Economics,
University of Rwanda, Kigali, Rwanda
E-mail: amutabazi@ur.ac.rw

Abstract

An increase in food prices has many effects for consumers especially for vulnerable people because this decreases their purchasing power. We use the spatial price transmission to examine the impact of a change in prices in one market in another market. Specifically, we analyze the spatial price transmission in beans and rice markets. We analyze monthly data from January 2002 to December 2014 of retail prices of beans and rice in Huye, Nyabugogo, Musanze, Gisenyi and Nyagatare markets. The series are stationary in their first differences and the Johansen co-integration tests reveal that the variables are co-integrated implying that there is a long-run relationship. Impulse-response functions show that if a shock on retail price of beans in Musanze is 100 per cent, it will not affect other markets in the first month but in the second month it will affect all markets. If there is a shock of 100 per cent in the retail prices of rice in the Huye market other markets will not be affected in the first month but in the second month the Musanze market will be more affected (25 per cent effect). Variance decompositions reveal that the effect of a shock in the price of beans in the Musanze market will be shared with other markets from the second month. For retail prices of beans, the Granger causality tests show that there is unidirectional Granger causality between prices in different markets; for retail prices of rice there is bidirectional Granger causality.

Keywords: Spatial price, co-integration and impulse-response functions.

JEL Classification Codes: E31; E64; Q11; P42;

1. Introduction

Price transmission analyzes the effects of a change in given prices due to a change in another price. Price transmission can be analyzed spatially from one region or country to another or vertically for one product. Food price crises deteriorate the food security situation and impact the food and nutrition security of the most vulnerable groups who consume purchased food.

A continuous analysis of the food situation is necessary to keep the issue high on policy agenda so that policies can be devised to mitigate the adverse effects of high food prices. Food is a necessity for survival; it is also among the most important ingredients for human development and national stability and it is the first requirement for the social and economic stability of a nation. Any negative shock in food supply or prices affects the lives of millions. Poor, hungry and malnourished people use some of their additional incomes either to produce or purchase more food (FAO et al., 2012).

According to the United Nations Food and Agriculture Organization in the recent past international prices of many food commodities have increased substantially (FAO et al., 2012). Higher prices of agricultural commodities provide positive incentives for increased investments in agriculture. However, better policy responses and improved governance are needed to ensure sustainability and to address the effects of increased price volatility and of higher costs of the food basket for the poor, most of whom are net food buyers (FAO et al., 2012).

There is great concern that if the current food price situation is not circumvented it will be a major source of welfare deterioration for both urban and rural poor (net food buyers). Inflation in food prices is critical for low-income economies like Rwanda. As some anecdotal evidence indicates failures of food security policies in many developing countries including Rwanda show that policy makers lack the evidence needed to make informed policy decisions.

This paper analyzes transmission of food prices in Rwanda. Rwanda is located in East and Central Africa and is bordered by Tanzania to the east, the Democratic Republic of Congo to the west, Uganda to the north and Burundi to the south. According to the 4th Rwandan Population and Housing Census the country's population was 10.5 million and it had 26,338 square km of land. The census also shows that Rwanda had a very high population density with 416 people per square km (NISR and MINECOFIN, 2014). The Rwandan economy is not diversified and its trade balance has been negative for a while now. Since 1994 the Rwandan government has put in more effort by adopting different policies for economic development. Different documents with development targets have been developed for the mid- and long-term. Among these are the Economic Development and Poverty Reduction Strategy (EDPRS) and Vision 2020.

As a result poverty has reduced significantly and the percentage of the population living below the poverty line decreased from 77.8 per cent in 1994 to 44.9 per cent in 2011 (National Institute of Statistics of Rwanda, 2011). As per the World Bank (2012) Rwanda has also improved the conditions of doing business in recent years.

In Rwanda, food prices of many products have increased in recent years. The reasons for this are diverse and inter-related. Rwanda is a developing country with a very high economic growth rate in comparison to its neighbors -- 7.2 per cent between 2003 and 2014 (AfDB et al., 2012; AfDB et al., 2015). The services sector is the main contributor to gross domestic product (GDP) with around a 45 per cent share followed by agriculture with around a 35 per cent share and industry with around a 16 per cent share. Prices and production have changed over time. We discuss price changes in beans and rice. We analyze the prices of beans in five different markets -- Huye, Nyabugogo, Musanze, Gisenyi and Nyagatare (Table 1).

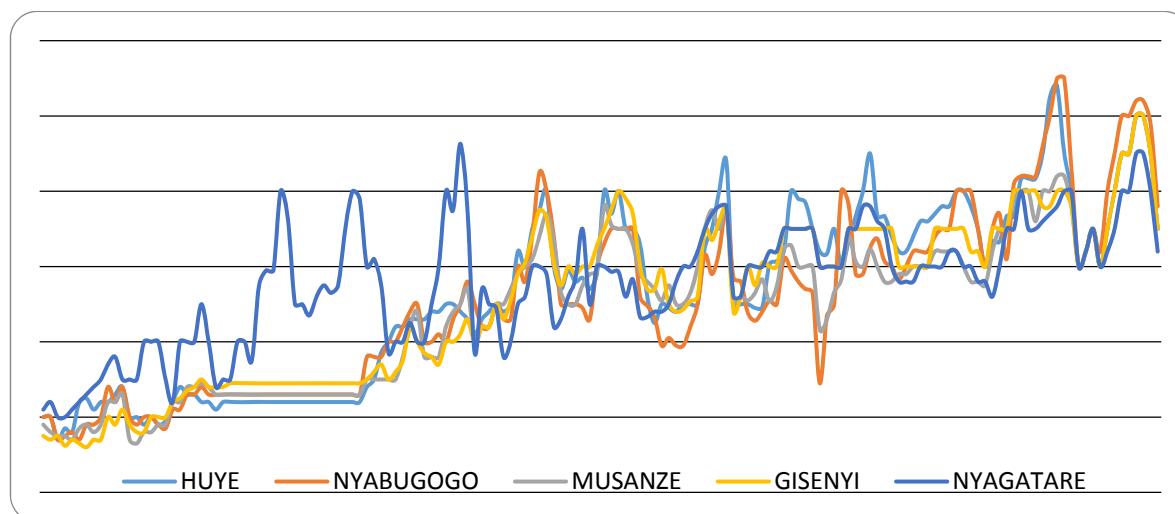
Table 7: Descriptive statistics of retail prices of beans in different markets (2002-14) (in Rwf per kg)

	Huye	Nyabugogo	Musanze	Gisenyi	Nyagatare
Average	264.4	253.9	246.0	255.1	279.0
Minimum	70	70	65	60	100
Maximum	540	550	500	500	463

Source: Authors' computations using data from the Ministry of Agriculture and Animal Resources (MINAGRI) (2016).

Prices of beans increased more than seven times on average in 12 years with increase being the highest (eight times) in the Gisenyi market and lowest at around five times in the Nyagatare market. The average shows that the Musanze market had the lowest price at Rwf 246 per kg (Figure 1).

Figure 3. Retail prices of beans in different markets (2002-14) (in Rwf per kg)



Source: Authors' computations using data from MINAGRI (2016).

Figure 3 shows that the retail prices of beans in all markets had an upward trend between 2002 and 2014. This can be explained by various reasons like an increase in demand in comparison to production (offer) and climate changes where production did not increase as expected.

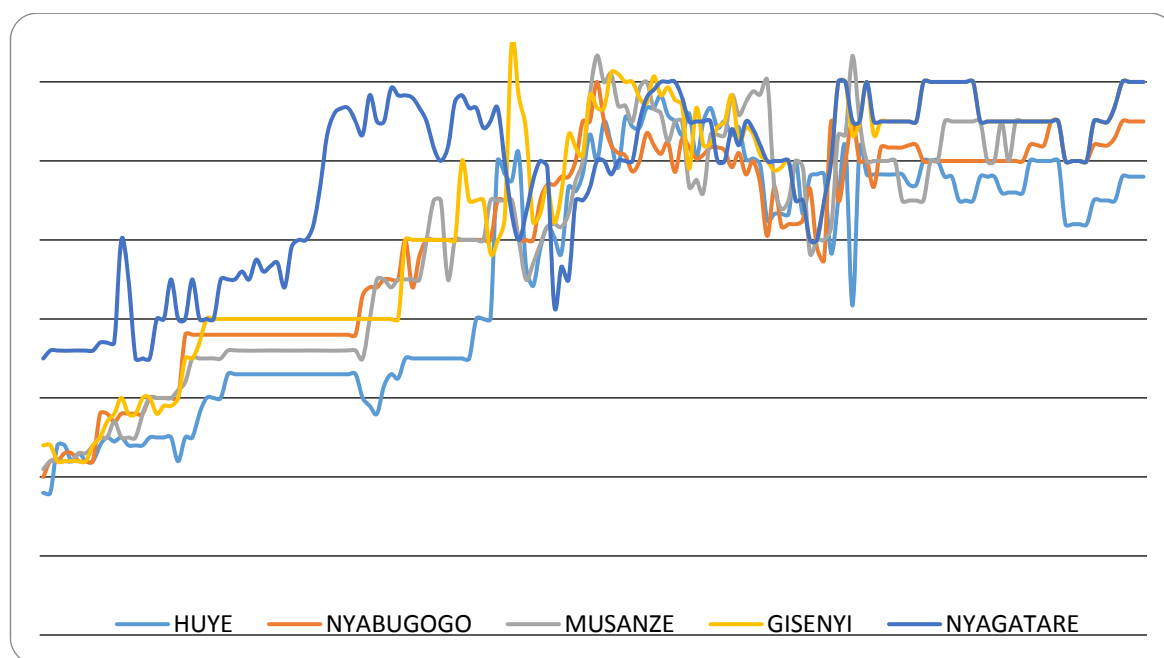
Table 8: Descriptive statistics of retail prices of rice in different markets (2002-14) (in Rwf per kg)

	Huye	Nyabugogo	Musanze	Gisenyi	Nyagatare
Average	465.3	504.2	510.2	533.8	579.3
Minimum	180	200	210	220	350
Maximum	683	700	733	750	700

Source: Authors' computations using data from MINAGRI (2016).

On average rice prices increased around three times between 2002 and 2014 with the highest increase in the Huye market (around four times) and the lowest increase in the Nyagatare market (two times). Figures show that on average the Huye market had the lowest prices at Rwf 465 per kg while the highest rice prices were in the Nyagatare market (Rwf 579 per kg) (Table 2).

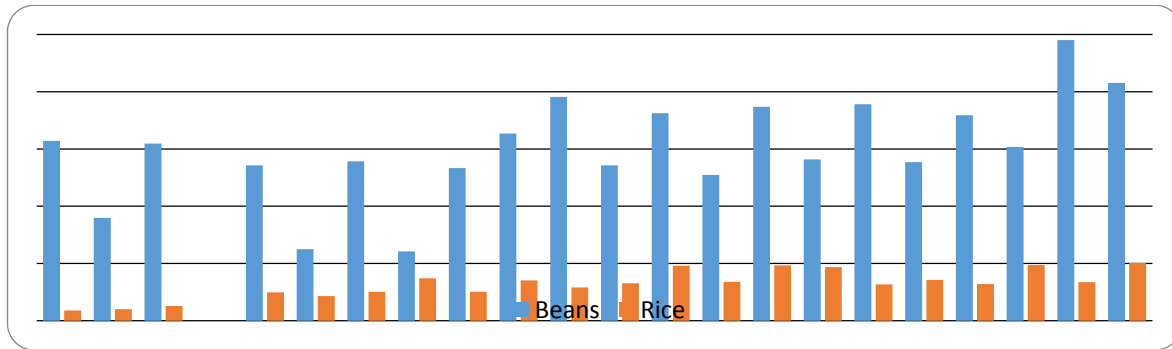
Figure 4. Retail prices of rice in different markets (2002-14) (in Rwf per kg)



Source: Authors' computations using data from MINAGRI (2016).

On average retail prices of rice increased three times in all the markets between January 2002 and December 2012. Figure 4 shows that there was an upward trend with fluctuations. After an analysis of retail prices of beans and rice in different markets in Rwanda we analyzed the production of beans and rice in metric tons (MT) in Rwanda (Figure 3).

Figure 5. Production of Beans and Rice (2002-12) (in MT)



Source: Authors' computations using data from MINAGRI (2016).

In general, the production of beans and rice increased but this increase was not significant and the production of beans increased 1.5 times in Season A and 2.3 times in Season B between 2002 and 2012 – a period of ten years -- and rice production increased 3.7 times in Season A and 5 times in Season B in the same period.

Therefore, generating policy relevant evidence and informing policymakers about the situation over time is relevant for interventions to avoid a food crisis. We considered spatial price transmission using the retail prices of food in different markets.

The specific objectives of our study are:

- Examining the existence of short and long run relationships between retail prices of beans and rice in different markets separately;
- Examining the shock effects on the dynamic path of retail prices of beans and rice in different markets separately; and
- Investigating the existence of Granger causality between retail prices of beans and rice in different markets separately;

2. Literature review

Some scholars have analyzed changes in food prices while others have examined the impact of food price transmission. According to FAO et al., (2012) the global food price situation in the world remained relatively stable from the 1970s till the early 2000s. However, since 2005 the prices of agricultural commodities have increased rapidly reaching unprecedented levels. Prices started soaring in 2007 and by mid-2008 they had reached the highest levels in 30 years. Global food prices stabilized over 2009-10 and thereafter starting soaring again for the second time beginning January 2011 and reached a peak in December 2011 exceeding the 2008 levels.

Conforti (2004) shows that price transmission is affected by the following factors: Transport and transaction costs, market power, increasing returns to scale in production, product homogeneity and differentiation, exchange rates and border and domestic policies. There are three types of price transmissions -- spatial price transmission, vertical price transmission

and cross-commodity price transmission. In spatial price transmission a commodity is commercialized between two different regions while in vertical price transmission the price of a good increases due to the rising price of one of its inputs and a cross-commodity price transmission happens when the price of a good which may be substituted for another good affect the price of the other good.

Some studies have been done on price transmission using the spatial approach (Conforti, 2004; Getnet et al., 2005; Minot, 2011) and the vertical approach (Conforti, 2004; Goodwin, 2006; Popovics and Tóth, 2005; Vavra and Goodwin, 2005). The food price crisis has many negative impacts for consumers, but it also offers some opportunities for producers.

We analyzed food price transmissions for potatoes and bananas products in Rwanda from the Musanze, Huye, Kibungo, Muhanga and Nyabugogo markets using monthly data for January 2002 and July 2013. Our results show that the prices were co-integrated and there was a long run relationship among the variables that we analyzed (Ruranga and Mutabazi, 2015). An analysis of food price transmission of beans and rice products is not conducted despite it is important to know how changes in prices in one market effect prices in other markets.

3. Data and Methodology

3.1. Data

Data for monthly retail prices was collected for beans and rice. The period of study is from January 2002 to April 2015 with a total of 156 observations. The markets covered are Huye in the Southern Province, Nyabugogo in Kigali City, Musanze in the Northern Province, Gisenyi in the Western Province and Nyagatare in the Eastern Province. Key data sources include the Ministry of Agriculture and Animal Resources and the National Institute of Statistics of Rwanda. This data was used in the spatial price transmission an analysis of beans and rice markets. The variables used are explained in Table 9.

Table 9: Variables and Descriptions

Variable	Description
PBHM	Monthly retail prices of beans in the Huye market
PBNM	Monthly retail prices of beans in the Nyabugogo market
PBMM	Monthly retail prices of beans in the Musanze market
PBGM	Monthly retail prices of beans in the Gisenyi market
PBNyM	Monthly retail prices of beans in the Nyagatare market
PRHM	Monthly retail prices of rice in the Huye market
PRNM	Monthly retail prices of rice in the Nyabugogo market
PRMM	Monthly retail prices of rice in the Musanze market
PRGM	Monthly retail prices of rice in the Gisenyi market
PRNyM	Monthly retail prices of rice in the Nyagatare market

Source: Authors' formulations.

3.2. Unit Root Tests

Stationarity was tested using Augmented Dickey-Fuller (ADF) tests. The general regression equation is presented as:

$$(1) \quad \Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{j=1}^p \gamma_j \Delta Y_{t-j} + \varepsilon_t$$

where, α is a constant, β is the coefficient of a time trend series, δ is the coefficient of Y_{t-1} is the lag order of the autoregressive process, $\Delta Y_t = Y_t - Y_{t-1}$ are first differences of Y_t , Y_{t-1} are lagged values of order one of Y_t , ΔY_{t-j} are changes in lagged values and ε_t is white noise. The parameter of interest in the ADF model is δ . The null hypothesis is $\delta = 0$ against $\delta < 0$. If $\delta = 0$, Y_t contains the unit root, this implies that the series is non-stationary.

3.3. VAR Lag Order Determination

The determination of an appropriate lag order in a VAR model was done using the Akaike information criterion (AIC), the Schwarz-Bayesian information criterion (BIC) and the Hannan-Quinn information criterion (HQIC). The general models for this information criteria are formulated as:

$$(2) \quad AIC(p) = \ln |\bar{\Sigma}(p)| + \frac{2}{T} pn^2 \quad (3)$$

$$BIC(p) = \ln |\bar{\Sigma}(p)| + \frac{\ln T}{T} pn^2$$

$$(4) \quad BIC(p) = \ln |\bar{\Sigma}(p)| + \frac{2 \ln \ln T}{T} pn^2$$

The AIC criterion asymptotically over-estimates the order with positive probability, while the BIC and HQ criteria estimate the order consistently under fairly general conditions if the true order p is less than or equal to $p_{\max}$.

3.4. Vector Autoregressions (VAR) Standard Form

We used a vector autoregression (VAR) model to analyze linear interdependencies among multiple time series. VAR with p lags in standard form for n variables is given as:

$$(5) \quad y_t = \psi d_t + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + u_t, \quad t = 1, 2, \dots, T$$

where,

y_t = an $(n \times 1)$ vector containing each of the n variables included in VAR

d_t = an $(q \times 1)$ vector of deterministic terms (such as constants, linear trends and dummies)

$A_i = (n \times n)$ matrices of coefficients

$u_t =$ an $(n \times 1)$ vector of error terms. Errors $u_1, u_2, u_3, \dots, u_T$ are uncorrelated white noise disturbances with mean $E\{u_t\} = 0$ and $E\{u_t u_{t-k}\} = \begin{cases} \sigma^2 & \text{for } k = 0 \\ 0 & \text{for } k \neq 0 \end{cases}$, this means that errors of variances are constant and co-variances are equal to zero. This means u_t is an $(n \times 1)$ vector with zero mean and a non-diagonal covariance matrix. For further analysis it is suitable to transform Equation 5 and put it in its unrestricted error correction representation.

3.5. Co-integration Tests and the Vector Error Correction (VEC) Model

The theory of integrated variables says that if the series are integrated of order one, $I(1)$, they may have a co-integration relationship. According to Hjalmarsson and Österholm (2007) co-integration methods have been very popular tools in applied economics since their introduction about 20 years ago. Different methods are used to test if the series are co-integrated like the Engle-Granger (EG) approach and the Johansen's procedure. The Engle-Granger approach is the most common single equation approach used for testing co-integration. It has several disadvantages especially for a model with more than two variables where there can be more than one co-integration relationship among the variables (Harris and Sollis, 2003). We used the Johansen approach where the trace test and the maximum eigenvalue test are presented as:

$$(6) \quad \lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$$

$$(7) \quad \lambda_{\text{max}}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

where, $\hat{\lambda}_i$ are the estimated values of the characteristics' roots (also called eigenvalues) obtained from the estimated π matrix. T is the number of usable observations.

Let $Y_t = (y_{1t}, \dots, y_{nt})'$ denote a $(n \times 1)$ vector of $I(1)$ time series. Y_t is co-integrated if there exists an $(n \times 1)$ vector $\beta = (\beta_1, \dots, \beta_n)'$ such that $\beta' Y_t = \beta_1 y_{1t}, \dots, \beta_n y_{nt} \square I(0)$. In other words, the non-stationary time series in Y_t is co-integrated if there is a linear combination that is stationary or identified of order zero. Enders (2010) demonstrated that the vector error correction model is an appropriate model if the series are co-integrated and is expressed as:

$$(8) \quad \Delta y_t = \psi d_t + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + u_t \quad \text{where, } \Pi = - (I - \sum_{i=1}^p A_i) \quad \text{and} \quad \Gamma_i = - \sum_{j=i+1}^p A_j$$

The reduced rank procedure allows Π to be factorized as $\Pi = \alpha \beta'$ where, α and β are both $(n \times r)$ and r is the rank of Π . If the rank of the matrix Π is equal to zero ($\text{rank}(\Pi) = 0$), the matrix is null and Equation 8 is the usual VAR model in first differences. If rank of Π

(r)=1, there is a single co-integrating vector and the expression Πy_{t-1} is the error-correction term and if $1 < r < n$, there are multiple co-integrating vectors. r corresponds to the number of linearly independent relationships among the variables in y_t . This is advantageous since it delivers a neat economic interpretation of the vector error correction model of Equation 8, whereby the r columns of β represent the co-integrating vectors that quantify the ‘long-run’ (or equilibrium) relationships between the variables in the system and the r columns of error correction coefficients of α , load deviations from equilibrium (that is, $\beta' y_{t-k}$) into Δy_t for correction, thereby ensuring that the equilibrium is maintained. The Γ_i matrices in Equation 8 estimate the short-run or transient effect of shocks on Δy_t and thereby allow the short and long-run responses to differ. The parameterization in Equation 8 allows the short run adjustment effects embodied in the new equilibrium (which leads to permanent changes in the level) to be distinguished from the effects of lagged differences (which are transitory). If two or more variables are stationary in their first differences, the co-integrated vector error correction (VEC) model is used to describe the dynamic inter-relationship among those variables. Vector error correction models (VECMs) estimate the speed at which a dependent variable may return to equilibrium after a change in an independent variable. VECMs are useful for estimating short-term and long-term effects. The tests of restrictions of the co-integrating vector of intercept or slopes in different models are required.

Impulse-response functions are calculated from reduced forms given in Equation 8 and it is required to have a knowledge of the structural economic representation from which Equations 5 and 8 are obtained. To investigate the dynamic responses of the system from economic variables’ shocks additional restrictions on the relationships among economic variables were placed. We used impulse-response functions (IRFs) and variance decompositions to analyze how a shock affected the dynamic paths of all the variables in a VAR model.

3.6. Granger Causality Tests

The Granger causality tests were used to investigate if variable Y can help forecast variable X. If it does not then we say that Y does not Granger cause X (Hamilton, 1994). The Granger causality tests between variables give four possibilities -- unidirectional causality from X to Y, unidirectional causality from Y to X, feedback or bilateral causality and independence or absence of Granger causality (Gujarati and Porter, 2009).

4. Findings and Discussion

We used different techniques to analyze retail prices of beans and rice in five different markets. ADF tests were done to test the stationarity of the data or existence of unit root, the Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ) for VAR lag order determination while trace and

maximum eigenvalue tests were done for co-integration. We also used the vector error correction model and the Granger causality techniques.

4.1 Unit root tests

Unit root tests were conducted to determine the stationarity of retail prices of beans and rice in different markets. The Augmented Dickey-Fuller (ADF) tests were used for retail prices of beans and the results are given in Table 10.

Table 10: ADF tests for monthly retail prices of beans in levels and first differences

Series	Critical value at 5%	ADF test statistic	Prob.
Series at levels			
Prices of beans in the Huye market (PBHM)	-2.880088	-2.087383	0.2501
Prices of beans in the Nyabugogo market (PBNM)	-2.880088	-2.166349	0.2195
Prices of beans in the Musanze market (PBMM)	-2.880088	-1.908973	0.3275
Prices of beans in the Gisenyi market (PBGM)	-2.880088	-1.903624	0.3300
Prices of beans in the Nyagatare market (PBNyM)	-2.880088	-1.697950	0.0550
Series' first differences			
Prices of beans in the Huye market (PBHM)	-1.942910	-11.26585 ^a	0.0000
Prices of beans in the Nyabugogo market (PBNM)	-1.942910	-11.12318 ^a	0.0000
Prices of beans in the Musanze market (PBMM)	-1.942910	-11.07429 ^a	0.0000
Prices of beans in the Gisenyi market (PBGM)	-1.942910	-11.39933 ^a	0.0000
Prices of beans in the Nyagatare market (PBNyM)	-1.942910	-12.55580 ^a	0.0000

Note: ^a significant at less than 1%.

Source: Authors' computations from MINAGRI (2016) data using E-Views 7.2.

The results in Table 10 show that the null hypothesis of existence of unit root is not rejected for retail prices of beans in all markets at levels since the probabilities are greater than the 5 per cent level of significance. ADF test for unit root in the first differenced series shows that all series are stationary at the 5 per cent significance level. If the variables are non-stationary at levels but stationary in the first differences it implies that they are of integrated order one I(1) at levels and integrated order zero I(0) in the first differences. Unit root tests' results using ADF tests for retail prices of rice are given in Table 11.

Table 11: ADF tests for monthly retail prices of rice in levels and first differences

Series	Critical value at 5%	ADF test statistic	Prob.
Series at levels			
Prices of rice in the Huye market (PRHM)	-2.880088	-2.143456	0.2282
Prices of rice in the Nyabugogo market (PRNM)	-2.880088	-2.182373	0.2136
Prices of rice in the Musanze market (PRMM)	-2.880088	-1.837675	0.3612
Prices of rice in the Gisenyi market (PRGM)	-2.880088	-1.928545	0.3185
Prices of rice in the Nyagatare market (PRNyM)	-2.880088	-2.382351	0.1484
Series' first differences			
Prices of rice in the Huye market (PRHM)	-1.942938	-7.198986 ^a	0.0000
Prices of rice in the Nyabugogo market (PRNM)	-1.942910	-12.24464 ^a	0.0000
Prices of rice in the Musanze market (PRMM)	-1.942910	-12.61532 ^a	0.0000
Prices of rice in the Gisenyi market (PRGM)	-1.942924	-13.73914 ^a	0.0000
Prices of rice in the Nyagatare market (PRNyM)	-1.942910	-12.27358 ^a	0.0000

Note: ^a significant at less than 1%.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results in Table 11 show that the null hypothesis of the existence of unit root is not rejected for all variables at levels. ADF test for unit root in the first differences shows that all series are stationary at the 5 per cent significance level. This means that retail prices of rice in different markets are integrated of order one I(1).

4.2 VAR Lag Order Selection

The determination of maximum lag p in a VAR was conducted in the two models of retail prices of beans and rice in different markets. The Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ) were used for this and the results for retail prices of beans are given in Table 12.

Table 12: VAR Lag Order Selection for retail prices of beans

Endogenous variables: PBGM PBHM PBMM PBNM PBNyM						
Included observations: 152						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3927.823	NA	2.05e+16	51.74767	51.84714	51.78808
1	-3508.804	804.9579*	1.15e+14*	46.56320*	47.16002*	46.80565*
2	-3490.702	33.58336	1.26e+14	46.65397	47.74814	47.09846
3	-3475.609	27.00893	1.44e+14	46.78432	48.37584	47.43085
4	-3458.234	29.94851	1.60e+14	46.88466	48.97352	47.73323

Note: * indicates lag order selected by criterion.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

Table 12 shows that the selected lag in the model of retail prices of beans is one. This means that the appropriate model for analysis of retail prices of beans is VAR (1). The results of lag order selection for retail prices of rice are given in Table 13.

Table 13: VAR Lag Order Selection for retail prices of rice

Endogenous variables: PRHM PRGM PRMM PRNM PRNyM						
Included observations: 152						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4171.690	NA	5.07e+17	54.95645	55.05592	54.99686
1	-3659.203	984.5149	8.30e+14	48.54214	49.13896*	48.78459*
2	-3625.723	62.11408	7.44e+14	48.43057	49.52473	48.87505
3	-3588.682	66.28436	6.36e+14*	48.27213*	49.86364	48.91866
4	-3564.510	41.66393*	6.46e+14	48.28303	50.37189	49.13160

Note: * indicates lag order selected by the criterion.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

In Table 13 SC and HQ criteria chose lag order one while AIC indicates lag three. If the criteria indicate different lags the use of the lag order given by Schwarz information criterion is recommended. This implies that the selected lag order is one and the appropriate model is VAR (1).

4.3 Co-integration tests

Co-integration tests are done to determine the existence of long-run equilibrium relationships between variables. We used the Johansen co-integration test and the trace test results for beans are given in Table 14.

Table 14: Johansen's co-integration trace test results for beans

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r > 0$	0.220389	110.3893	69.81889	0.0000
$r \leq 1$	$r > 1$	0.158189	72.04949	47.85613	0.0001
$r \leq 2$	$r > 2$	0.136528	45.53080	29.79707	0.0004
$r \leq 3$	$r > 3$	0.116036	22.92460	15.49471	0.0032
$r \leq 4$	$r > 4$	0.025199	3.930350	3.841466	0.0474

Note: Trace test indicates 5 co-integrating eqn(s) at the 0.05 level.

**MacKinnon-Haug-Michelis (1999) p-values.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The trace test indicates that there are five co-integrating equations. The maximum eigenvalue test results for the co-integration test of beans are given in Table 15.

Table 15: Johansen's co-integration maximum eigenvalue test results for beans

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r = 1$	0.220389	38.33985	33.87687	0.0137
$r = 1$	$r = 2$	0.158189	26.51869	27.58434	0.0680
$r = 2$	$r = 3$	0.136528	22.60620	21.13162	0.0308
$r = 3$	$r = 4$	0.116036	18.99425	14.26460	0.0083
$r = 4$	$r = 5$	0.025199	3.930350	3.841466	0.0474

Note: Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The maximum eigenvalue test demonstrates that there is one co-integrating equation. Both tests indicate that retail prices of beans in selected markets are co-integrated. The Johansen's co-integration trace test results for rice are given in Table 16.

Table 16: Johansen's co-integration trace test results for rice

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r > 0$	0.310939	123.6439	69.81889	0.0000
$r \leq 1$	$r > 1$	0.183894	66.29038	47.85613	0.0004
$r \leq 2$	$r > 2$	0.143145	34.99596	29.79707	0.0115
$r \leq 3$	$r > 3$	0.044397	11.20508	15.49471	0.1992
$r \leq 4$	$r > 4$	0.026977	4.211588	3.841466	0.0401

Note: Trace test indicates three co-integrating eqn(s) at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results given in Table 16 using the trace test indicate that there are three co-integrating equations. The Johansen's co-integration maximum eigenvalue test results for rice are given in Table 17.

Table 17: Johansen's co-integration maximum eigenvalue test results for rice

Null Hypothesis	Alternative Hypothesis	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
$r = 0$	$r = 1$	0.310939	57.35353	33.87687	0.0000
$r = 1$	$r = 2$	0.183894	31.29442	27.58434	0.0159
$r = 2$	$r = 3$	0.143145	23.79088	21.13162	0.0206
$r = 3$	$r = 4$	0.044397	6.993493	14.26460	0.4899
$r = 4$	$r = 5$	0.026977	4.211588	3.841466	0.0401

Note: Max-eigenvalue test indicates three co-integrating eqn(s) at the 0.05 level;

**MacKinnon-Haug-Michelis (1999) p-values.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results of the maximum eigenvalue test given in Table 11 show that there are three co-integrating equations. The trace test and maximum eigenvalue test give the same conclusions that there are three co-integrating equations.

4.4 Vector Error Correction Model

If the time series are not stationary at levels but stationary in their first differences and co-integrated the appropriate model specification is the vector error correction model. Estimation results of VECM give the parameters in the co-integration equation (β), the adjustment coefficients (α) and short-run coefficients.

4.4.1 Retail Prices of Beans in the Musanze Market (PBMM) Model

Parameters of the co-integrating equation for the VEC model in retail prices of beans in the Musanze market (PBMM) along with their t-statistics are:

$$\Delta \text{PBMM}_t = -59.21 + 1.39 \text{PBHM}_{t-1} - 1.51 \text{PBGM}_{t-1} - 1.05 \text{PBNM}_{t-1} + 0.35 \text{PBNyM}_{t-1}$$

(5.24462) (-5.92791) (-5.26147) (2.78769)

(.):t-statistics

All parameters in the co-integration equation of retail prices of beans in Musanze are statistically significant at the 5 per cent level of significance. This implies that there is a long-run relationship between PBMM and PBHM, PBGM, PBNM and PBNyM in Rwanda. The estimates of the short-run parameters of the same model with their standard errors and t-statistics are:

Parameters of PBNM and PBHM in the co-integration equation are statistically significant while those in PBMM, PBGM and PBNyM are not significant.

4.4.2 Retail prices of rice in the Huye Market (PRHM) Model

Parameters of the co-integrating equation for VEC in the PRHM model along with their t-statistics are:

$$\Delta \text{PRHM}_t = -396.4 - 0.45 \text{PRMM}_{t-1} - 8.19 \text{PRGM}_{t-1} + 8.43 \text{PRNM}_{t-1} + 0.48 \text{PRNyM}_{t-1}$$

(-0.45131) (-8.13444) (6.25385) (0.93370)

(.):t-statistics

Parameters of PRGM and PBNM are statistically significant at the 5 per cent level of significance and parameters of PRMM and PRNyM are not statistically significant. This implies that there is a long-run relationship between PRHM and PRGM and PRNM in Rwanda. The estimates of the short-run parameters of the same model with their standard errors and t-statistics are:

$$\Delta \text{PRHM}_t = 0.03\text{PRHM}_{t-1} + 0.004\text{PRMM}_{t-1} + 0.06\text{PRGM}_{t-1} - 0.01\text{PRNM}_{t-1} - 0.02\text{PRNyM}_{t-1}$$

(2.41714) (0.484466) (7.27660) (-1.29125) (-0.54802)

(.):t-statistics

Short-run parameters in PRHM and PRGM are statistically significant while those in PRMM, PRNM and PRNyM are not significant.

4.5 An analysis of Structural Shocks

An analysis of how a shock effects the dynamic path was done using impulse-response functions (IRFs) and variance decompositions. Impulse-response functions (IRFs) give the dynamic marginal effects of each shock on all the variables over time while variance decompositions demonstrate the importance of each of the shocks as a component of the overall variance of each of the variables over time. The results of impulse-response functions for the beans model are given in Table 18.

Table 18: Normalized Impulse-Response Functions (IRFs) for the beans model (in %)

Month	Shock of 100% on PBMM				Shock of 100% on PBHM			
	PBHM	PBNM	PBGM	PBNyM	PBMM	PBNM	PBGM	PBNyM
1	0.00	0.00	0.00	0.00	80.03	0.00	0.00	0.00
2	13.27	20.65	8.39	11.29	94.44	27.69	20.10	2.31
3	14.88	19.97	5.43	6.42	95.02	30.73	17.82	-5.43
4	14.82	21.18	7.16	6.72	94.95	33.73	20.69	-6.88
5	14.36	21.32	6.94	6.26	94.71	34.80	21.05	-8.35
6	14.27	21.50	7.11	6.18	94.53	35.50	21.55	-8.95
7	14.16	21.56	7.13	6.09	94.44	35.85	21.74	-9.34
8	14.11	21.60	7.16	6.06	94.39	36.04	21.86	-9.53
9	14.08	21.62	7.17	6.03	94.36	36.15	21.93	-9.64
10	14.07	21.63	7.18	6.02	94.34	36.21	21.96	-9.70
11	14.06	21.64	7.19	6.01	94.33	36.24	21.98	-9.73
12	14.06	21.64	7.19	6.01	94.33	36.26	21.99	-9.75
Month	Shock of 100% on PBNM				Shock of 100% on PBGM			
	PBMM	PBHM	PBGM	PBNyM	PBMM	PBHM	PBNM	PBNyM
1	117.53	21.35	0.00	0.00	132.70	49.62	13.20	0.00
2	131.96	69.95	-19.24	3.39	149.62	49.89	22.45	9.28
3	138.31	82.86	-18.37	12.82	150.97	61.44	20.62	12.04
4	140.01	88.11	-22.10	16.56	152.14	63.51	19.10	13.33
5	140.71	91.50	-23.24	19.13	152.47	64.67	18.30	14.30
6	141.09	93.14	-24.09	20.38	152.61	65.34	17.82	14.79
7	141.29	94.07	-24.49	21.11	152.68	65.69	17.56	15.06
8	141.40	94.57	-24.73	21.50	152.73	65.88	17.41	15.21
9	141.45	94.84	-24.86	21.72	152.75	65.98	17.33	15.29
10	141.49	94.99	-24.93	21.84	152.76	66.04	17.29	15.34

11	141.50	95.08	-24.97	21.90	152.77	66.07	17.26	15.36
12	141.51	95.12	-24.99	21.94	152.77	66.09	17.25	15.38
Shock of 100% on PBNyM								
Month	PBMM	PBHM	PBNM	PBGM				
1	48.01	19.26	-4.49	22.19				
2	46.35	18.36	12.85	21.40				
3	45.77	16.47	15.42	23.32				
4	45.63	13.59	17.78	25.17				
5	45.32	12.13	18.85	25.66				
6	45.16	11.38	19.47	26.07				
7	45.07	10.94	19.79	26.26				
8	45.02	10.70	19.97	26.37				
9	44.99	10.57	20.07	26.43				
10	44.98	10.50	20.12	26.47				
11	44.97	10.46	20.15	26.48				
12	44.96	10.44	20.17	26.49				

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results of the reactions of all markets to any shock for 12 months given in Table 18 are interesting and useful for policy formulations. For instance, if a shock is 100 per cent on the retail prices of beans in Musanze it will not affect other markets in the first month; in the second month it will affect all markets with more effect in the Nyabugogo market (20 per cent) followed by the Huye market (13 per cent). This result is aligned with the reality of the Rwandan economy. Table 12 gives information up to 12 months and the effect if a shock is in another market. The results of impulse-response functions (IRFs) for the model of retail prices of rice are given in Table 19.

Table 19: Normalized Impulse-Response Functions (IRFs) for model of rice (in percentage)

Shock of 100% on PRHM					Shock of 100% on PRMM			
Month	PRMM	PRNM	PRGM	PRNYM	PRHM	PRNM	PRGM	PRNYM
1	0.00	0.00	0.00	0.00	-14.14	0.00	0.00	0.00
2	25.10	16.40	-8.60	9.77	-2.00	29.62	0.93	15.26
3	18.45	22.28	-17.51	13.02	-5.73	22.23	-3.05	19.24
4	24.09	22.15	-18.96	14.97	-4.43	27.22	-1.35	20.04
5	22.10	23.27	-18.67	15.28	-4.78	23.96	-1.09	19.95
6	23.21	22.15	-18.27	15.30	-4.69	25.08	-0.32	19.81
7	22.60	22.50	-17.95	15.19	-4.67	24.27	-0.36	19.71
8	22.84	22.15	-17.92	15.15	-4.70	24.63	-0.27	19.69
9	22.70	22.31	-17.89	15.13	-4.67	24.46	-0.34	19.68
10	22.76	22.23	-17.92	15.13	-4.69	24.56	-0.33	19.69
11	22.73	22.28	-17.92	15.13	-4.68	24.52	-0.34	19.69
12	22.74	22.26	-17.92	15.13	-4.69	24.54	-0.34	19.69
Shock of 100% on PRNM					Shock of 100% on PRGM			

Month	PRHM	PRMM	PRGM	PRNYM	PRHM	PRMM	PRNM	PRNYM
1	-8.68	11.43	0.00	0.00	8.72	16.66	12.24	0.00
2	1.01	37.30	-1.66	9.78	12.93	15.45	32.79	1.65
3	-3.66	31.01	9.15	11.20	9.34	19.89	57.13	6.82
4	-0.69	33.63	9.83	10.04	10.04	24.31	63.60	13.14
5	-2.24	31.74	12.05	9.56	9.36	25.92	65.92	15.77
6	-1.37	32.27	11.55	9.27	9.67	26.30	65.09	16.26
7	-1.83	31.94	11.73	9.27	9.56	26.20	64.70	16.13
8	-1.60	32.09	11.50	9.27	9.64	26.09	64.35	15.96
9	-1.72	32.04	11.54	9.30	9.61	26.04	64.32	15.88
10	-1.66	32.08	11.50	9.30	9.63	26.02	64.30	15.85
11	-1.69	32.06	11.51	9.30	9.62	26.02	64.32	15.85
12	-1.67	32.07	11.51	9.30	9.62	26.02	64.33	15.86
Shock of 100% on PBNyM								
Month	PRHM		PRMM		PRNM		PRGM	
1	7.31		17.48		7.47		22.00	
2	3.43		10.46		8.57		21.65	
3	4.53		9.75		1.97		26.30	
4	4.05		8.64		1.11		29.68	
5	4.38		8.35		-0.05		30.36	
6	4.24		8.17		0.20		30.42	
7	4.31		8.19		0.16		30.22	
8	4.27		8.19		0.28		30.14	
9	4.28		8.21		0.28		30.10	
10	4.27		8.21		0.29		30.10	
11	4.28		8.21		0.29		30.11	
12	4.28		8.21		0.29		30.11	

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

Table 19 shows the reactions of prices of rice in different markets due to a shock in one market. For instance, a shock of 100 per cent in rice prices in the Huye market (PRHM) will not affect the other markets in the first month but in the second month PRMM will be more affected at 25 per cent followed by PRNM at 16 per cent. The same analysis can be done with other shocks and reactions in different markets of rice as presented in Table 19. Variance decompositions results for the beans model are given in Table 20.

Table 20: Variance Decomposition for the beans model

Overall variance Shock	Month	PBMM	PBHM	PBNM	PBGM	PBNYM
RPMM	1	100	0	0	0	0
	2	96.45719	0.779302	1.88745	0.311838	0.564222
	...	...	...	...	...	..

	12	94.51893	1.468081	3.305856	0.369617	0.337519
RPHM	1	39.04191	60.95809	0	0	0
	2	41.92084	54.86196	2.097634	1.104979	0.014588
	...	...	...	...	...	..
	12	45.56402	46.22177	5.723037	2.148707	0.342466
RPNM	1	56.91524	1.878548	41.20622	0	0
	2	57.37541	9.828465	32.09478	0.680198	0.02115
	...	...	...	...	...	..
	12	56.85035	22.50414	18.15479	1.488582	1.002146
RPGM	1	58.22111	8.141117	0.57614	33.06163	0
	2	63.2827	7.833926	1.073032	27.674	0.136335
	...	...	...	...	...	..
	12	65.93696	11.45005	0.950435	21.12237	0.540188
RPNYM	1	17.47853	2.812733	0.152755	3.734212	75.82177
	2	17.33516	2.756291	0.721073	3.700237	75.48724
	...	...	...	...	...	..
	12	18.44279	1.568668	2.88032	5.675287	71.43293

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

Table 20 shows that after a shock on the retail prices of beans in the Musanze market the effect in the first month will be 100 per cent in the Musanze market; in the second month the effect will be 96 per cent where around 2 per cent will be in the Nyabugogo market and the remaining will be shared by the other markets and after 12 months the effect will be 94 per cent in the Musanze market, 3 per cent in the Nyabugogo market and the remaining will be in the other markets. Table 20 also gives information on shocks and effects on retail prices of beans in the other markets. Variance decomposition results for the rice model are given in Table 21.

Table 21: Variance Decomposition for the rice model

Shock \ Overall variance	Month	PRHM	PRMM	PRNM	PRGM	PRNYM
PRHM	1	100	0	0	0	0
	2	92.70076	4.303685	1.837179	0.505534	0.65284
	...	...	...	...	...	..
	12	79.85934	6.876547	6.382399	4.056415	2.825295
PRMM	1	1.958948	98.04105	0	0	0
	2	0.945071	93.90096	4.069775	0.004013	1.080185
	...	...	...	...	...	..
	12	0.288529	92.34307	4.611468	0.009307	2.747625
PRNM	1	0.738183	1.280534	97.98128	0	0

	2	0.486727	9.701458	89.18517	0.017597	0.609052
	...	...	...	...	...	..
	12	0.145054	14.99044	81.97578	1.599636	1.28909
PRGM	1	0.723107	2.643818	1.42663	95.20645	0
	2	1.635096	3.472795	8.237607	86.63615	0.018349
	...	...	...	...	...	..
	12	1.755583	10.44676	63.17739	21.22659	3.393674
PRNYM	1	0.490242	2.804316	0.512003	4.439775	91.75366
	2	0.297513	1.893783	0.590095	4.347376	92.87123
	...	...	...	...	...	..
	12	0.194361	0.877316	0.105192	7.656556	91.16658

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

Table 21 shows how variance decompositions in rice are distributed in different markets from the first month up to 12 months. The importance of the shock is distributed among all the markets. Twelve months after a shock in the Huye market, it will have more importance in Musanze market (7 per cent); a shock in the Musanze market will have more effect in Nyabugogo (5 per cent) while a shock in the Nyabugogo market will have more importance in Musanze (15 per cent).

4.6 Granger causality

Granger causality tests investigate if a scalar "y" can help in forecasting another scalar "x" (Hamilton, 1994). In the Granger causality analysis there are three possibilities -- unidirectional causality, bilateral causality and bidirectional causality -- and absence of causality or independence of series. Results of the Granger causality tests of retail prices of beans in different markets are given in Table 22.

Table 22: Granger causality of retail prices of beans in different markets

Pairwise Granger Causality Tests Sample: 1 156 Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
PBHM does not Granger Cause PBMM	155	0.61634	0.4336
PBMM does not Granger Cause PBHM		8.61609 ^a	0.0038
PBGM does not Granger Cause PBMM	155	2.84248	0.0939
PBMM does not Granger Cause PBGM		3.85035	0.0516
PBNM does not Granger Cause PBMM	155	0.24478	0.6215
PBMM does not Granger Cause PBNM		7.52996 ^a	0.0068

PBNyM does not Granger Cause PBMM	155	0.07450	0.7853
PBMM does not Granger Cause PBNyM		4.01715 ^b	0.0468
PBGM does not Granger Cause PBHM	155	11.0172 ^a	0.0011
PBHM does not Granger Cause PBGM		0.08332	0.7732
PBNM does not Granger Cause PBHM	155	2.14953	0.1447
PBHM does not Granger Cause PBNM		15.9212 ^a	0.0001
PBNyM does not Granger Cause PBHM	155	0.15992	0.6898
PBHM does not Granger Cause PBNyM		3.24088	0.0738
PBNM does not Granger Cause PBGM	155	0.26854	0.6051
PBGM does not Granger Cause PBNM		6.43324 ^b	0.0122
PBNyM does not Granger Cause PBGM	155	9.9E-05	0.9921
PBGM does not Granger Cause PBNyM		4.07522 ^b	0.0453
PBNyM does not Granger Cause PBNM	155	2.13707	0.1458
PBNM does not Granger Cause PBNyM		3.11199	0.0797

Note: ^a significant at less than 1% and ^b significant at 5%.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results in Table 22 show that for retail prices of beans there is unidirectional Granger causality from Musanze to Huye, from Musanze to Nyabugogo, from Musanze to Nyagatare, from Gisenyi to Huye, from Huye to Nyabugogo, from Gisenyi to Nyabugogo and from Gisenyi to Nyagatare. There is no bidirectional Granger causality between all the variables and there is absence of Granger causality between Gisenyi and Musanze, between Huye and Nyagatare and between Nyabugogo and Nyagatare.

Table 23: Granger causality of retail prices of rice in different markets

Pairwise Granger Causality Tests			
Sample: 1 156			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
PRHM does not Granger Cause PRMM	155	6.64340 ^a	0.0109
PRMM does not Granger Cause PRHM		25.7251 ^a	1.E-06
PRGM does not Granger Cause PRMM	155	11.9416 ^a	0.0007
PRMM does not Granger Cause PRGM		14.2607 ^a	0.0002
PRNM does not Granger Cause PRMM	155	38.5239 ^a	5.E-09
PRMM does not Granger Cause PRNM		11.5243 ^a	0.0009
PRNyM does not Granger Cause PRMM	155	3.77960	0.0537

PRMM does not Granger Cause PRNyM		1.62707	0.2041
PRGM does not Granger Cause PRHM	155	11.1272 ^a	0.0011
PRHM does not Granger Cause PRGM		12.1901 ^a	0.0006
PRNM does not Granger Cause PRHM	155	28.4451 ^a	3.E-07
PRHM does not Granger Cause PRNM		5.44135 ^a	0.0210
PRNyM does not Granger Cause PRHM	155	2.64089	0.1062
PRHM does not Granger Cause PRNyM		0.94930	0.3314
PRNM does not Granger Cause PRGM	155	47.2258 ^a	2.E-10
PRGM does not Granger Cause PRNM		7.49170 ^a	0.0069
PRNyM does not Granger Cause PRGM	155	1.15335	0.2846
PRGM does not Granger Cause PRNyM		3.40411	0.0670
PRNyM does not Granger Cause PRNM	155	3.05335	0.0826
PRNM does not Granger Cause PRNyM		3.54926	0.0615

Note: ^a significant at less than 1%.

Source: Authors' computations of MINAGRI (2016) data using E-Views 7.2.

The results in Table 23 show that for retail prices of rice there is bidirectional Granger causality between Huye and Musanze, between Musanze and Gisenyi, between Huye and Gisenyi and between Nyabugogo and Gisenyi. There is no unidirectional Granger causality among the variables and there is absence of Granger causality between Musanze and Nyagatare, between Huye and Nyagatare, between Gisenyi and Nyagatare and between Nyabugogo and Nyagatare.

5. Summary and Conclusions

In recent years food prices have increased and have reduced consumers' purchasing power. We analyzed the spatial price transmission in beans and rice markets in Rwanda using monthly retail prices from January 2002 to December 2014 for 156 observations. Price transmission was analyzed spatially in the selected markets of Huye, Nyabugogo, Musanze, Gisenyi and Nyagatare. Spatial price transmission is important for analyzing the impact of a change in prices in one market in another market. We used different econometric techniques to examine the relationship between monthly retail prices in five different markets.

The retail prices of beans and rice in selected markets had upward trends where on average the prices of beans increased more than two times while the prices of rice increased more than three times. The stationarity test done using the Augmented Dickey-Fuller showed that all the series were not stationary at levels but stationary in their first differences which means that the variables were integrated of order one. Lag selection criteria indicated that the appropriate lag for VAR models was one for beans and rice prices' models separately. The Johansen co-integration test and trace and maximum eigenvalue tests showed that the

variables were co-integrated and the findings revealed that there was a long-run relationship between the variables. Vector error correction tests showed that there was a short-run relationship.

We also analyzed structural shocks using impulse-response functions (IRFs) and variance decompositions. IRFs were calculated for the beans and rice markets for 12 months. IRFs showed that a shock of 100 per cent on the retail prices of beans in Musanze led to no affects in the other markets in the first month; in the second month it affected all markets at different levels and the more affected market was Nyabugogo (20 per cent) followed by Huye (13 per cent). IRFs for retail prices of rice showed that a shock of 100 per cent on prices of rice in the Huye market did not affect the other markets in the first month and in the second month Musanze was more affected (25 per cent) followed by Nyabugogo (16 per cent). This result was aligned with the reality of Rwandan economy but further studies are recommended for more details. Variance decompositions showed that after a shock on the retail prices of beans in the Musanze market the effect was 100 per cent in the Musanze market in the first month and in the second month the effects were shared by Musanze (96 per cent), Nyabugogo (2 per cent) and the remaining shared by the other markets. After 12 months the effects were 94 per cent in the Musanze market, 3 per cent in the Nyabugogo market and the remaining in other markets. Retail prices of rice variance decompositions were distributed in different markets and the results showed that after 12 months of a shock in the Huye market, the shock had more importance in the Musanze market (7 per cent); a shock in the Musanze market had more effect in Nyabugogo (5 per cent) while a shock in the Nyabugogo market had more importance in Musanze (15 per cent).

The Granger causality tests demonstrated that for retail prices of beans there was unidirectional Granger causality from Musanze to Huye, from Musanze to Nyabugogo, from Musanze to Nyagatare, from Gisenyi to Huye, from Huye to Nyabugogo, from Gisenyi to Nyabugogo and from Gisenyi to Nyagatare. For rice retail prices there was bidirectional Granger causality between Huye and Musanze, between Musanze and Gisenyi, between Huye and Gisenyi and between Nyabugogo and Gisenyi. These findings are relevant for policymakers and other economic operators.

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Chapter Fourteen

External Economic Shocks and Food Price Volatility in Rwanda: Evidence from the ARCH and GARCH models

Sandrine Unezeza¹ and Jean Baptiste Habyarimana²

¹Corresponding author:
Department of Applied Statistics
School of Economics
University of Rwanda, Kigali, Rwanda,
E-mail: sunezeza@gmail.com

²Department of Economics
School of Economics
University of Rwanda, Kigali, Rwanda
E-mail: krdrimn@gmail.com

Abstract

This paper adopts and explains the use of autoregressive conditional heteroscedasticity (ARCH) and generalized autoregressive conditional heteroscedasticity (GARCH) models to investigate how variations in the price of crude oil in Rwanda and in the world market as an external economic shock affect the price of cereals in Rwanda's domestic market. Our empirical results show that cereal price series are linearly related to crude oil price series and that they suffer from a high relative variability. Price returns' analyses reveal that there is evidence of volatility in cereal price returns clustering from variations in the price of crude oil in both the domestic Rwandan market and the world market. ARCH and GARCH results demonstrate that volatility in the market price of cereals in Rwanda is strongly influenced by own past squared residuals and by past squared residuals in the price of crude oil in both domestic and world markets. Further, the scedastic functions reveal that upward movements in the price of crude oil in Rwanda lead to a period of high cereal prices (maize and wheat). To reduce inefficiencies in the domestic cereal distribution system while improving cereal market efficiency and ensuring food security, this paper suggests that trade policy in Rwanda should take into consideration the relationship that exists between the price of crude oil and the price of cereals. This paper also suggests that as there exists a negative relationship between the devaluation of the Rwandan currency and the price of crude oil in Rwanda, stabilizing the Rwandan franc will lead to stability in crude oil prices which will be a key factor in rendering the cereal distribution system in the country more efficient.

Keywords: External economic shock, food price volatility, ARCH and GARCH models.

JEL Classification Codes: C32; C53; E31; Q18;

1. Introduction

Food access, which is determined by food price stability among other things, plays an important role in ensuring food security in any country (Food and Agriculture Organization, 2006). Thus, variations in food market prices are linked to instability about food security where large and unexpected surges in food prices are inversely related to food security and poverty (Diaz-Bonilla and Ron, 2010; FAO, 2011; Ivanic and Martin, 2008). However, food price stability offers various benefits to consumers and producers because it is an important factor that helps economic agents to take effective investment, saving, production and consumption decisions (Grega, 2002). Among other things, variations in oil prices are one of the factors which can be linked to food price volatility in the domestic market (FAO, 2011).

Oil is considered as input for bridging food markets where it is used in the transport industry. Therefore, oil prices play a big role in the food distribution system in which the price of food transported from one market to another relates to the cost of transport (FAO, 2011). Further, the cost of transport depends on oil price levels. When oil prices increase in the world market they also increase in the domestic market depending on the level of domestic oil consumption. Thus, an increase in oil prices leads to an increase in the cost of transport which also affects food prices throughout the food distribution system. Second, when oil prices decrease in the world market, oil prices in the domestic market also decrease. Hence, variations in oil prices are among the factors that can distort the food distribution system and therefore lead to variations in cereal prices. For net oil importer countries, an effective food distribution system depends on the stability of oil prices in both domestic and world markets. This suggests that any oil price instability also causes inefficiencies in the food distribution systems in these countries either in international transport and domestic food distribution or in domestic food distribution alone. An ineffective food distribution system may result in domestic food market inefficiencies caused by abrupt changes in the cost of transport, leading also to unexpected food price variations in the domestic market (FAO, 2011). Therefore, in one way or another, food prices prevailing in domestic markets are linked to oil prices through the effect of oil price variations which cause food price variations through variations in the cost of transport. This shows that oil price volatility is one of the channels which results in food price volatility for both domestically produced foods and/or imported foods. However, it should be noted that oil prices do not directly affect food prices, but they are related in their variances.

The trade balance for staple commodities reveals that in addition to domestically produced cereals they are also among the food commodities mainly imported in Rwanda (MINAGRI et al., 2016). This shows that like domestic transport costs, international transport costs may have an influence on the price of cereals domestically traded in Rwanda. As Rwanda is a net importer of oil (MINIRENA et al., 2011), the effectiveness of its food distribution system depends on the stability of oil prices in both domestic and world markets. Consequently, food price variations in the Rwandan domestic market are probably related to variations in the price of oil in both domestic and world markets.

This paper investigates if this liaison exists between cereal price variations in the Rwandan domestic market and oil price variations in the Rwandan and world markets. We selected

four highly traded and consumed cereals in Rwanda: maize, rice, wheat and sorghum (NISR, 2016). Linking our investigation and the food security situation in Rwanda, the outcome of food price variations as a result of variations in oil prices is food security instability.

This paper has two main research objectives: first, to apply the ARCH and GARCH models to analyze the relationship between volatility in cereal prices in Rwanda and oil price variations in both the Rwandan and world markets. And second, to use scedastic functions to understand the liaison between cereal prices' conditional variances in Rwanda and oil price variations in the Rwandan and world markets. To achieve these objectives, this paper answers two main research questions. First, if there is evidence to conclude that variations observable in the prices of cereals in the domestic market in Rwanda are related to oil price variations in the Rwandan and world markets. And second, if high conditional variances in the prices of cereals in Rwanda are related to high oil price variations in both the Rwandan and world markets.

2. Literature review

2.1. Concepts and definitions

External economic shock

An economic shock is an event that produces a significant change within an economy despite occurring outside of it. Economic shocks are unpredictable and typically impact supply or demand throughout markets.¹ A shock is an unexpected event that can affect an economy positively or negatively. A shock can occur on either the demand side or the supply side: a demand side shock refers to an unexpected fall or increase in the demand for goods and services whereas a supply side shock refers to an unexpected fall or increase in the supply of goods and services that are available to consumer. Shocks can be endogenous or exogenous. Exogenous shocks mostly affect the poorest countries. Positive shocks do not offset negative ones partly because negative shocks have irreversible effects (Varangis et al., 2004).

A hike in oil prices is a well-known classic exogenous shock, which leads to petrol rationing, power rationing, recession and inflation.² As Rwanda is a net importer of oil, a shock in oil prices reverberates in its transport system because of which its food distribution system is also affected. There are resulting effects of this on transport costs and these variations may also cause variations in prices of commodities that use transport.

Price volatility

Price volatility has been defined as a variation from the price's average value over a measurement period. If a price varies a great deal from month to month, price volatility will be high, and conversely if the month to month variations are low, the value of volatility will

¹ 'Economic Shock': <http://www.investopedia.com/terms/e/economic-shock.asp#ixzz4aeCImbze>

² <http://www.businessstudiesalevel.co.uk/exogenous%20shocks.pdf>

also be low (Aizenman and Pinto, 2004). On the one hand, price volatility determines price fluctuations over time and shows the degree of the price spread. On the other hand, price stability can be observed in a situation where prices do not change much over time. This shows an absence of volatility and is usually preferable over price volatility (Aizenman and Pinto, 2004). Therefore, this leads us to conclude that all price variations do not create problems. Prices with small variations are usually considered to have minor effects on consumer and producer behaviors. However, large variations are considered to have a major impact on the behaviors of both consumers and producers because they create uncertainty about future investment decisions for producers and render consumers' purchasing power unstable (Aizenman and Pinto, 2004; FAO, 2011; WFP, 2008).

Various authors have investigated price volatility to understand market segmentation and/or integration and characterize how commodity price variations are interlinked commodity by commodity or how they are spatially related. They do this by analyzing how price variations in a given commodity can influence variations in the prices of other commodities or how two or more markets selling a given commodity may be related through the behavior of the price prevailing in each market. In addition, studies have also analyzed price variability to assess the impact of price volatility on market efficiency in food commodities and food security. First, high price volatilities in food commodities, increased food market inefficiencies; second high and positive price volatilities negatively affect households' purchasing power, and worse, households' food security; lastly, high and negative food price volatilities lead to improvements in households' purchasing power and then improvements in food security (Diaz-Bonilla and Ron, 2010; FAO, 2011).

The food distribution system

The food distribution system is a method of distributing or transporting food or drink from one place to another.³ Food distribution is considered a sub-set of the food system, where food distribution systems vary from one location to another (FAO, 2011).⁴ Consequently, inefficiencies in the food distribution system may result in food price volatility (Dillon and Barret, 2015). Apart from this, food price volatility observed in staple food commodities in particular is also influenced by crop yield instability as a result of climate variability, exchange rate volatility, variations in crude oil prices, food stock variability, export concentration, interest rate volatility and economic and policy reforms (FAO, 2011; Grega, 2002; ICTSD, 2009; Sarris, 2014; WB, 2013). Hence, variations in crude oil prices are cited among external economic shocks which can disturb food distribution systems as variations in crude oil prices are one of the channels through which there can be volatility in food prices.

2.2. Crude oil and cereal transport

Even though almost all developing countries depend on agriculture most of them are not self-sufficient in terms of cereal production (OECD, 2010). To compensate for the gap

³ http://en.m.wikipedia.org/wiki/food_distribution

⁴ <http://www.fao.org/docrep/W0078e/w0078e04.htm>

between their cereal production and demand, these countries mostly import cereals; this involves international transport and the costs related to it (Ivory, 1990; Veeman and Veeman, 1992). In addition, the amount of cereals consumed domestically in these countries is subject to domestic cereal distribution which requires shifting cereals from one domestic market to another involving domestic transport and the costs related to it. In our study we rely on the theory that variations in crude oil prices are related to cereal price volatility whereby a decrease in crude oil prices leads to a decline transport costs and then a decline in the prices of goods and services that are marketed (WB, 2013).⁵ The same theory also confirms that in developing countries which are net importers of crude oil and which import a big part of their products, crude oil prices greatly determine the prices of goods and services in local markets (WB, 2013).⁶ As Rwanda is among the net importers of crude oil, variability in crude oil prices in either the world market or in the domestic market is, in one way or another, transmitted to variability in cereal prices.

Taking maize as a primary staple food in the region (Ethiopia, Kenya, Tanzania, and Uganda), on average, a 1 per cent increase in global oil prices leads to 0.26 per cent increase in maize prices without considering the change in global maize prices. The dependency of local maize prices on global maize prices is 0.42 per cent, where a 1 per cent simultaneous increase in global oil prices and maize prices leads to a 0.68 per cent increase in local maize prices (Baltzer; 2013; Benson et al., 2008). To link the variations in the prices of staple food items to the distance within and between countries, the results of the Law-of-One-Price (LOP) tested after running level regressions in east Africa show that the border effect measured by the border dummy coefficient was considerable within a distance ranging from 300 to 6,000 km (Versaille, 2012). Cities that did not share a border showed higher departures from LOP compared to cities in adjacent countries (Versaille, 2012).

2.3. Literature on volatility modeling

A series of volatility models have been used in literature to characterize different variations in financial series. The most used volatility models can be grouped into seven important volatility models: latent volatility or (misleadingly) stochastic volatility models; implied volatility models; historical volatility models; scaling index volatility models; exponentially weighted moving average models; autoregressive conditional volatility models; and vector autoregressive models. In the stochastic volatility models, part of the changes in volatility are due to random shocks while in conditional volatility models, volatility δ_t is time varying but not stochastic. Unlike conditional and stochastic volatility models, historical volatility (HIS) models build directly on realized volatility. HIS models simply involve calculating the variance (or standard deviation) of returns in the usual way over some historical period; this then becomes the volatility forecast for all future periods (Khan et al., 2008). There are two major types of HIS models: single state HIS models and the regime switching and transition exponential smoothing models (Khan et al., 2008). The implied volatility is the market's forecast of the volatility of underlying asset returns over the lifetime of an object.

⁵ <http://siteresources.worldbank.org/INTGEP/Resources/335315-1257200370513/04--Ch4--96-127.pdf>

⁶ <http://siteresources.worldbank.org/INTGEP/Resources/335315-1257200370513/04--Ch4--96-127.pdf>

Exponentially weighted moving average is a simple extension of the historical volatility measure which allows more recent observations to have a stronger impact on the forecast of volatility than older data points. Under an exponential weighted moving average (EWMA) specification, the latest observation carries the largest weight, and weights associated with previous observations decline exponentially over time. Literature shows that EWMA has two advantages over the simple historical model: first, in practice volatility is likely to be affected more by recent events which carry more weight than events in the past. Second, the effect of a single given observation on volatility declines at an exponential rate as weights attached to recent events fall (Brooks, 2008).

Autoregressive volatility models are a relatively simple example of the class of stochastic volatility specifications (Brooks, 2008). They obtain time series of observations on some volatility proxy. The non-linear models in widespread use in finance are the autoregressive conditionally heteroscedastic (ARCH) model; the generalized autoregressive conditionally heteroscedastic (GARCH) model; the asymmetric GARCH models (exponential generalized autoregressive conditionally heteroscedastic (EGARCH) model proposed by Nelson (1991) and the GJR model named after Glosten, Jagannathan and Runkle (Glosten et al., 1993); and the multivariate generalized autoregressive conditionally heteroscedastic (MGARCH) model. MGARCH models allow the conditional covariance matrix of the dependent variables to follow a flexible dynamic structure and allow the conditional mean to follow a vector autoregressive (VAR) structure (Engle and Kroner, 1995).

In the literature on volatility modeling that was reviewed it was found that two general classes of volatility models have been widely used. The first type formulates conditional variance directly as a function of observables. The second formulates models of volatility that are not functions purely of the observable; these are called latent volatility or (misleadingly) stochastic volatility models. Latent volatility models can be arbitrarily elaborated upon with structural breaks at a random time and with random amplitudes, multiple factors, jumps and fat-tailed shocks, fractals and multifractals and general types of non-linearities. Such models can typically be simulated but are difficult to estimate and forecast. This has led volatility modelers to frequently use the first type of models, conditional variance directly as a function of observables of which ARCH and GARCH are two main examples.

GARCH models are mainly characterized by the ARMA structure (Bollerslev, 1986; Drost and Nijman, 1993; Engle, 1982). For instance, when a process ε is GARCH (1, 1), ε^2 is ARMA (1, 1). This is the main reason for the widespread use of such models in financial econometrics. The second reason is that in econometrics these models perform well and are easy to estimate and forecast. Recent econometric contributions bridge the gap between these two types of modeling volatility by balancing theories behind volatility models that are a function of observables and those that are not a function of observables. Vector models were developed for this and the well know volatility models of this kind are the vector autoregressive (VAR) models, the vector error correction models and the Bayesian vector autoregressive with stochastic volatility models that allow an interpretation of a sudden large movement in the data as a result of drawing from a distribution with a randomly increased but unobserved variance (Uhlig, 1997).

Another important recent contribution to econometrics literature relates to improvements in volatility estimations. Most applications in literature show that one can use price range information to improve volatility estimation; this practice constitutes an important part in developing the VAR model for volatility.

3. Methodology and data

3.1. Conceptual framework

Oil prices can affect cereal prices through three main channels. First, higher oil prices can increase the costs of farm inputs such as chemical fertilizers, fuel tractors or pumps. Second, high global oil prices can stimulate market demand, for instance for corn, to convert into biofuel, thereby driving up the prices of some cereal commodities like maize in the global market which is then transmitted to the local market through trade linkages. Third, oil price increases can drive up transport costs which affect all traded commodities, cereals included (Beckman et al., 2013). The first and second channels are not of much importance for our paper which focuses on the third channel. As Figure 1 shows, cereal commodities mainly produced in Rwanda such as sorghum and maize are traded from rural areas to semi-urban areas and/or urban areas while cereal commodities that are not mainly produced in Rwanda are imported from outside the country to urban areas and then transported to semi-urban and/or rural areas. This circuit shows that both national and international transport may affect the prices of cereals in the Rwandan domestic market. Our paper does not focus on road infrastructure, the customs process and weather conditions but instead focuses on oil prices as one of the determinants of transport costs and observes how a shock in crude oil prices either in the world market or in the domestic market in Rwanda may lead to variations in cereal prices.

Insert Figure 1 about here

3.2. Empirical model

As this paper investigates how external economic shocks affect cereal price variations in Rwanda, this sub-section starts by differentiating ‘oil prices as an external economic shock’ and ‘price volatility.’ First, a shock is an unexpected event that can affect the economy positively or negatively and it can be endogenous or exogenous. Oil price hikes are a well-known classic exogenous shock, which leads to petrol rationing, power rationing, recession and inflation.⁷ As Rwanda is a net importer of oil, a shock in oil prices reverberates in its transport system which also affects the food distribution system. The resulting effects are on the cost of transport variations which may also cause variations in prices of commodities like cereals that use transport. Second, price volatility has been defined as a variation from the price’s average value over a measurement period (FAO, 2011). However, all price variations do not create problems. Prices with small variations are usually considered to have minor effects on consumer and producer behaviors. However, large variations are considered

⁷ <http://www.businessstudiesalevel.co.uk/exogenous%20shocks.pdf>

to have a major impact on both consumers and producers' behaviors because they create uncertainty about future investment decisions for producers and render consumers' purchasing power more unstable (FAO, 2011).

In addition, high price volatilities in food commodities, increase food market inefficiencies; high and positive price volatilities negatively affect households' purchasing power, and worse, households' food security. Further, high and negative food price volatilities lead to improvements in households' purchasing power and then improvements in food security (Diaz-Bonilla and Ron, 2010; FAO, 2011).

3.2.1. Descriptive statistics

To assess the variance in our variables we used the coefficient of variation, where CV is estimated as (Pannervelam, 2004):

$$(1) \quad CV = \frac{\delta}{\bar{X}}$$

where, CV is the coefficient of variation, δ is the standard deviation and $\bar{X}$ is the mean. To check variability in selected series, our paper assumes that any time series with CV greater than 10 per cent, records a high relative variability.

In addition to this, the Pearson product-moment correlation (r) was used to assess how each time series for food prices is related to each time series for oil prices either in the domestic or world markets. As in the conceptual framework, our paper explains that cereal prices and oil prices do not have a direct relationship, but an indirect relationship and the estimated r helps us to know the sign of the correlation among selected time series. For two variables x (oil price) and y (cereal price), r is estimated as (Pannervelam, 2004):

$$(2) \quad r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

3.2.2. Estimation of price return

Let P_t denote the oil price (either in the domestic or world market) or the price of a cereal commodity (maize, rice, sorghum or wheat) in time period $t \in T = \{0, 1, 2, \dots, 228\}$. Whereby, 228 observations are considered in this study which covers the period January 1998-December 2016. We computed the net price returns as in Martins-Filho et al., (2010), in which the net returns of the most recent period (R_t) is computed as:

$$(3) \quad R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad \text{and the log-returns computed as } r_t = 100[\ln(P_t) - \ln(P_{t-1})]$$

The estimated log-returns are used to assess volatility clustering from the series of crude oil price returns (either domestic or world market) to series of cereal price returns (maize, rice, sorghum and wheat).

3.2.3. The ARCH and GARCH models

This paper investigates how external economic shocks affect cereal price variations in Rwanda. Literature on volatility modeling demonstrates that two general classes of volatility models are widely used (Bollerslev, 1986; Brooks, 2008; Engle, 1982; Khan et al., 2008; Uhlig, 1997). The first type formulates conditional variance directly as a function of observables. The second general class formulates models of volatility that are not functions purely of observables; these are called latent volatility or (misleadingly) stochastic volatility models. Our paper uses the first class and mobilizes and explains the application of ARCH and GARCH models to investigate how cereal price variations relate to crude oil prices in both domestic and world markets.

3.2.3.1. ARCH model's specification

Traditionally, heteroscedasticity and autocorrelation have been considered major problems in time series. Working on financial markets, Engle (1982) showed that large and small errors tend to occur in clusters such as exchange rates and stock market returns. To look at time heteroscedasticity in time series data, Engle proposed ARCH. The ARCH specification helps focus on the mean and the variance of the time series which are useful when we want to understand the magnitude of volatility in time series data.

Consider the following model (Engle, 1982):

$$(4) \quad Y_t = \rho Y_{t-1} + \beta X + \varepsilon_t$$

The ARCH model is often simplified as:

$$(5) \quad Y_t = \rho Y_{t-1} + \beta X + \varepsilon_t \quad \varepsilon_t \sim (0, \sigma_t^2)$$

$$\text{where} \quad \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_p \varepsilon_{t-p}^2$$

where, σ_t^2 is the conditional disturbance variance.

3.2.3.2. GARCH model's specification

The main constraint in using the ARCH model is that the α_i parameters have to be positive. Most of the times the estimation produces negative estimates of α_i . Bollerslev (1986) solved this problem by proposing GARCH. In this model, the autoregression (AR) process (ARCH model) is turned into an autoregressive moving average (ARMA) process by adding a moving average process. The GARCH (p, q) model, where p is the order of the GARCH terms σ^2 and q is the order of the ARCH terms ε^2 , is given by Bollerslev (1986) as:

$$(6) \quad \sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \dots + \beta_p \sigma_{t-p}^2$$

$$(7) \quad \sigma_t^2 = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i \sigma_{t-i}^2$$

Equation (7) clearly shows that the value of the conditional disturbance variance depends on both the past values of the shocks and its own past values.

3.3. Data sources and description

This study relies on secondary data. The main cereals selected are rice, maize, sorghum and wheat. The sample period covered is 1998 to 2016 or 216 months. Monthly information on prices of cereals was sourced from the National Institute of Statistics of Rwanda and that on crude oil prices from the National Bank of Rwanda. Apart from this data, this study also used the consumer price index sourced from the National Institute of Statistics of Rwanda and the world food price index sourced from the Food and Agricultural Organization's webpage. As the collected cereal prices and crude oil prices in the domestic market were in the local currency (Rwandan francs), this study used monthly exchange rates RWF/USD to convert all the prices to USD. Daily exchange rates were sourced from the National Bank of Rwanda, from which we estimated the average monthly exchange rates. To standardize the original monthly prices of crude oil in the domestic market expressed in RWF/liters with the price of crude oil in the world market expressed in USD/barrel, we converted original monthly prices of crude oil in the domestic market in USD/barrel, where 159 liters = 1 barrel. Our study also used the GDP deflator to correct inflation from gathered cereal and crude oil prices. The GDP deflator was sourced from the National Institute of Statistics of Rwanda.

4. Findings and discussion

4.1. Measuring variations in the prices of cereals and crude oil

Information about cereal price variability demonstrates that the spread of prices was higher in sorghum (CV = 40 per cent). Although, variability in the price of crude oil in both the Rwandan and world markets seems to be the same (CV=56 per cent), but the high interquartile range which is also a measurement of variability like CV demonstrates that high variability in crude oil prices was observable in the Rwandan market as compared to the world market. This is because the price of oil in Rwanda was higher even when crude oil prices decreased in the world market. This can be explained by the inverse relationship between crude oil prices and the devaluation of the Rwandan currency. Being a net importer of crude oil, the devaluation of the Rwandan currency vis-à-vis USD which is used for importing by Rwanda rendered the import of crude oil more expensive. As we said in our methodology that any time series with CV greater than 10 per cent has a high relative variability, our results in Table 1 reveal that all analyzed time series suffered from high relative variability. In addition, the correlation coefficients between the price of selected cereals and the price of crude oil showed the existence of a high and positive correlation between the price of cereals and the price of crude oil in the domestic market when compared to the effect of crude oil prices in the world market. This was expected as we considered the food distribution system in a country (Rwanda), which is a net importer of crude oil. The correlation matrix shows one exception, where the correlation between the price of maize

and that of crude oil is the same in both the Rwandan market and the world market at 53 per cent and 51 per cent respectively.

Insert Table 1 about here

4.2. An analysis of cereals and crude oil price returns

As can be seen in Figures 2 and 3, the price returns series show random and rapid changes. Therefore, technically they are said to be volatile. The observed volatility seems to change over time and high volatility is observable in cereal commodities as compared to crude oil prices. Although there was cereal price volatility in 1998-2005, much more volatility was observed in 2006-10. Even though Figure 2 demonstrates that the price of crude oil in the world market experienced positive and negative changes it also shows that changes in the domestic price of crude oil were the most positive in 1998-2016. This may explain the upward movements in cereal prices experienced in this period (NISR, 2017). These movements may be linked to the positive changes in the price of crude oil in the domestic market which resulted in positive changes in transport costs. From the descriptive statistics in Table 1 and price returns in Figures 2 and 3, it is clearly observable that there is evidence of cereal price volatility clustering from variations in the price of crude oil in both the Rwandan and world markets to variations in the prices of selected cereals. This could be a good indication for applying ARCH and GARCH to handle this volatility clustering from crude oil prices to cereal prices.

Insert Figure 2 about here

Insert Figure 3 about here

4.2. ARCH and GARCH estimates

The results in Table 2 for the unit-root test show that in level all series appear to be non-stationary but they appear to be stationary in the first differences which implies that all series are integrated of order one, denoted by $I(1)$. This suggests using estimated price returns as shown in Figures 2 and 3 for estimating ARCH and GARCH models to investigate conditional volatility over January 1998-December 2016.

First, by estimating how conditional variances in crude oil prices in the Rwandan domestic market and the world market affect variations in the price of rice in the Rwandan domestic market, the results in Table 2 show that the estimated coefficient of crude oil prices in the domestic market was positive and statistically significant at the 5 per cent level of significance. This suggests that variations in the price of rice in the domestic market were positively related to variations in the price of crude oil in the domestic market. This result predicts that positive changes in crude oil prices in Rwanda lead to positive changes in the price of rice in the domestic market. Second, by estimating how conditional variances in crude oil prices in the domestic and world markets affect variations in the price of maize in the domestic market, Table 2 demonstrates that the estimated coefficients of crude oil prices in both the domestic and world markets are not statistically significant at the 10 per cent, 5

per cent and 1 per cent levels of significance. Third, by estimating how conditional variances in crude oil prices in the domestic and world markets affect variations in the price of sorghum in the domestic market, Table 2 reveals that the estimated coefficient of crude oil prices in the domestic market was positive and statistically significant at the 10 per cent level of significance while it was negative and statistically significant at the 5 per cent level of significance for crude oil prices in the world market.

These results predict that positive changes in crude oil prices in Rwanda and in the world market respectively lead to positive and negative changes in the price of sorghum in the domestic market in Rwanda. Fourth, by estimating how conditional variances in crude oil prices in the domestic and world markets affect variations in the price of wheat in the domestic market, Table 2 also demonstrates that the estimated coefficient of crude oil prices in the domestic market was positive and statistically significant at the 5 per cent level of significance. This result predicts that positive changes in crude oil prices in Rwanda lead to positive changes in the price of wheat in the domestic market.

The results in Table 2 show that positive changes in the price of crude oil in Rwanda may result in food distribution inefficiencies likely to cause positive changes in the prices of rice, sorghum and wheat in the country. However, positive changes in the price of crude oil in the world market led to food distribution inefficiencies which were able to cause negative changes in the price of sorghum. On average, a 1 per cent increase in the price of crude oil in Rwanda led to a 0.14 per cent, 0.25 per cent and 0.14 per cent increase in the price of rice, sorghum and wheat respectively. As Rwanda is a net importer of crude oil, our paper's empirical findings show that positive variations in the price of crude oil in Rwanda are, in one way or another, translated into positive cereal price volatility mainly in rice, sorghum and wheat prices. These results are supported by the fact that a decrease in crude oil prices leads to a decline in transport costs and then a decline in the prices of goods and services and vice-versa (WB, 2013)⁸ and second by the factor that variations in the prices of crude oil can cause inefficiencies in the food distribution system which may result in food price volatility (FAO, 2011; Grega, 2002; Sarris, 2014; WB, 2013). However, positive variations in the price of crude oil in the world market are, in one way or another, translated into negative sorghum price volatility, whereby a 1 per cent increase in the price of crude oil in the world market led to a 0.13 per cent decrease in the price of sorghum. This may be explained by the fact that sorghum has been marginalized by main agricultural and food security policies in the country (MINAGRI, 2011) resulting in low domestic consumption and high sorghum exports. Therefore, when the price of crude oil in the world market increases it becomes expensive to export the domestically produced sorghum leading to lower sorghum prices in the domestic market as the stock of sorghum increases while domestic consumption is lower.

The results in Table 2 show that the price of maize in Rwanda does not seem to be influenced by crude oil price variations. This may be explained by the fact that the biggest share of maize (79.7 per cent) domestically produced is auto-consumed by households (NISR, 2016). This suggests that only a small quantity of domestically produced maize (approximately 20.3

⁸ <http://siteresources.worldbank.org/INTGEP/Resources/335315-1257200370513/04--Ch4--96-127.pdf>

per cent) becomes a part of the food distribution system. This is an insignificant amount to be affected by variations in the price of crude oil.

Table 2 also demonstrate that for all the four selected cereal series, the absolute sum of coefficient for crude oil prices in the Rwanda domestic market and that in the world market is less than 1 which indicates a finite variance in the prices of rice, maize, sorghum and wheat in the domestic market in Rwanda and the price of crude oil in both the domestic and world markets.

Insert Table 2 about here

4.6. Estimates of scedastic functions

Disentangled cereal conditional variances from the ARCH model using scedastic functions demonstrates that for the prices of wheat, rice and maize, conditional variances peaked between 2009-16; this is a period which corresponds to surges in the price of crude oil in the Rwanda domestic market (Figure 4). This implies that upward movements in the price of crude oil in the domestic market in Rwanda led to a period of high price volatility in wheat, maize and rice. This may have resulted from the fact that compared to the price of sorghum, where conditional variances peaked during the period of low crude oil prices, the other three cereal commodities (maize, sorghum and wheat) were the most traded food commodities among food security crops in Rwanda. Food security crops selected for Rwanda include rice, maize, wheat, Irish potatoes, beans, cassava, banana and soybean (MINAGRI, 2011). Therefore, the exclusion of sorghum from among food security crops resulted in its low tradability and may explain the behavior of its conditional variances as their high peaks corresponded with periods of low crude oil prices. This was expected as maize, rice and wheat are highly traded in Rwanda and are subject to transport costs throughout the food distribution system.

Insert Figure 4 about here

5. Conclusion and policy implications

This paper adopted autoregressive conditional heteroscedasticity (ARCH) and generalized autoregressive conditional heteroscedasticity (GARCH) models as external economic shocks to investigate how variations in the price of crude oil in Rwandan and in world markets affect cereal prices in the domestic market in Rwanda. The main findings of this paper show that, on average, a 1 per cent increase in the price of crude oil in Rwanda led to a 0.14 per cent, 0.25 per cent and 0.14 per cent increase in the prices of rice, sorghum and wheat respectively. However, a 1 per cent increase in the price of crude oil in the world market led to a 0.13 per cent decrease in the price of sorghum. The other main findings of this paper also show that: (i) volatility in the market price of rice in the Rwandan market was strongly influenced by own past squared residuals (13 per cent) and by past squared residuals in the price of crude oil in both the domestic and world markets (7 per cent); (ii) volatility in the market price of maize in the Rwandan market was strongly influenced by

own past squared residuals (25 per cent); (iii) volatility in the market price of sorghum in the Rwandan market was strongly influenced by own past squared residuals (35 per cent); and (iv) volatility in the market price of wheat in the Rwandan market was strongly influenced by own past squared residuals (32 per cent).

Two policy implications flow from the main results of this paper. First, it is very important for policymakers to recognize the relationship between the price of cereals and the price of crude oil because this can provide us with new thoughts about reducing inefficiencies in the domestic cereal distribution system. Reducing inefficiencies which may hamper the cereal distribution system will help in improving the cereal market's efficiency and integration in Rwanda and thus lead to food security through easy access to cereal commodities or cereal products. Second, there is evidence of volatility in cereal price returns clustering from variations in crude oil prices in both the domestic Rwandan market and the world market. Rwanda being a net importer of crude oil, economic reforms in Rwanda should focus on stabilizing the value of the Rwandan franc vis-à-vis USD. This may result in crude oil price stability in Rwanda. Thereafter, crude oil price stability will be a key factor in improving the effectiveness of the cereal distribution system, the efficiency of the cereal market and food access and acquisition in the country.

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Table 24: Summary of descriptive statistics

		Correlation		Variability measures	
		PCOR	PCOW	CV	iqr
Price of crude oil-Rwanda	PCOR	1.00		0.56	151.23
Price of crude oil-world	PCOW	0.80	1.00	0.56	59.78
Price of rice	PR	0.86	0.55	0.36	0.53
Price of maize	PM	0.53	0.51	0.29	0.12
Price of sorghum	PS	0.83	0.57	0.40	0.24
Price of wheat	PW	0.66	0.37	0.27	0.29

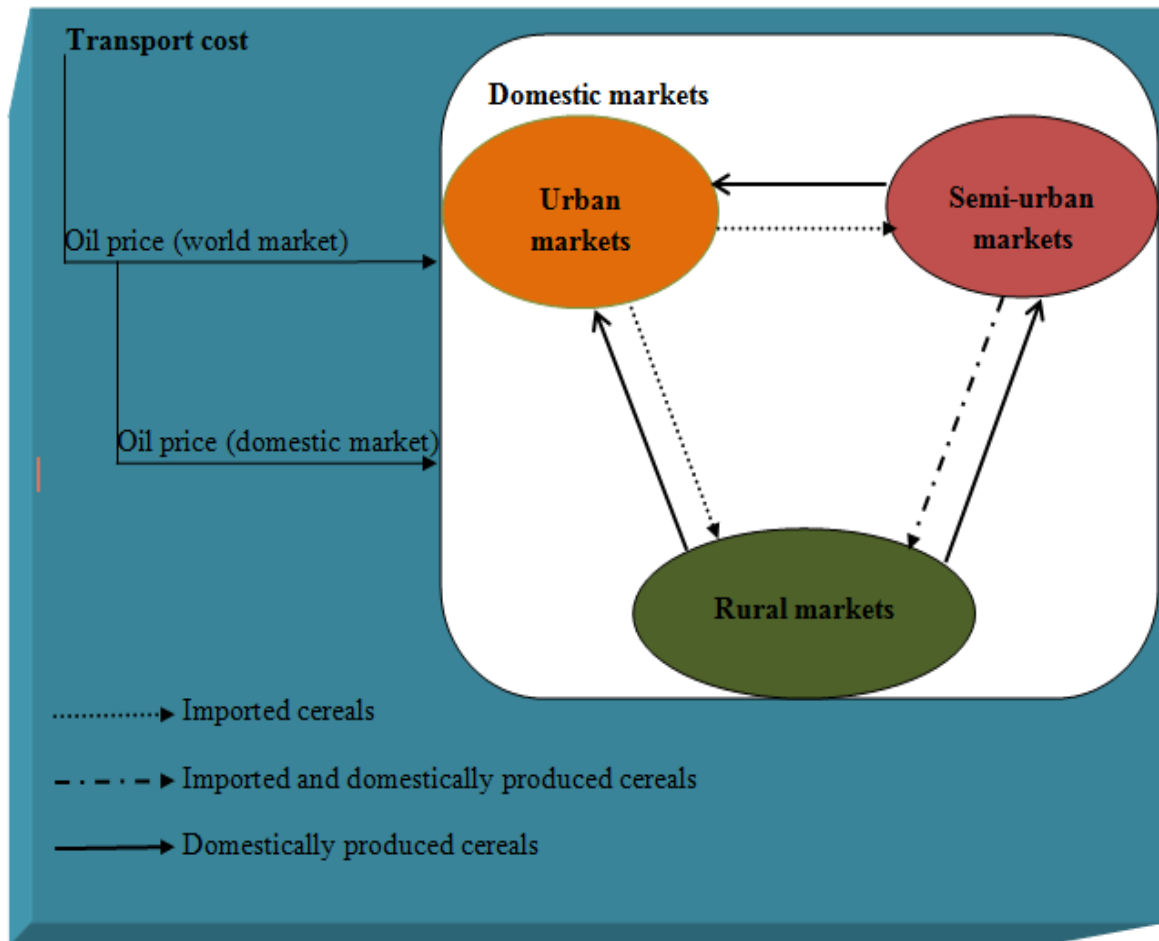
cv: coefficient of variation; p50: median; iqr: interquartile range

Table 2: ARCH and GARCH summary results

Variable	Crude oil price/Rwanda	Crude oil price/world	Rice price	Maize price	Sorghu m price	Wheat price
Crude oil price/Rwanda			0.14** (0.06)	-0.09 (0.13)	0.25* (0.14)	0.14** (0.06)
Crude oil price/world			-0.01 (0.02)	-0.08 (0.06)	-0.13** (0.06)	-0.01 (0.03)
ARCH effect			0.13*** (0.04)	0.25** (0.11)	0.35*** (0.12)	0.32*** (0.08)
GARCH effect			0.07*** (0.16)	-0.03 (0.27)	-0.06 (0.13)	0.02 (0.20)
Constant			2.94 (2.30)	47.00 (15.30)	40.88*** (9.39)	21.06*** (5.51)
Number of obs.			227	227	227	227
Wald chi2 (2)			6.04**	2.55	7.59**	4.66*
Log likelihood			-638.27	-777.94	-769.60	-702.54
ADF test (data in level)	-1.08	-1.60	0.02	-2.42	-1.26	-1.75
ADF test (price returns)	-15.40***	-11.61***	-13.33***	-9.96***	-10.12***	-17.25***

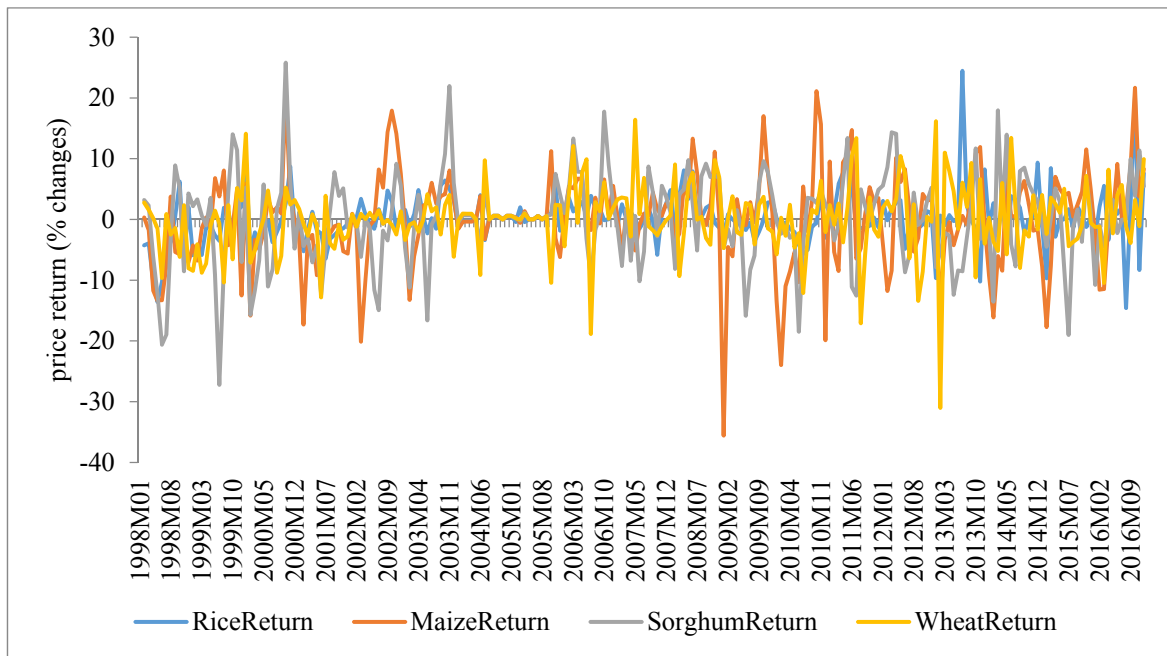
*Figures in brackets are standard errors; *, **, *** indicate 10%, 5%, and 1% significance levels respectively. ADF test: augmented dickey-fuller (ADF) test for unit root.*

Figure 1: Cereal transport system



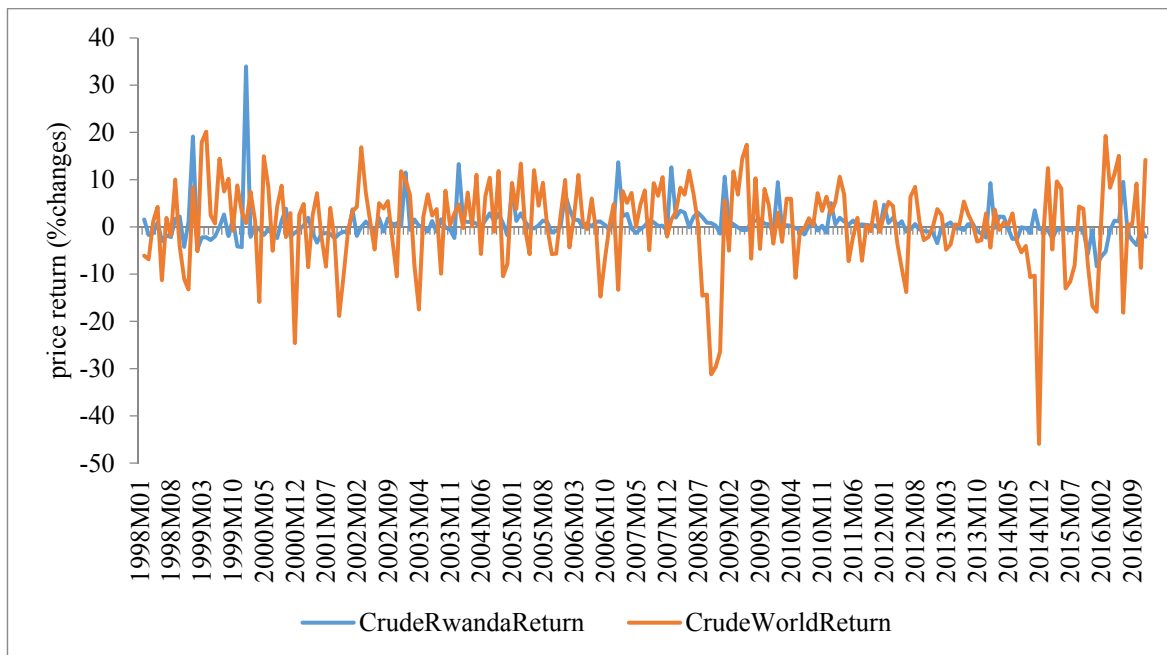
Source: Author's designed food distribution system.

Figure 2: Cereal price returns



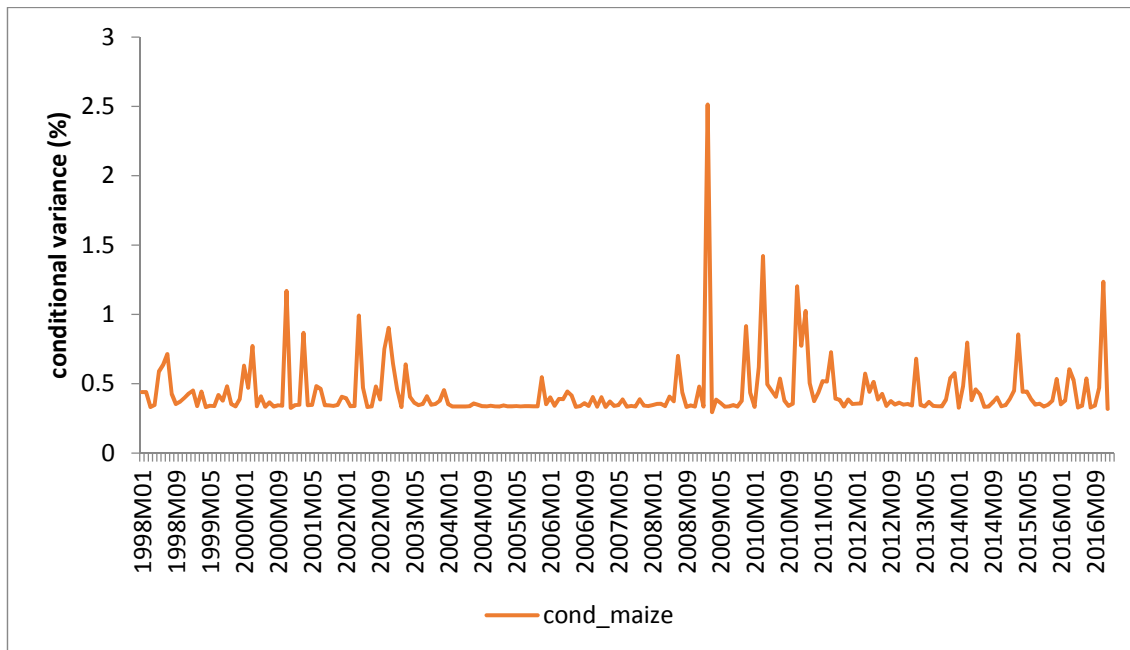
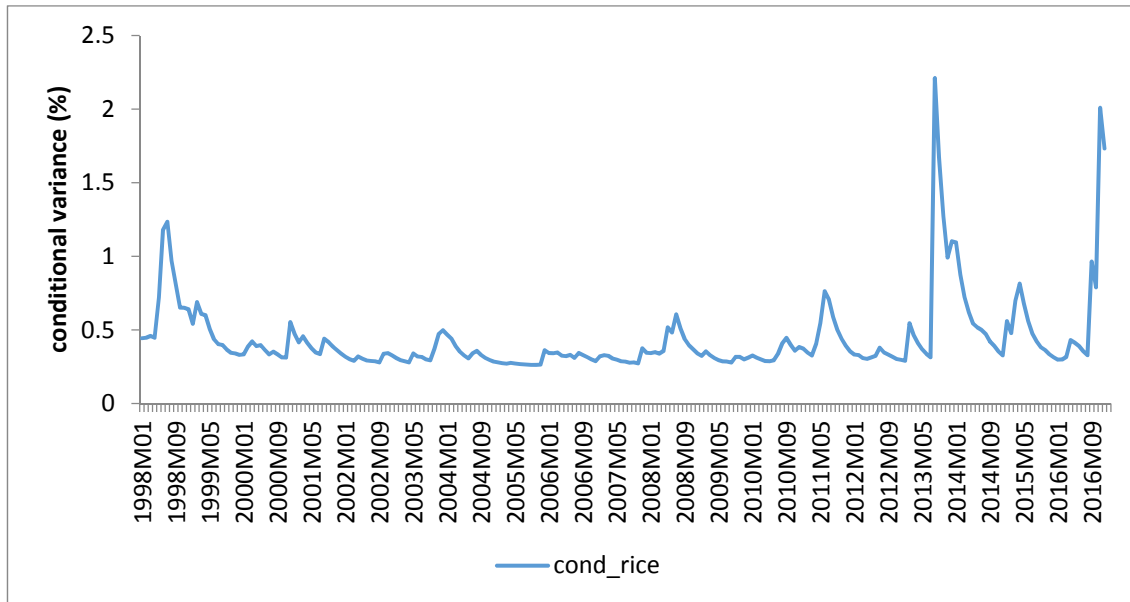
Source: Author's own computations.

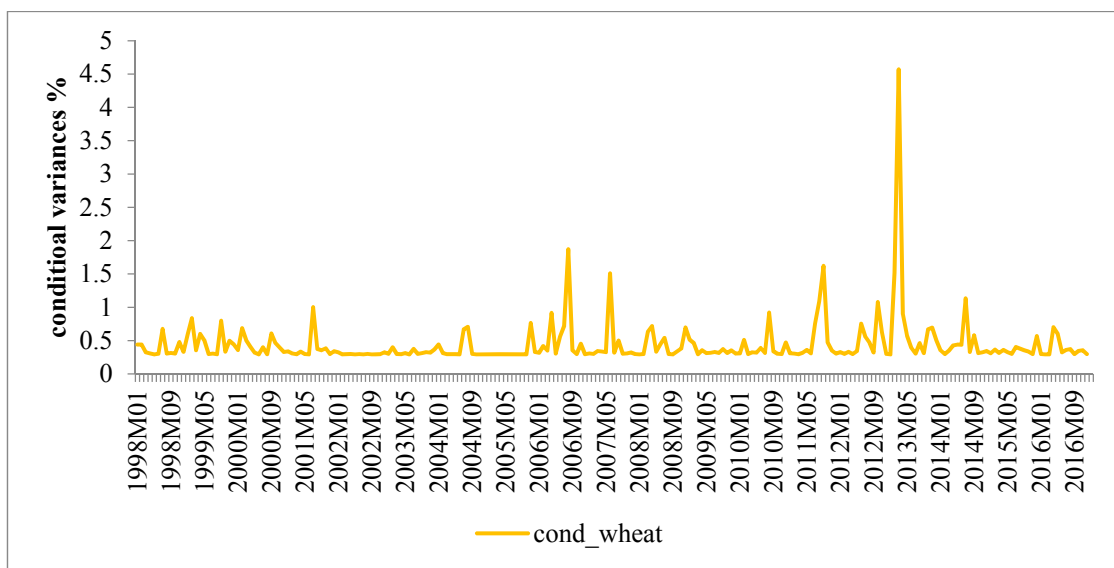
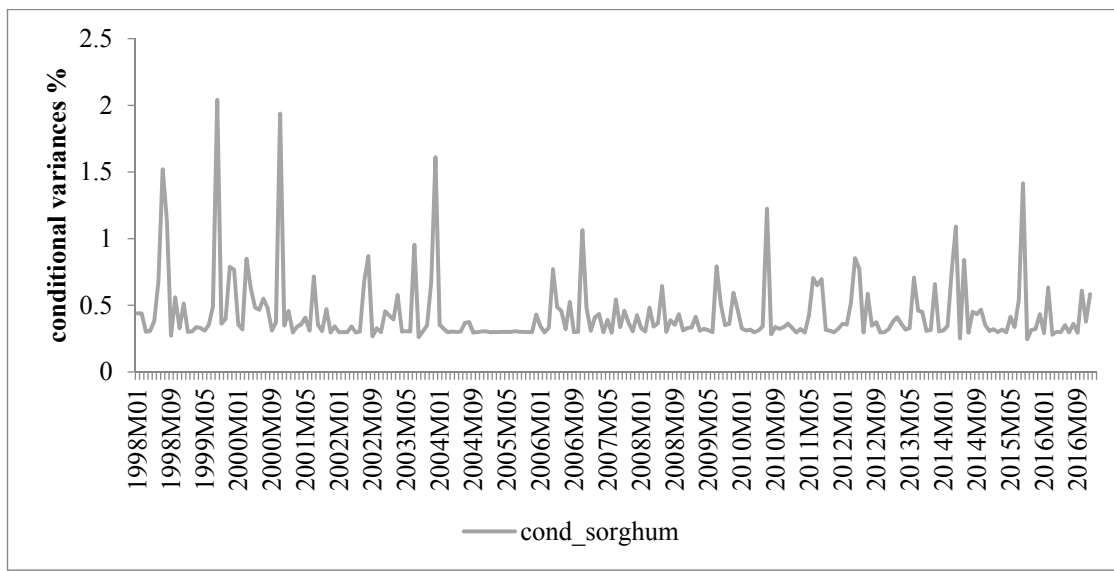
Figure 3: Crude oil price returns



Source: Author's own computations.

Figure 4: Conditional variances for cereals





Source: Author's own computations.

Note: Conditional variances presented in this figure are measured as percentage of the total conditional variances ever experienced from January 1998-December 2016.

Part Seven. Capital Market and Investment

Chapter 15. Gisele C. Umuhoza, “Factors influencing the development of the capital markets in a developing economy: Rwanda Stock Exchange”.

Chapter 16. Jonas Barayandema and Idrissa Ndizeye, “The determinants of investment decision on Rwanda stock exchange”.

Chapter 17. Thomas R. Kigabo, “Monetary transmission mechanism in Rwanda”.

Chapter 18. Thomas R. Kigabo and Ananias Gichondo, “Excess liquidity and monetary policy in Rwanda”.

Chapter Fifteen

Factors Influencing the Development of Capital Markets in Rwanda: A Case Study of the Rwanda Stock Exchange

Gisele Umuhoza Cyuzuzo¹

University of Rwanda (UR)
College of Business and Economics
E-mail: ugisele29@gmail.com

Abstract

This study investigates the factors influencing the development of capital markets in Rwanda. Its main objective is to study how macroeconomic variables affect the growth and development of the Rwanda Stock Exchange (RSE). It also analyzes RSE's contribution to the increasing economic growth in Rwanda. The study uses quarterly secondary data from 2011 to 2016 and estimates two models using the GLM method. It measures RSE's performance by market capitalization. The macroeconomic variables that it uses are the key repo rate, inflation rate and money supply; consumption is used as a conditioning variable. It uses GDP as the dependent variable, market capitalization as the independent variable and capital formation and consumption as the conditioning variables to analyze the second model. It uses a 2SLS regression method to overcome the endogeneity problem. Our results show that among the four macroeconomic variables only money supply had a statistically significant relationship with market capitalization as we found that an increase in money supply by one Frw led to an increase in the market capitalization ratio by 0.003. The results also show that there was a positive relationship between market capitalization and GDP where an increase in market capitalization by one unit increased GDP by 0.19.

Keywords: Capital market, economic growth, monetary policy, investment, financial development.

JEL Classification Codes: G24; O47; E52; G23; E22; O16;

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1. Introduction

Capital formation is one of the main factors responsible for a country's economic and financial growth. Developing countries need considerable investment capital for providing basic infrastructure, education facilities and developing agricultural and industrial ventures. According to Arowolo (1971), success in mobilizing needed capital for development has varied among countries and has depended on the availability of domestic savings within the economy and the inflow of foreign capital. For a country like Rwanda which is still building its economy it is not easy to get loans from banks primarily because the projects that are being developed in Rwanda are risky and take long to generate benefits. Hence, Rwanda needs capital markets (CMA, 2012-2015) to play an alternative role for the banking sector which currently dominates the financial sector in Rwanda with high costs for the private sector willing to acquire capital from banks. According to Yartey and Adjasi (2007) stock markets provide an opportunity for growing companies to raise capital at lower costs. They emphasize that companies in countries with developed stock markets are less dependent on bank financing.

Several authors recognize the role of capital markets in boosting economic growth in countries and offering alternative solutions to people looking for capital. According to Levine and Zervos (1998) capital markets boost savings and increase the quantity and quality of investments by providing individuals with additional financial instruments that may better meet their risk preferences and liquidity needs. According to Gursamy (2009) well developed financial markets play an important role in mobilizing savings by collecting funds saved by households and public and private entities when they purchase shares or bonds; in spurring investments by enabling companies to acquire the needed capital and in increasing national growth by ensuring a transfer of surplus funds to deficit funds; and in entrepreneurship and industrial growth by availing necessary financial resources.

Many economists consider stock markets as the pulse of an economy as in most of the cases they react quickly to any economic or political change in a certain country. According to Singh (2010), a capital market in which security prices adjust rapidly to the arrival of new information is called an efficient capital market. Stock market behavior is affected by several factors including macroeconomic factors (domestic or international), social, political and institutional factors, market expectations about future economic growth and any change in the monetary and fiscal policy. Macroeconomic factors that affect a stock market include interest rate, inflation rate, money supply, economic growth and exchange rate.

In 2000 Rwanda adopted Vision 2020 which aims at transforming the country into a middle-income country with a knowledge based economy. To achieve this, an annual economic growth target of 11.5 per cent is required which can only be achieved with at least 20 per cent savings of GDP and domestic investments of up to 30 per cent of GDP. The Capital Market Authority (CMA) was established under the Capital Market Act of 2011 to guide the development of capital markets. Earlier the Rwanda Capital Market Advisory Council (CMAC) was established in 2007 to develop the capital market in Rwanda, facilitate the trading of debt and equity securities and to enable securities transactions and perform

regulatory functions over the Rwanda Securities Exchange which was created in 2011.² This is a limited company in which the government owns 20 per cent while the remaining is owned by brokers and other stakeholders. It has eight listed companies of which four are foreign owned. Transactions are carried out manually and cleared electronically through a central securities depository system that is managed by the Central Bank.

Several authors support the role of stock markets in increasing economic growth in a country; this has also been proven in many developed countries. It was on this basis that Rwanda established the Capital Market Authority in 2011. According to CMA (2015), the total amount of funds raised during the financial year 2014-15 was Frw 55 billion compared to Frw 12.5 billion in financial year 2013-14. This increase was supported by the government's long-term debt issuance program launched in 2014 to support capital market development and for mobilizing infrastructure funding. The Government of Rwanda adopted an institutional and regulatory framework to support CMA's development and since 2014 it has launched the government's long-term debt issuance program. However, despite all these efforts, during 2016 market capitalization went down to US\$ 3.3 billion from US\$ 3.8 billion in 2015. This was attributed to the country's overall economic performance and other factors such as low client turnover and the fact that only a few products were traded on RSE. Hence, our study assesses how macroeconomic variables affect the stock market's performance.

The main objective of our study is to analyze the effects of macroeconomic variables on RSE's performance. Its specific objectives are analyzing the evolution of the performance of the Rwanda Stock Exchange, analyzing RSE's contribution to Rwanda's economic development and providing suitable policy measures that will contribute to an improvement in RSE's performance and also contribute to economic growth in Rwanda. Our study answers the following questions: What are the macroeconomic variables that affect RSE's performance? Does RSE's performance contribute to economic growth in the country? If yes, what is its contribution to this growth?

Based on these questions, we formulated two hypotheses: macroeconomic factors (inflation rate, exchange rate and key repo rate) have no significant relationship with RSE's performance and RSE does not contribute to economic development in Rwanda.

Our research focuses on the Rwanda Stock Exchange and the factors affecting its performance with the main focus on macroeconomic variables. It covers the period from 2011 up to the third quarter of 2016. We also study the effect of the capital market on economic growth in the country.

1.2. Problem statement

According to Dudley and Hubbard (2004) more developed capital markets have played a major role in countries' economic and financial growth as they have the ability to mobilize funds that are then channelled to individuals or groups of people who need the money to start or expand their businesses which result in growth in a country's economy.

²See [https:// minecofin.gov.rw/capital markets](https://minecofin.gov.rw/capital%20markets)

Learning from these countries' experiences, Rwanda created its capital market in 2011 and since then it has adopted an institutional and regulatory framework to support its development. The government also launched the long-term debt issuance program in 2014. This program consists of issuance of government treasury bonds to the public to increase new products available on the RSE which will attract new investors and thus contribute to the development of the stock market. However, despite these efforts in 2016 market capitalization went down to US\$ 3.3 billion from US\$ 3.8 billion in 2015. This was attributed to the country's overall economic performance and other factors such as a low client turnover and only a few products being traded on RSE. However, little is known about how the macroeconomic environment affects the stock market's performance in Rwanda. It is in this backdrop that our study assesses which macroeconomic variables affect the stock market and to what extent so as to be able to formulate suitable recommendations that may be used to improve RSE's performance.

2. Literature Review

2.1. Introduction to the financial market and the capital market

According to Gursamy (2009), a financial market is an institution or an arrangement that facilitates the exchange of financial instruments including deposits and loans, corporate bonds and stocks, government bonds and other instruments. Financial market transactions may take place in a stock exchange or by telephone or using other electronic media. Financial markets comprise of the money market where people lend or borrow money for a short period like one night or for a maximum of a year; capital market in which people lend or borrow money for more than one year; debt market which specializes in selling and buying bonds; and the Eurobond market in which bonds are sold and bought denominated in a currency that is not the national currency of the issuing country.

Other components of the financial market include the equity market which is also called the stock market which has stocks of different companies listed on it; commodity market which specializes in the trading of primary goods like wheat, coffee and minerals; derivatives market for financial instruments like future contracts or options; futures market where people agree to trade specific quantities of commodities or financial instruments in the future at a given time; foreign exchange market where people buy or sell different currencies; financial services market that comprises of different institutions that provide financial services; depository market and non-depository market. Not all these constituents are available in all countries especially in developing countries like Rwanda where the capital market is still in its early stages.

Our study mainly focuses on the capital market which is a highly specialized and organized financial market that represents the facilities and institutional arrangements for the sale and purchase of medium- and long-term funds. Like any other market, the capital market has buyers who are borrowers of funds and sellers who are lenders of funds.³ The capital market comprises of a primary market and a secondary market. The primary market deals with the

³ See https://en.wikipedia.org/wiki/Capital_market

issue of new securities. It is a market for raising fresh capital in the form of shares and debentures. The government or the corporate sector which is willing to raise capital funds through issuing securities approaches the primary market. Issuers exchange financial securities for long term funds.

The primary market allows the formation of capital in the country and for accelerated industrial and economic development. In this way newly issued financial assets are bought and sold. The popular ways by which capital funds are raised in the primary market are public issues or initial public offerings (IPOs) where a company willing to raise capital issues a certain number of its shares to the public depending on the amount of capital needed. Securities are issued to members of the general public and it is the most popular method of raising long-term funds; the rights issue where instead of going public and calling the general public to buy its shares a company issues a certain number of shares that are proposed to existing shareholders as a pre-emptive right. Under this method, additional securities are offered for subscription to existing shareholders; and private placement is a method for a company to raise capital by issuing shares that are sold to a group of small investors.

The secondary market deals with people who want to acquire shares in companies by purchasing shares from investors who already have them in certain companies. In this market no fresh capital is made available to the producers on account of the transactions. The secondary market is crucial in a capital market as it offers an opportunity to investors who bought their shares in the primary market to sell them in case they want cash or no longer want to be investors in a company. The liquidity of the secondary market has a big impact on the primary market as when companies listed on the secondary market are actively trading it is possible for existing companies to issue new shares because it shows how investors are thirsty to invest in them and it also makes the environment favorable for new companies to raise capital as active participants in the market are happy to have new products at their disposal. According to Yartey and Adjansi (2007) liquid stock markets enhance investments in the long term yielding profits and this leads to improved capital allocation and economic growth in the country. Buying and selling of securities in a secondary market is carried out through a stock exchange. Currently there is one stock exchange in Rwanda which is recognized by the government. This is different from other countries which have more than one stock exchange.

In the capital market, capital resources are raised using capital market instruments. The most frequently used capital market instruments include preferential shares which are shares whose dividends are paid before the announcement of the common dividend; preferential rights are those shares whose owner has the right to buy someone else's property in case of a certain event; and equity shares which are ordinary shares that are held by individuals or corporates in a certain company. The owners of these shares incur the profit and loss of a company. Then there are also non-voting equity shares which are shares that result in additional issuance of shares by a company which is done without changing the interests of the existing shareholders; convertible cumulative preference shares which have the advantage of accumulating arrears of dividend and can also be transformed into ordinary shares; company fixed deposits which are deposits made by an individual or a corporate in a certain company which will generate a safe interest rate independent of any market

fluctuations; warrants which are a financial instrument which provides buyers the right to buy shares in a company at a given price during a certain fixed period; and debentures which are documents that show that a company has borrowed a certain amount of money that will be repaid following some agreed to terms and conditions.

A bond is like a loan which pays interest periodically, mostly every six months at a fixed interest rate, and repays the principal at a pre-decided time called maturity. The differences between bonds depend on the nature of the issuer who can be a government or a private entity such as a bank or any other organization wanting to raise capital. Government bonds are considered 'risk-free' in the domestic market because the payment of interest and principal is certain. Some types of government bonds are treasury bills which are short-term bonds that mature within one year or less. Treasury bonds and treasury notes are also called long bonds and offer maturities of 20 and 30 years. Treasury notes are issued with maturities of one, three, five, seven and 10 years.

Several variables are used for measuring a stock market's performance. According to Demirgiic-Kunt and Levine (1996) the traditional characteristics of a stock market are market capitalization which represents the value of all the shares listed on the stock market; amount of new stock offerings which is the number of new shares issued by the stock market; number of listed companies and turnover and institutional characteristics including regulations, information disclosure, transparency rules and trading costs; and asset pricing characteristics.

2.2. Effect of capital markets on economic growth

Stock markets are recognized by many economists because of the role that they play in a country's economic performance. According to Fama and French (2005) the primary role of the capital market is allocation of ownership of the economy's capital stock. He found that there is a positive dependence in day to day price changes and returns on common stocks. Naceur and Labidi (2010) argues that mature financial systems can cause high and sustained rates of economic growth given that they act as a source of finance for business set ups. In his study that covered 52 Middle East and North African (MENA) countries from 1989 to 2005, Naceur found that a well-developed stock market led to an increased profit opportunity for banks which in turn spurred economic growth in a country. According to Pardy and Mundial (1992) the development of a stock market is accompanied by financial deepening and that countries with more developed stock markets have financial systems that issue more credit to the private sector as a share of GDP than countries with less developed stock markets. This implies that a more developed stock market will allow firms to increase borrowings from financial intermediaries. According to him, a sound and efficient stock market can contribute to economic growth in the long run while in the short run it plays a role in financial deepening and liberalization.

According to Caporale et al., (2004) a well-developed stock market can foster economic growth in the long run. Their empirical work tested for causality in VARs using a sample of seven countries. They found that through the issuance and repurchase of government bonds, stock markets played an important role in formulating appropriate monetary policies. By

running an autoregressive distributive lag regression Mauro (2003) found that there was a significant correlation between output growth and stock returns. However, Minier (2003) indicates that the effect of a stock market on economic growth may take some time to appear, particularly in countries with less developed stock markets. By running a regression tree technique he found that economic growth and financial development were positively correlated in countries with high market capitalization. However, he found that this relationship did not hold for countries with low market capitalization.

Dailami et al., (1990) share the same view. They discuss the Korean and Indian stock markets during the period 1980 to 1989 when the Korean market capitalization increased from 6.3 per cent of GNP in 1980 and went up to 73.1 per cent of GNP in 1989. The same thing happened in India though not to the same extent, where market capitalization rose from 4.4 per cent of GNP to 8.5 per cent of GNP in 1989. These spectacular results in the two countries were supported by important macroeconomic and policy changes where in Korea the period was characterized by reduced inflation, large household savings and a sharp turnaround balance of payments from deficit to surplus. However, the authors go further and talk about the costs of adopting capital markets as an alternative to the usual banking system as a source of capital. The first cost is the possibility that managers may pursue goals that are different from shareholders' profit aspirations. The second cost is the nature of stock markets which is sometimes volatile. The third cost relates to the role of stock markets in takeover activities and its impact on companies' competitiveness and efficiency.

Talking about the role of the stock market in China, Li (1994) emphasizes the role of securities markets by arguing that often stock markets are a means of overcoming the negative effects of government financial repression. He gives an example that if a privately owned firm cannot gain access to credit from the dominant state banking system, then an equity issue could represent a viable alternative funding source. He says this to support the idea of transforming state-owned enterprises into shareholding companies which would enable them to acquire the necessary funds to reform, modernize and reduce their dependence on debt finance and improve corporate governance.

However, though stock markets have been praised for their proven role in accelerating economic growth in a country, some authors argue that stock markets can harm an economy due to the fact that some or even most of the time they tend to be volatile especially in developing countries where they are not yet stable. For example, Laurenceson (2001) argues that economic development in China would have been best served by focusing on reforming existing credit markets. In his study, he found that listing the state-owned enterprises (SOEs) was important in terms of raising funds for their reforms. However, on the macro-level their impact on the overall level of saving mobilization and allocation of capital was negligible. Singh (1997) and Singh and Weisse (1998) takes an even more extreme position and argues that stock markets are in fact likely to harm economic development due to their susceptibility to market failures which is often manifested in the volatile nature of stock markets especially in many developing countries. They recommend that less developed countries should promote bank based systems, influence the scale and composition of capital inflows and prevent a market for corporate control from emerging.

2.3. Factors affecting a stock market's performance

Stock markets are affected by different factors and their performance is mostly defined by them. Different authors have argued that for a stock market to be efficient and thus perform at its best, suitable rules and regulations have to be put in place. Also for a country to have a vibrant stock market it must have adequate institutions that oversee and regulate this sector. According to Pardy and Mundial (1992) the two pre-requisites for sound securities markets are the macroeconomic and fiscal environment that is conducive to the supply of good quality securities and sufficient demand for them and legal, regulatory and institutional infrastructure capable of supporting efficient operations of the securities market. Roe (2006) argues that the reason why some rich nations have strong capital markets while others have weak ones is because they have suitable institutional laws that protect outside shareholders. However, he adds that it is not so much the type of institutions that have counted in the world's richest nations but whether a nation has used them to support its capital markets.

Supporting the same view Beck (2006) argues that financial systems require developed legal and information infrastructure to function well. In fact, outside investors are reluctant to invest in companies if they are not able to exert corporate governance and protect their investments by controlling shareholders/owners or the management of the companies. However, according to Crotty (2009) more regulations do not always mean better outcomes. Lightly regulated financial markets allow individual and institutional investors to achieve maximum returns for a given risk level and choose the amount of risk that is optimal for them. According to Levine (2011) political and powerful clans frequently use well-intentioned government interventions for their own benefits thus having suitable institutional laws and government regulations and for this a country's stock market is not enough and what is needed is proper implementation of the regulations.

Another key element to be considered for the development of a stock market is the liberalization of the stock market. This means that no institution, be it public or private, should intervene to directly influence the conduct of stock markets. This argument is supported by Kaminsky and Schmukler (2003) who says that when equity markets are not liberalized then these markets will not develop and this will affect the economic development of a country as investors may opt to seek funds from economies that have equity markets that are fully liberalized. The role of market liberalization is also proven by Li (2012) whose empirical work ran an OLS and an IV regression using data from 95 countries from all over the world from 1975 to 2000. He found that countries in sub-Saharan Africa that have had tremendous economic development had their equity markets liberalized some time back and their economies continued to develop well. These countries include Kenya and Nigeria while those that still have equity markets that are not liberalized are facing challenges of low economic development in their economies.

Buying a stock in a certain company means that one has become the owner of that company. This further means that he or she would like to know if the business is profitable or not; actually it is his/her right to have all the relevant information about the company in which he/she has invested. That is why information disclosure, particularly financial information disclosure is important for a stock market to develop. Meek et al. (1995) defines voluntary disclosures as free choices on the part of a company's management to provide accounting

and other information in their annual reports that is deemed relevant for the decision-making needs of users. He argues that most organizations gain some benefits by disclosing information to their stakeholders.

Kendi (2014) found that there was a strong positive and significant relationship between voluntary disclosures and stock returns and concluded that firms can increase stock returns by increasing voluntary disclosures. According to her, governments should also have more regulations on disclosures to ensure that individuals investing in stock markets get more information. According to Cooke (1989) disclosed financial information is essential for investors to efficiently allocate scarce resources and assess investment options. However, Asava (2013) did a study on the effect of voluntary disclosures on stock returns of companies registered on the Nairobi Stock Exchange using SPSS. He conducted a regression analysis on each voluntary disclosure category with stock returns and found that stock returns of companies composing the NSE 20 share index were not affected by voluntary release of information.

The importance of information disclosure is emphasized by Demirgiic-Kunt and Levine (1996) who says that economies with strong information disclosure laws; internationally accepted accounting standards; and unrestricted international capital flows tend to have more liquid markets. He adds that developing markets are characterized as having low levels of liquidity, high information asymmetry and thin trading because of their weak institutional infrastructure. This is explained by the fact that if one knows that a given company is performing well she will invest in it and there is no other way of knowing this unless the company discloses the information. Another important factor to consider is shareholders' protection. Classens et al. (2001) argues that countries with strong shareholder protection are more likely to have well developed stock markets due to the fact that investors do not fear expropriation. The development of stock markets in these countries is explained by the liquidity of the stock markets given that ownership in such markets can be relatively dispersed. This is also emphasized by La Porta et al., (2000) when they say that the differences in stock market development in different countries is explained by how well investors are protected by law from expropriation by managers and controlling shareholders of firms. According to them financial markets need some protection for outside investors either by courts, government agencies or the market participants themselves.

Several studies have shown that stock markets are directly influenced by macroeconomic conditions. In fact, these variables are the fundamentals of every economy so much so that any change in one or all of these variables has important repercussions on the stock market's performance. According to Osei (1998) the macroeconomic environment is very important for foreign investors. Hence, if more foreign investors are expected to play an active role in emerging stock markets, then serious attempts need to be made to reduce inflation and rapidly depreciating currencies so that their capital base is not eroded. In Kenya high interest rates that have been rising because of domestic borrowings have led many investors to liquidate their equities in preference for high yielding government papers. According to Aurangzeb (2012) interest rates and inflation in South Asia have a negative relationship with stock market performance. Geetha et al. (2011) studied the relation between inflation and

stock returns in three countries, the US, Malaysia and China. His results suggest a long run relationship between inflation and stock returns for the three countries.

Others like Ndunda (2016) have analyzed the effect of selected macroeconomic variables, inflation rate, money supply, exchange rate and GDP. Their studies show a significant relationship between market capitalization and inflation rate, GDP and money supply. Garcia and Liu (1999) in their study of macroeconomic determinants of stock market development using pooled data of 15 industrial and developing countries for the period 1980 to 1995 found that the real income rate, investment rate and financial intermediary development had a significant relationship with market capitalization while inflation rate did not have any important role in the growth of market capitalization. Maskay (2007) tested the two opposing theories between Keynesian economists and the theory of real activity and found that money supply increased stock prices. Christos and Alexandros (2006) investigated the impact of monetary policy on stock returns and found that a decrease in money supply led to a decrease in stock market value.

Bernanke and Kuttner (2005) used vector autoregression to analyze the effect of change in the US federal fund rates and found that the market reacted fairly strongly to surprise fund rate changes and that the market reacted little or did not react to changes in the federal reserve rate if this was anticipated by market participants. According to Osei (1998) differences in effective tax rates on incomes from different financial instruments can influence how investors make their financial and investment decisions. He argues that differences also determine whether an individual should invest in securities or whether a corporate body should raise funds through equity or debt instruments. Therefore, high tax rates may discourage investors from investing in financial instruments. Apart from the macroeconomic environment, an effective tax rate and the political environment, particularly political stability are also crucial for the development of emerging stock markets as these reduce the chances of unexpected wars and unrest that threaten investments and life and this guarantees safety nets for investments (Mbaru 2003) (the summary of literature review is given in Table 1).

Table 1: Summary of literature review

Author	Year	Data period	Sample size	Method	Findings
Ben Narceur	2010	1989-2005	52	GMM	A stock market leads to high profits for banks
Bernanke and Kuttner	2004	1989-2002	131	VAR model regression	Stock markets react to federal fund rates
Caporale et al.	2004	1977-1998	21	VARs model regression	An efficient stock market enhances growth
Claessens et al.	2001	1994-1999	156	OLS	Market cap is explained by low inflation and shareholder protection

Crotty	2009	1930-2008	US	Critical assessment	More regulations do not always mean better outcomes
Dermirgiic and Ross Levine	1996	1986-1993	44	OLS	Developing markets are characterized as having a low level of liquidity, high information asymmetry and thin trading
William and Glenn	2004	1990-1994	5	Critical assessment	The development of capital markets leads to economic growth by creating more jobs and generating higher wages
Ioannidis and Kontonikas	2008	1972-2002	13	OLS	Monetary policy shifts affect stock returns significantly
Graciela Laura Kaminsky	2003	1973-2003	28	OLS	Financial liberalization leads to more stable markets in the long run
La Porta et al.	2000		49	Critical assessment	Investor protection by law explains stock market development
James Laurenceson	2002	1991-1998	902	EMH testing	On a macro-level, listing of state owned enterprises had a negligible impact on the level of saving and capital allocation in China
Levine and Zervos	1998	1976-1993	44	CAPM Integration and APT Integration	The level of capital market development has statistically significant relationships with future values of output growth
Ross Levine	2011	1960-1995	71	OLS	Suitable regulations have a positive impact on stock market development
Paolo Mauro	2003	1989-1998	25	Autoregressive distributive lag regression	High market capitalization leads to output growth
Jenny Minier	2003	1976-1993	31	Regression tree techniques	Growth and financial development are positively correlated in countries with high levels of market capitalization
Meek et al.	1995	1989	226	OLS	Organizations gain some benefits by disclosing information
Maskay	2007	1959-2006	178	Two stage regression model	There is a positive relationship between changes in money supply and stock prices
Pardy and Mundial	1992	1984-2000	32	Critical assessment	There is a significant relationship between stock market development and financial depth

M.J. Roe	2006	1913-1945	14	Empirical analysis of data	The reason why some rich nations have strong capital markets while others have weak ones is because they have suitable institutional laws that protect outside shareholders
Li	2012	1975-2000	95	OLS and IV	Equity market liberalization leads to economic development
Mwangi and Mwititi	2014	2009-1913	20	The Pearson Product Moment	A positive and significant relationship exists between voluntary disclosures and stock returns
Geetha et al.	2011	2000-2009	10	Vector Error Correction Modelling	A long run relationship between inflation and stock returns for three countries
Ndunda	2014	2005-2014	62	OLS	Inflation, money supply, GDP have a significant relationship with market capitalization
Christos and Ianodis	2006	1972-2002	13	OLS	A decrease in money supply leads to a decrease in stock market value
Garcia and Liu	1999	1980-1998	15	OLS	The real income rate, investment rate and financial intermediary development have a significant relationship with market capitalization while the inflation rate has no important role in the growth of market capitalization

3. Overview of the Rwandan economy, monetary policy and capital market

3.1. Evolution of the Rwandan economy

The Rwandan gross domestic product reached Frw 6,618 billion in 2016 up from Frw 5,956 billion in 2015, and like many years since 2011 the services sector had a large share of contribution to the economic growth (47 per cent of total GDP). The agriculture sector contributed 31 per cent of the GDP while the industry sector contributed 17 per cent of the GDP. For a long time now, a large part of the Rwandan population has been engaged in agriculture which is mostly subsistence. This is also the reason why though this sector employs a large number of people, it contributes very little to economic growth in the country.

Before colonialization, the Rwandan economy was dominated by agriculture and cattle raising. Agriculture was subsistence and trade in goods and services was paid through a barter system. Other professions like arts and craft, hunting and iron work were also practiced. The introduction of money as a medium of exchange by the Germans and Belgians changed the Rwandan economy where the value given to cattle as a sign of wealth was

replaced by money. The Central Bank was founded in 1964, two years after independence and it was assigned the role of regulating and supervising the financial, monetary and payment systems in the country. The forming of the Central Bank led to significant economic growth till the end of 1980 when the prices of tea and coffee -- major exports of the country -- declined. The consequences of this poor economic performance combined with a high rate of population growth resulted in declining per capita GDP throughout the 1980s and 1990s.

In 1990 the liberation war started which was followed by the 1994 genocide against the Tutsi which destroyed the fragile economy. The proportion of the population below the poverty line increased from 53 per cent to 70 per cent between 1993 and 1997 and the country was destroyed in all political and socioeconomic aspects. To recover from this tragedy, the Government of Rwanda started several programs among which was the privatization of state owned enterprises. These programs combined with humanitarian aid resulted in the recovery of the economy where GDP grew at 9 per cent in 1995 and at 13 per cent in 1996; this trend continued during the emergency transitional period that ended in 2000.

After the end of this period, the Government of Rwanda embarked on a long run strategy known as Vision 2020, which aimed to transform the country into a knowledge-based, middle-income country by 2020. Rwanda also adopted the millennium development goals in 2000 and at the end of this program the country had achieved almost all the goals. To achieve Vision 2020, Rwanda undertook institutional reforms which saw the creation of the Ministry of Finance and Economic Planning (MINECOFIN) and the Rwanda Revenue Authority (RRA) in 1997. The office of the auditor general was established in 1998 to improve financial accountability. The Rwanda Development Board (RDB) was created in 2008 with the merger of several important government institutions such as the Office Rwandais du Tourisme et Parc Nationaux (ORTPN) and the Rwanda Investment and Export Promotion Agency (RIEPA) and it was given the mission to fast track the country's economic development. A mid-term strategy, the Economic Development and Poverty Reduction Strategy (EDPRS) was also developed. It was conducted in two phases which were divided into five years each. EDPRS 1 which ended in 2012 saw the GDP growth averaging at 8.2 per cent annually, which translated into GDP per capita growth of 5.1 per cent per year and significant poverty reduction. The second phase of EDPRS started in 2013 and had a target of 11.5 per cent annual GDP growth, 28 per cent increase in exports and less than 10 per cent (from 24 per cent) of Rwandan household to be in extreme poverty. Since 2000, Rwanda has been one of the fastest growing economies in Africa and in the world. From 2000 to 2016, its average annual GDP growth rate was 7.75 per cent.

3.2. Monetary Policy

Monetary policy in Rwanda is formulated and implemented by the Central Bank of Rwanda (BNR). Its evolution can be seen in three periods. In the first period (1964 to 1990) the Central Bank used the direct monetary instrument (one-to-one correspondence between the instrument and the policy objective). This period was characterized by direct monetary controls by BNR regulating the demand and supply of money, controlling exchange rates and directing credit to priority sectors for the government. Its main missions were

maintaining monetary stability, implementing credit and exchange rate policies conducive to harmonious economic development, issuing the national currency and playing the role of the government treasury. In 1981, BNR's role was expanded to include the formulation of the monetary policy, the credit and exchange policy to support the implementation of the government's economic policy and to protect the overall stability of the national currency. Left here

The second phase started in 1990 and ended in 1995. During this period BNR started financial liberalization. This was done after the realization that the direct monetary policy was inefficient especially in terms of optimal allocation of resources. BNR became fully liberalized in 1995 when direct measures were progressively replaced by indirect instruments such as open market operations, the discount window and the required reserve ratio. Since 1995, BNR is using a monetary targeting regime with broad money as the nominal anchor, reserve money as the operating target and price stability as the ultimate objective. It was after this move that BNR started removing all the foreign exchange, capital movement and credit controls and opened up the economy which consequently led to the emergence of commercial banks. In 2004 BNR reviewed its regulatory framework and increased the minimum capital requirements for banks from Frw 1.5 billion to Frw 5 billion.

At that time regional banks in Rwanda started opening their doors. BNR successfully carried out its core mandate of ensuring price stability helping Rwanda maintain the lowest levels of inflation in the region even during the most economically volatile times. BNR used monetary aggregates and currency reserves like repos and treasury bills to manage the money in circulation. In 2009, the bank introduced the key repo rate and also introduced interest rates as a monetary policy tool. Today, BNR's monetary policy committee announces whether it has increased or reduced the key repo rate every quarter and this has an impact on the behavior of the markets which impacts control of inflation.

In 2016, BNR maintained a prudent monetary policy in a context of high pressures on the Frw exchange rate due to the global economic crisis as well as high demand for the dollar which got accelerated by an increase in imports and the fact that agriculture performed poorly during the period. An increase in food prices and transport costs led to an increase in inflation from 4.5 per cent in January 2016 to 7.3 per cent in December 2016. The rising food prices stemmed from reduced food supply following poor performance in agricultural production. Broad money (M3) grew by 7.5 per cent in 2016 to Frw 1592.7 billion, lower than 21.1 per cent recorded in December 2015. The deceleration in money supply growth in 2016 was due to a reduction in the growth of net domestic assets to 1.7 per cent as compared to 57.3 per cent in 2015 despite an expansion of 15 per cent in foreign assets in 2016 after a contraction of 6.9 per cent in 2015.

The key repo rate was maintained at 6.5 per cent to ensure that the banking sector continued to finance economic activities while limiting inflationary pressures from the monetary sector. In line with economic activities, the total new authorized loans to the private sector increased by 6.3 per cent in 2016 compared to 13.7 per cent in 2015; total outstanding credit to the private sector expanded by 7.8 per cent in 2016; broad money increased by 7.5 per cent; and headline inflation increased from 4.5 per cent in January 2016 to 7.3 per cent in December

2016. It went up from an average of 2.5 per cent in 2015 to 5.7 per cent in 2016 mainly driven by rising food prices and transport costs.

3.3. The Capital market in Rwanda

Rwanda's capital market was established in 2011. Before its establishment, the Rwanda Capital Market Advisory Council was created in 2007 to develop the capital market in Rwanda, facilitate the trading of debt and equity securities, enable securities transactions and also to regulate the Rwanda Securities Exchange.⁴

CMA conducts its business under seven laws: the investment code law, law providing for incentives under the capital market, law governing the holding and circulation of securities, law governing the establishment and creation of trusts and trustees, law establishing the capital market, law regulating collective investment schemes and law regulating the capital market business in Rwanda. As stipulated in the special official gazette published on 28 May 2010, the capital market in Rwanda offered tax incentives including income tax exemption; capital gain tax where secondary market transactions in listed securities is exempt from the capital gains tax; corporate income tax which stipulates that newly listed companies in the capital market are taxed for a period of five years at 20 per cent if these companies sell at least 40 per cent of their shares to the public, at 25 per cent if these companies sell at least 30 per cent of their shares to the public and 28 per cent if these companies sell at least 20 per cent of their shares to the public. For Rwandans and the East African Community's residents withholding tax on dividends and interest income on securities listed on the capital market and interest arising from investments in listed bonds were reduced to 5 per cent.

The first IPO in Rwanda was in 2011 when the Government of Rwanda decided to sell its 30 per cent stake in Brasserie et Limonaderie du Rwanda (BRALIRWA) of which 25 per cent was sold to the public and 5 per cent was sold to Heineken International. The IPO was over-subscribed by 274 per cent in all investor pools. In the same year, the government decided to sell its 20 per cent stake in Bank of Kigali (BK) to the public and the bank simultaneously raised new capital which was equivalent to 25 per cent of the company's capital. In 2013 the government issued sovereign bonds worth US\$ 400 million. A strong vote of confidence for Rwanda's economy and the country led to a massive over-subscription of the sovereign bonds at 650 per cent. The bonds have a maturity of ten years at a fixed interest rate of 6.875 per cent. In the same year CMA assisted in the establishment of the Rwanda National Investment Trust (RNIT).

Being a big player in capital market development the government published its bond issuance program in February 2014 to come to the market every quarter. It is in that spirit that a 3-year treasury bond worth Frw 12.5 billion was issued in February 2014. This bond too was over-subscribed by 240 per cent signalling investor confidence in the outlook for Rwanda's currency and economy. The book building method was used to price the bond and the bond was priced at a fixed 11.475 per cent coupon rate with an average yield of 11.625 per cent. In May 2014, the International Finance Corporation (IFC) issued a 5-year bond

⁴See [https:// minecofin.gov.rw/capital markets](https://minecofin.gov.rw/capital%20markets)

worth Frw 15 billion. This bond nicknamed ‘Umuganda’ was the first placement by a non-resident issuer in Rwanda’s domestic capital market. The bond was the second corporate bond in the market after the one issued in 2008 -- BCR currently known as I&M Bank. It was issued following the IFC program which was established to support capital market development in the region. Orders were received from different public and private institutions including pension funds, insurance companies, banks and other financial institutions and it was over-subscribed 2.19 times. The bond was priced with a yield of 12.25 per cent per annum. In November 2014 after undergoing an internal International Organization of Securities Commission’s (IOSCO) review, CMA became an associate member of IOSCO.

The third IPO was by the Crystal Telecom Limited (CTL) holding company established by Crystal Ventures Limited (CVL) on 21 May 2015 where 270,177,320 shares were issued to the public. The shares had a face value of Frw 50 per share and were offered at Frw 105 per share. The offer was over-subscribed 124 per cent. In the same year the Government of Rwanda issued four bonds totalling Frw 55 billion with different maturities ranging between three and 10 years under the Treasury Bond Issuance Program. In 2016 the primary equity market did not record any new IPOs. However, the Government of Rwanda through the quarterly bond issuance program issued four bonds with a total face value of Frw 55 billion. The maturities of the bonds are three, five and 15 years, the latter being the longest in the market so far. Currently, 12 bonds are listed on RSE among which ten were issued by the Government of Rwanda and the remaining two are corporate bonds.

In February 2017, the Government of Rwanda through the Ministry of Finance and Economic Planning sold its 19.81 per cent shares in I&M Bank Rwanda Ltd. to the public through an IPO. This was done in line with the government’s program of disinvesting public enterprises. In this IPO, a total of 99,030,400 I&M Bank Rwanda Ltd.’s shares held by the government were sold to the public.⁵

Before the Rwanda Stock Exchange started its operations in 2011, transactions took place in the over-the-counter (OTC) market which was established by the Capital Market Advisory Council in January 2008. The OTC market was activated with the cross-listing of the Kenya Commercial Bank (KCB) on 18 June 2009 and two government bonds. A total of 91,600 shares were traded at an opening price of Frw 160 per share with the lowest price of Frw 140 and the highest price of Frw 182 per share. The traded shares yielded a turnover of Frw 15,129,100 in 66 transactions. The first bond (FXD1/2010/2yrs) worth Frw 2.5 billion at a fixed rate of 9.5 per cent was issued on 14 January 2010 with maturity in 2012. The second one (FXD2/2010/3yrs) worth Frw 2.5 billion was issued on 25 April 2010 and matured in 2013 at a fixed rate of 9.75 per cent. There was one government and one corporate outstanding bond. The government bond (FXD3/2008/3yr) worth Frw 5 billion matured in 2011 and Banque Commerciale du Rwanda’s (BCR) corporate bond worth Frw 1 billion matures in 2017.

RSE was officially launched on 31 January 2011. Since then trading operations are taken up on RSE which was demutualized from the start as it was registered as a limited company.

⁵See <https://www.cma.rw>

RSE is 60 per cent owned by brokers, 20 per cent by the Government of Rwanda and 20 per cent by other institutional shareholders. It conducts trading through a dual process -- an open outcry trading session is conducted on the trading floor during formal trading hours (9 am – 12 pm) and an OTC market where a member is allowed to buy or sell directly to clients in their offices. RSE's rules permit brokers or traders to transact either face to face or over the telephone after formal trading hours on normal working days after which all OTC transactions have to be reported to RSE not later than an hour after the transaction. OTC transactions are reported in the next formal trading session for settlement.

From July 2012 to June 2013, RSE recorded a total turnover of Frw 39.2 billion from 124.2 million shares traded in 1,873 deals compared to Frw 20.2 billion from 122.1 million shares traded in 1,983 deals registered in 2011-12. This represent an increase of 94 per cent in money terms and an increase of about 2 per cent in the number of shares traded. The market was driven by the activities on the counters of domestic companies which amounted to 99.9 per cent in the total turnover. At the end of June 2012, RSE's market capitalization was Frw 1,261 billion compared to Frw 846.8 billion as of 30 June 2011, translating into an increase of 49 per cent. This increase in market capitalization was a result of the increase in the prices of three stocks, BRALIRWA, BK and KCB.

In the financial year ended June 2014, the secondary market for equities recorded an increase of 9 per cent in the value of shares traded reaching Frw 42.6 billion, up from Frw 39.2 billion recorded in 2012-13. The number of shares traded in 2013-13 dropped by 32 per cent compared to the previous year as 84.9 million shares were traded as opposed to 124.2 million shares traded in the previous financial year; 1,652 transactions were registered in 2013-14 while the year before recorded 1,873 deals. By 30 June 2014, RSE's market capitalization stood at Frw 1,399 billion compared to a market capitalization of Frw 1,261 billion as of 30 June 2013. The increase of Frw 138 billion in market capitalization resulted from the cross-listing of Uchumi shares on RSE and changes in share prices of listed securities.

In the 12-month period ending June 2015, the secondary market for equities recorded an increase in the value of shares traded by 35 per cent reaching Frw 57.5 billion up from Frw 42.6 billion recorded in 2013-14. The number of shares traded in 2014-15 more than doubled to 187.4 million up from 84.9 million shares traded in the previous financial year. By 30 June 2015, RSE's market capitalization had increased from Frw 1,399 billion in June 2014 to Frw 2,893 billion or double the previous year. This is explained by the cross-listing of Equity Bank's shares on RSE. In 2014-15 in the secondary bonds market, bonds worth Frw 1.7 billion were transacted compared to a turnover of Frw 57 million registered in the previous year.

In the 12-month period ending June 2016, the secondary market for equities recorded a decrease of 41 per cent in the value of shares traded to Frw 16.43 billion down from Frw 57.49 billion recorded in 2014-15. The number of shares traded in 2015-16 was 88.2 million, down from 187.4 million shares traded in the previous financial year. By 30 June 2016, RSE's market capitalization had reduced to Frw 2,808 billion from Frw 2,893 billion in the same period in the previous year.

The secondary market forms an integral part of the capital market in Rwanda. Rwanda has one stock exchange that is recognized by the government. This exchange operates through a number of electronically linked counters at different locations thus making it a national trading system. It aims at helping small companies and start-ups to overcome the problems of raising capital through public issues at exorbitant costs. It also helps investors to overcome the problems of ill-liquidity, inaccessibility, delayed settlements and transfers that abound in traditional stock exchanges. Equity shares or 'ordinary shares' are the most traded instrument on the RSE. Like other central banks worldwide BNR exercises supervision and oversight of payment and settlement systems. Holding and transfer services were outsourced to the Central Depository and Settlement Corporation (CDSC), Kenya till the Rwanda Central Securities Depository (CSD) was established in 2011.

4. Data

This section presents the data used and the reasons why it was selected for our study. Quarterly time series data starting from the Q1-2011 to Q3-2016 was used which led to 23 observations. The data on market capitalization ratio was obtained from the RSE secretariat. Data on key repo, exchange rate, money supply and inflation was obtained from BNR's website and all other data was obtained from the website of the National Institute of Statistics of Rwanda (NISR).

We analyze two models: In the first the effect of macroeconomic variables on the capital market and in the second the effect of the capital market on economic growth were analyzed. For an analysis of the effect of macroeconomics variables on the capital market's performance we used the market capitalization ratio (MCR) which measures the stock market's size; this is the dependent variable in our study. It is calculated as the ratio of market capitalization (which measures the value of a stock market) of the stock market to the country's GDP. Its selection is motivated by data availability.

The macroeconomic variables include key repo (KR) which is the rate at which the commercial banks borrow from the Central Bank. This is the main monetary instrument used by the Central Bank of Rwanda in conducting monetary policy. The expected sign for this variable is positive given that an increase in the key repo rate leads commercial banks to increase their lending rates to the private sector. The private sector in turn prefers to raise capital through the capital market rather than using the banking system. The second macroeconomic variable used is money supply (MS) which is the amount of money in circulation in the economy at any point of time. We used the monetary base (M1) to price the bond. The expected sign for money supply is positive because an expansionary monetary policy is likely to stimulate the economy making it possible for firms to get credit for production expansion. This leads to an increase in sales and thus increased earnings for these firms. An increase in earnings means that the firms will give bigger dividends which in turn will have a positive impact on the capital market as more people will be willing to invest in them.

The third macroeconomic variable used is inflation (INFL). According to Mishikin (2007) this is a sustained increase in the general price level of goods and services in an economy

over a period of time resulting in a loss in the value of the currency. The expected sign for inflation is negative as high rates of inflation increase the cost of living and a shift of resources from investments to consumption. This leads to a fall in the demand for market instruments and subsequently to a reduction in the volume of stocks traded. This in turn negatively affects the stock market's performance. The last variable which is a conditioning variable is consumption (CSPN). The expected sign for this variable is positive as an increase in consumption raises production capacity utilization with positive effects on profits. This in turn has a positive effect on stock prices which increase the market capitalization of the stock market.

For an analysis of the effect of the capital market on the overall economy we used GDP as a measure of economic growth. The dependent variable is market capitalization (MC) which measures the stock market's size. The expected sign for this variable is positive because the stock market's good performance means that firms are able to raise money from the public which helps them expand their businesses and this has a positive impact on economic growth in the country. The second variable is consumption (CSPN) which represents the overall consumption of the population. The expected sign for this variable is positive. The contribution of consumption to economic growth is positive because as people consume more firms' revenues increase and this translates into overall economic growth in a country. The third and last variable is capital formation (CF) which is an increase in the combination of capital stock with labour to provide services and produce goods. The expected sign for this variable is positive because an increase in capital formation always leads to an increase in produced goods. This means more profits by companies that lead to economic growth.

Table 25. Correlations matrix of variables (N= 23)

	MC	KR	MS	INFL	CSPN	GDP	CF	CSPN
MCR	1							
KR	-0.1461	1						
MS	0.8351	-0.1425	1					
INFL	-0.4105	0.1847	-0.5508	1				
CSPN	0.4278	0.2360	0.6552	-0.5624	1			
GDP						1		
CF						0.9523	1	
CSPN						0.8672	0.8313	1

Source: Author's compilation.

Table 2 shows the correlation coefficients of all the variables. We produce the correlation matrix to assess the relationship between the variables. The coefficients show that market capitalization was highly correlated with money supply; the correlation coefficient between the two variables is 0.83. Inflation and consumption have a relatively small correlation with the market capitalization ratio; their correlation coefficients are -0.41 and 0.42 respectively. There is small or almost no correlation between the key repo rate and the market capitalization ratio; the correlation coefficient is only -0.14. The coefficient of correlation

between money supply and inflation is 0.55 while the coefficient of correlation between money supply and consumption is 0.56. The coefficient of correlation between key repo and money supply is 0.14. The correlation coefficient between key repo and inflation is 0.18, the correlation coefficient between key repo and consumption is 0.23. The correlation between inflation and consumption is 0.56.

For the second model, the coefficients show that all the independent variables are highly correlated with GDP. Market capitalization is highly correlated with GDP as the coefficient of correlation between the two variables is 0.86. Capital formation is also highly correlated with GDP as the coefficient of the correlation is 0.95 and this is also true of GDP and consumption where the coefficient of correlation is 0.85.

Table 26: Summary statistics of data (N=23)

	Mean	Std. Dev.	Maximum	Minimum
MCR	1.1336	0.4670	2.1200	0.2300
KR	6.7894	0.5000	7.5000	6.0000
MS	497.7504	135.0994	840.4325	345.0000
INFL	4.1263	2.2491	8.3000	0.2000
GDP	1,267.1300	218.8470	1,662.0000	877.0000
MC	1,650.4350	837.3657	2,928.0000	815.0000
CF	329.3913	68.9207	459.0000	200.0000
CSPN	1,100.3910	251.3261	1,411.0000	233.0000

Source: Author's compilation.

Table 3 shows the summary statistics of the dependent and independent variables. The market capitalization ratio has a mean of 1.13 with a standard deviation of 0.46. The highest value of the market capitalization ratio is 2.122 while its lowest value is 0.23. The mean of key repo is 6.7 with a standard deviation of 0.5. The highest value of the key repo rate is 7.5 while the lowest value is 6. The mean of money supply is 497.7 with a standard deviation of 135. The highest value of money supply is 840 while its lowest value is 345. The mean of inflation is 4.12 with a standard deviation of 2.2. The highest value of inflation is 8.3 and the lowest value is 0.2. The mean of consumption is 1,041 with a standard deviation of 236. The highest value of consumption is 1,288 while the lowest value is 233.

The average GDP is Frw 1,267 billion. The highest value of GDP is Frw 1,662 billion while its lowest value is Frw 877 million, all with a standard deviation of 218. The market capitalization average is Frw 1,650 billion; its highest value is of Frw 2,928 billion while its lowest value is Frw 815 million, all with a standard deviation of 837. The average capital formation is Frw 329 million; the highest value of capital formation is Frw 459 million while the lowest value is Frw 200 million. The standard deviation is 68. The average consumption is Frw 1,100 billion; the highest value of consumption is Frw 1,411 billion while the lowest value is Frw 233. The standard deviation is 251.

5. Methods

We investigated the relationship between the stock market's performance represented by the RSE market capitalization ratio with macroeconomic variables money supply, repo rate, inflation rate and consumption as the conditional variables.

Real activity theorists argue that an increase in money supply increases stock prices and vice versa and Keynesian economists argue that there is a negative relationship between stock prices and money supply (Sellin, 2001). Mishikin (2007) defines interest rate as the cost of borrowing or the price paid for the rental of funds. Any change in this variable results in a fluctuation in stock prices because it affects the profitability of businesses. Mishikin (2007) also defines inflation as a continual increase in the price level. High rates of inflation increase the cost of living and a shift of resources from investments to consumption. This leads to a fall in the demand for market instruments and subsequently to a reduction in the volume of stocks traded. An increase in consumption raises production capacity utilization with positive effects on profits and this has a positive effect on the stock prices of a given company. We now regress the following model to estimate the effect of macroeconomic variables on the market capitalization ratio:

$$(1) \text{MCR} = \beta_0 + \beta_1 \text{KR} + \beta_2 \text{INFL} + \beta_3 \text{MS} + \beta_4 \text{CSPN} + \varepsilon$$

We also investigated the relationship between economic growth in Rwanda and stock market performance. We used RSE's market capitalization, consumption and capital formation as independent variables. According to Seetanah et al. (2012), a well-developed stock market contributes to a country's economic growth by increasing the savings rate and investments. Consumption being a component of GDP it has an immediate effect on this as other things remaining constant an increase in consumption will raise the GDP by the same amount. An increase in capital formation of a nation leads to a nation's economic growth as this is caused by the growth in the production capacity and thus an increase in the goods and services produced and at the same time an increase in the national income level. Therefore, our model will be:

$$(2) \text{GDP} = \beta_0 + \beta_1 \text{MC} + \beta_2 \text{CF} + \beta_3 \text{CSPN} + \varepsilon$$

In order to get suitable model the data was transformed from linear into non-linear data which gives us the following model:

$$(3) \ln \text{GDP} = \beta_0 + \beta_1 \ln(\text{MC}) + \beta_2 \ln(\text{CF}) + \beta_3 \ln(\text{CSPN}) + \varepsilon$$

In order to fix the endogeneity problem between GDP and market capitalization we did the 2SLS where an instrument variable (IV) was selected. We selected the number of listed companies on RSE. This led us to a new model:

$$(4) \ln \text{MC} = \beta_0 + \beta_1 \ln(\text{CF}) + \beta_2 \ln(\text{CSPN}) + \beta_3 \ln(\text{LC}) + \varepsilon$$

After estimation of this new model the results were used to calculate the estimated market capitalization which is used in Equation 3 with the EMC being the estimated market capitalization. The model to be estimated is:

$$(5) \ln GDP = \beta_0 + \beta_1 \ln(EMC) + \beta_2 \ln(CF) + \beta_3 \ln(CSPN) + \varepsilon$$

Table 27: A comparison of the models

Model	R2	SSR	F stat
$MCR = \beta_0 + \beta_1 KR + \varepsilon$	0.044	4.55	0.97
$MCR = \beta_0 + \beta_1 MS + \varepsilon$	0.57	2	28
$MCR = \beta_0 + \beta_1 INFL + \varepsilon$	0.074	4.40	1.69
$MCR = \beta_0 + \beta_1 KR + \beta_2 INFL + \varepsilon$	0.10	4.25	1.18
$MCR = \beta_0 + \beta_1 MS + \beta_2 INFL + \varepsilon$	0.58	1.96	14
$MCR = \beta_0 + \beta_1 KR + \beta_3 MS + \varepsilon$	0.58	1.96	13
$MCR = \beta_0 + \beta_1 KR + \beta_2 INFL + \beta_3 MS + \beta_4 CSPN + \varepsilon$	0.61	1.81	7
$\ln GDP = \beta_0 + \beta_1 \ln(EMC) + \varepsilon$	0.90	0.069	189
$\ln GDP = \beta_0 + \beta_1 \ln(EMC) + \beta_2 \ln(CF) + \varepsilon$	0.95	0.03	204
$\ln GDP = \beta_0 + \beta_1 \ln(EMC) + \beta_2 \ln(CF) + \beta_3 \ln(CSPN) + \varepsilon$	0.95	0.032	129

Source: Author's compilation.

Based on the results in Table 4, the model that contains all the four macroeconomic variables was preferred for analyzing the effect of macroeconomic variables on market capitalization. This was selected because it had the highest coefficient of determination (R^2) (equal to 0.61) and a low sum of square residuals of 1.81 compared to other models. For an analysis of the effect of market capitalization on economic growth we selected the last model for the same reason of high R^2 of 0.95 and low sum of square residuals.

6. Empirical results and interpretation

We estimated two models in our study. In the first model we analyzed the effect of macroeconomic variables on market capitalization. The data was regressed using E-views 8 by running the GLM estimation. We used this method to overcome the problem of multicollinearity. But before that we tested the heteroscedasticity using Breusch-Pagan-Godfrey, autocorrelation and normality to make sure that the estimates were BLUE. While testing for heteroscedasticity we used the F-test rule which states that when the numerical value of the computed f-statistic exceeds absolute 3 then the test is statistically significant and when the value of f-statistic is less than 3 then the test is statistically insignificant. In other words this means that at a 5 per cent level of significance we will reject the null hypothesis that there is no heteroscedasticity when the f-statistic exceeds absolute 3 and we will fail to reject the null hypothesis when f-statistic is less than 3. In our case as the f-statistic is 1.222474 which is less than 3; this implies that we failed to reject the null hypothesis. We thus conclude that there is no heteroscedasticity. Also using the p-values we

find that at the 5 per cent level of significance we failed to reject the null hypothesis as the p-value is 0.3454 which is higher than 0.05. We, therefore, conclude that there is no heteroscedasticity.

The f-test for autocorrelation shows that the f-statistic is 0.762238 which is less than 3. This leads us to conclude that at the 5 per cent level of significance we failed to reject the null hypothesis. We hence conclude that there is no autocorrelation. Also, the p-value of 0.6947 is greater than 0.05 which leads us to conclude that there is no autocorrelation. To get R² which is the goodness of fit, a statistical measure of how close the data is to the fitted regression line was done. Given that we used the generalized linear model (GLM) to estimate our model we had to calculate it using the results of the estimation which led us to a value of 0.95. This means that our data was close to the fitted regression line. Further, the LR statistic was less than 0.05 which led us to believe that the model was significant.

In the second model, the results in the correlation matrix showed that there was high multicollinearity as the coefficient of correlation was higher than 0.70. Here again we estimated this model using GLM. To solve the problem of endogeneity before applying GLM we applied the 2SLS (two stage least square) where the number of listed companies on RSE was selected as the IV (instrument variable). The results of the two models' estimations are presented in Table 5.

Table 28: Parameter estimates with standard errors (N=23)

		Model 1		Model 2	
Variable	Variable definition	coefficient	Std error	coefficient	Std error
C	Constant	-0.1550 ^a	1.1285	3.3767	0.2841
KR	key repo	0.0892 ^a	0.1695		
INFL	Inflation	-0.0361 ^a	0.0361		
MS	Money supply	0.0029 ^a	0.0007		
CSPN	Consumption	-0.0006 ^a	0.0005	0.0048 ^a	0.04072
CF	capital formation			0.4086 ^a	0.1177
MC	Market capitalization			0.1876 ^a	0.0447
R ² adjusted		0.95		0.96	

Source: Author's calculations.

Note: Significant at the 5 per cent level of significance.

6.1. Determinants of market capitalization

Column 3 in Table 5 shows the estimation results of the first model in which we regressed market capitalization on the macroeconomic variables (money supply, inflation, key repo rate) with consumption as the conditional variable. The p-value test shows that within the four variables only money supply was statistically significant. The results also show that an increase in money supply by one franc increased the market capitalization rate by 0.0029. This approves the real activity economists' theory that an increase in money supply means that money demand is increasing in anticipation of economic activity. This further implies

higher expected profitability which causes stock prices to rise and thus results in an increase in the market capitalization ratio of a stock market. It is also in accordance with Ndunda (2016) who analyzed the effect of selected macroeconomic variables, inflation rate, money supply, exchange rate and GDP. Ndunda's study shows a significant relationship between market capitalization and inflation rate, GDP and money supply. The only difference is that in our study we did not find any other variables to be significant.

In our study all the other variables were not statistically significant. Though not statistically significant key repo was positively related to the market capitalization ratio where an increase in key repo by one unit led to an increase in market capitalization by 0.089. This is in accordance with Bernanke and Kuttner (2005) who analyzed the effects of unanticipated changes in the federal fund rates on equity and found that stock markets reacted mostly to unannounced changes in federal fund rates.

Inflation rate had a negative relationship with the market capitalization ratio where an increase in inflation by one unit decreased the market capitalization rate by 0.036. This is in accordance with Geetha's (2016) study which shows that there was a long-run relationship between inflation rate and stock prices. It is also in accordance with Ndunda (2016) though there is no significance. For all the authors an increase in inflation led to a decline in stock market prices. Finally, if consumption increased by one unit this decreased market capitalization by 0.0006. This is in accordance with our theory which states that an increase in consumption raises production capacity utilization with positive effects on profits and this will have a positive effect on the stock prices of a given company. Based on this information we regressed the model to estimate the effect of macroeconomic variables on the market capitalization ratio.

6.2. Determinants of economic growth

Column 4 in Table 5 shows the estimation of the second model in which we regressed the GDP growth ratio on market capitalization, capital formation and consumption. The p-value test shows that capital formation had a positive and significant relationship with GDP, where an increase in capital formation by one unit led to an increase in GDP by 0.40 and an increase in market capitalization by one unit led to an increase in GDP by 0.18. The significance of capital formation is supported by Shuaib and Ndidi (2015) whose study found a significant relationship between capital formation and economic development in Nigeria. The significance of capital formation is also supported by Bakare (2011) and Ainabor et al., (2014) who show that capital formation has a direct relationship with economic growth. The results corroborated the Harrod-Domar model which proved that the growth rate of the national income is directly related to the saving ratio and/or capital formation which means that the more an economy is able to save and invest out, the greater will be the growth of that economy. Our results also show that market capitalization has a positive relationship with economic growth where an increase in market capitalization by one unit increases GDP by 0.18. This is in accordance with Levine and Zervos (1998); Narceur (2010) and Pardy and Mundial (1992) who say that the economic development of a country depends on the robustness of its stock markets as they act as a source of finance for businesses and by the

fact that apart from providing a means of diversifying risks for both capital raisers and investors they can also play a role in capital allocation and corporate monitoring. They can also be a means for governments to exercise market based rather than direct fiscal and monetary policies. Capital markets are also expected to accelerate economic growth by providing a boost to domestic savings and increasing the quantity and quality of investments; they also provide individuals with additional financial instruments that may better meet their risk preferences and liquidity needs. We found the relationship between consumption and economic growth to be positive though not statistically significant. An increase in consumption by one unit led to an increase in economic growth by 0.0048.

7. Usefulness of the results and policy recommendations

Vision 2020's main goal is transforming Rwanda into a middle-income country with a knowledge-based economy for which the country has set a target of 11.5 per cent annual GDP growth; the private sector is expected to be the backbone of the economy. In order to spur the economy, the Central Bank has been using the accommodative monetary policy, where it kept the key repo rate at 6.5 per cent. By doing so, the Central Bank intended to support the private sector and it was hoped that the commercial banks will decrease their lending rates and thus help the private sector to acquire loans from banks at low costs. However, the commercial banks did not react as expected as the lending interest rate is between 16-18 per cent which is still high compared to other countries in the region.

This shows that the banking sector in Rwanda is not influenced by the Central Bank's monetary instruments and this is hurting the private sector as its access to capital from commercial banks which is the main source of capital in Rwanda is very expensive and this is also hurting Rwandan economic growth. Considering that the global economy is facing a financial crisis and that it is not easy to get debt especially for a developing country like Rwanda which is undertaking risky and long gestation projects and having realized that the stock market is responsive to changes in money supply which can be influenced by the Central Bank, it is recommended that the Central Bank should consider a monetary policy that targets the capital market as an alternative way if the country is to achieve its vision. But before that based on the theory of market efficiency we would suggest that a study to investigate whether the RSE is efficient be done to educate policymakers so that they can start formulating policies that promote the use of the stock market as a source of capital. This is also supported by our second model where market capitalization shows a positive and significant relationship with GDP which means that developing the stock market will spur economic growth in the country.

Based on the Harrod-Domar model which proved that the growth rate of national income was directly related to the saving ratio and/or capital formation we would recommend that initiatives like ITERAMBERE funds which encourage the population to save be given more priority as this will contribute to achieving the country's savings targets that will help it to achieve Vision 2020. All the actions undertaken will not mean anything if the Rwanda stock market is not active and attractive enough for investors to be willing to join it. It is in this backdrop that we recommend that much effort be put into educating the public about the

stock market. This will increase the number of new investors and increase the activities on the stock market which will make it more attractive for regional and international investors.

RSE and CMA officials should start if they have not done so yet to educate corporate organizations about raising capital using the stock market. This too will increase the number of products available on the stock market which will make it more attractive for new investors. All of this will lead to better stock market performance and economic growth. It will also facilitate companies to get capital at lower prices, which will lead to increased investments and economic growth. The government should continue to contribute to the development of the capital market by issuing shares from private companies in which it is a shareholder to increase the number of products available on the stock market as this has a positive impact on the performance of the stock market. Quarterly issues of bonds should also be maintained to develop the stock market and at the same time to contribute to economic growth.

8. Summary, conclusion and suggestions for future data and research

The main objective of this study was to analyze the effect of the macroeconomic variables on the development of the Rwanda Stock Exchange with the specific objective of analyzing RSE's evolution and the impact of its development on general economic growth in Rwanda. This was done with the aim of formulating suitable policy recommendations that will contribute to RSE's development. We collected quarterly time series data from January 2011 up to the third quarter of December 2016 which was analyzed using E-views by doing GLM estimation for the first model. Here we studied the effect of macroeconomic variables on market capitalization using consumption as the conditioning variable. For the second model we studied the effect of market capitalization on GDP using capital formation and consumption as the conditioning variable. To solve the problem of endogeneity we used the 2SLS where the number of listed companies was used as the instrument variable.

We tested two hypotheses against the obtained results and were able to answer the research questions. In our first model our results showed that among the four macroeconomic variables which were regressed on the market capitalization ratio only money supply had a statistically significant relationship with market capitalization where we found that an increase in money supply by one Frw led to an increase in market capitalization ratio by 0.003. The other variables (key repo rate, inflation rate and consumption) showed no statistical relationship with the stock market's performance. In the second model market capitalization showed a positive and statistically significant relationship with economic growth where an increase in market capitalization by one unit increased economic growth by 0.18.

Capital formation also showed a positive and statistically significant relationship with economic growth where an increase in capital formation by one unit led to an increase in GDP by 0.40. Based on these results we tested the hypothesis at the 5 per cent level of significance and rejected the null hypothesis that money supply has no statistically significant relationship with RSE's performance and concluded that money supply influenced RSE's performance. At the 5 per cent level of significance we failed to reject the

null hypothesis that inflation rate, key repo rate and consumption had no statistically significant relationship with RSE's performance. We concluded that the three variables did not have any significant influence on RSE's performance. At the 5 per cent level of significance we rejected the null hypothesis that RSE does not contribute to the country's economic development and concluded that RSE's performance had an impact on economic growth in Rwanda. We set out with three questions: What are the macroeconomic variables that affect RSE's performance? Does RSE's performance contribute to economic growth? If yes what is its contribution to this growth? To answer to the first question is that among the four selected macroeconomic variables, money supply was the only one that affected RSE's performance. To the second question, the answer is yes, RSE's performance contributed to economic growth in the country and an increase in market capitalization by one unit increased GDP by 0.18.

Given the significance of RSE's performance on economic growth and given that Rwanda already has a well-established institutional and legal framework and that the country is experiencing a long period of peace and political stability we suggest that more effort be put to strengthen RSE by increasing awareness and educating Rwandans about it. Regional integration with other stock markets will also be useful as it will open RSE to new participants and this will boost its performance and have a positive impact on economic growth. Given the fact that money supply has an impact on RSE's performance, the Central Bank should use this instrument to influence this sector which may play an alternative role as a source of capital for investments and as a way of saving. The government should also continue developing the capital market by issuing shares from private companies in which it is a shareholder to increase the number of products available on the stock market.

Given that the stock market in Rwanda is still new we encountered the problem of finding little information. Time and financial means were also a constraint and we did not manage to go to the field to collect data from stakeholders. Hence, for future research we recommend that primary data from market players be collected to analyze qualitative data to see if the well-established institutional and legal frameworks are contributing to RSE's effective development. Based on the theory of market efficiency we suggest that a study investigating whether RSE is efficient be done to inform policymakers so that they can start formulating policies that will promote the use of the stock market as a source of capital for investors. We suggest that a study be done on the impact of the regional integration of Rwanda on RSE's performance.

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Appendix A

Data used to estimate the effect of macroeconomic variables on the market capitalization ratio

Period	MCR	KR	CSPN	inflation	MS
Q1:2011	0.23	6	905	4.1	345.0
Q2:2011	1.04	6	233	5.8	361.6
Q3:2011	1.02	6	868	6.6	357.6
Q4:2011	0.94	7	946	8.3	373.7
Q1:2012	0.80	7	950	8.2	426.1
Q2:2012	0.83	7.5	932	5.9	424.4
Q3:2012	0.89	7.5	1010	5.6	407.5
Q4:2012	0.92	7.5	1106	3.9	422.6
Q1:2013	1.03	7.5	1054	3.2	451.3
Q2:2013	1.11	7	1007	3.7	500.4
Q3:2013	1.06	7	1051	5.1	476.8
Q4:2013	1.11	7	1108	3.6	486.0
Q1:2014	1.15	7	1215	3.4	495.4
Q2:2014	1.13	6.5	1164	1.4	564.5
Q3:2014	1.08	6.5	1193	0.2	548.3
Q4:2014	0.96	6.5	1276	2.1	569.6
Q1:2015	2.12	6.5	1238	0.8	598.1
Q2:2015	2.05	6.5	1240	2.8	751.1
Q3:2015	1.92	6.5	1288	3.7	700.9
Q4:2015	1.04	6.5	1395	4.5	757.2
Q1:2016	1.82	6.5	1381	4.6	760.7
Q2:2016	1.81	6.5	1338	5.5	780.8
Q3:2016	1.66	6.5	1411	5.8	882.0

Source: National Bank of Rwanda; the Rwanda Stock Exchange.

Data used to estimate the effect of market capitalization on economic growth

Period	GDP	CF	MC	CSPN
Q1:2011	877	233	821	905
Q2:2011	918	200	815	233
Q3:2011	1018	227	940	868
Q4:2011	1039	245	960	946
Q1:2012	1019	273	829	950
Q2:2012	1059	250	846	932
Q3:2012	1166	294	946	1010
Q4:2012	1193	331	1069	1106
Q1:2013	1138	322	1234	1054
Q2:2013	1185	307	1260	1007
Q3:2013	1233	318	1261	1051
Q4:2013	1308	344	1372	1108
Q1:2014	1282	341	1449	1215
Q2:2014	1314	343	1445	1164
Q3:2014	1395	339	1417	1193
Q4:2014	1394	383	1339	1276
Q1:2015	1378	373	2928	1238
Q2:2015	1414	369	2892	1240
Q3:2015	1520	371	2925	1288
Q4:2015	1541	426	2820	1395
Q1:2016	1542	459	2817	1381
Q2:2016	1549	402	2802	1338
Q3:2016	1662	426	2773	1411

Source: The Rwanda Stock Exchange; National Institute of Statistics.

Listed companies on the Rwanda Stock Exchange

Companies	Origin
BRALIRWA (BLR)	Rwanda
Bank of Kigali (BoK)	Rwanda
Crystal Telecom (CTL)	Rwanda
I&M Bank (IMR)	Rwanda
Kenya Commercial Bank (KCB)	Kenya (Cross listed)
Uchumi Supermarket Ltd(USL)	Kenya (Cross listed)
Equity Bank	Kenya (Cross listed)
National Media Group (NMG)	Kenya (Cross listed)

Source: The Rwanda Stock Exchange.

Ownership of Rwanda Stock Exchange

Institution	Share
Government of Rwanda	20%
CDH Capital Ltd	10%
Baraka Capital Ltd	10%
Dyer and Blair Rwanda	10%
Faida Security	10%
MBEA Brokerage and financial services Rwanda	10%
African Alliance Rwanda	10%
SONARWA	1%
Development Bank of Rwanda (BRD)	8%
SORAS	1%
Rwanda Social Security Board	10%

Source: The Rwanda Stock Exchange.

Bonds listed on the Rwanda Stock Exchange

Code of the bond	Issuer	Maturity Year	Face Value (Frw)	Coupon rate
RW000A19BPS5	Government of Rwanda	2019	10 billion	12% fixed
RW0001ZX0A8	Government of Rwanda	2018	15 billion	11.55% fixed
RW0001ZTAM0	Government of Rwanda	20121	15 billion	12.47% fixed
RW000A19D0U5	Government of Rwanda	2022	10 billion	12.375% fixed
RW0001Z2RJ7	Government of Rwanda	2025	10 billion	12.925% fixed
RW0001Z5Z93	Government of Rwanda	2020	15 billion	11.950% fixed
RW00018VK03	Government of Rwanda	2018	15 billion	11.80% fixed
RW000187KN1	Government of Rwanda	2021	15 billion	12.00% fixed
RW000182K48	Government of Rwanda	2021	10 billion	13.50% fixed
RW000A185V91	Government of Rwanda	2021	15 billion	12.25%
RW0001GQRL2	I&M Bank	2018	1 billion	10.50%
RW0001ZJZU1	IFC	2019	15 billion	12.25%

Source: The Rwanda Stock Exchange.

Heteroscedasticity test: Breusch- Pagan- Godfrey results

F-statistic	1.222474	Prob. F (4,14)	0.3454
Obs*R-squared	4.918398	Prob. Chi-Square (4)	0.2958
Scaled explained SS	6.334830	Prob. Chi-Square (4)	0.1755

Source: Author's calculations.

Autocorrelation test: Breusch-Godfrey correlation LM test results

F-statistic	0.762238	Prob. F (12,2)	0.6947
Obs*R-squared	15.59097	Prob. Chi-Square (12)	0.2107

Source: Author's calculations.

Chapter Sixteen

The Determinants of Investment Decisions in the Rwanda Stock Exchange

Jonas Barayandema¹, Idrissa Ndizeye²

¹Corresponding author

Department of Management, College of Business and Economics
University of Rwanda, E-mail: jbarayandema@ur.ac.rw

²Department of Management, College of Business and Economics
University of Rwanda, E-mail: indizeye@ur.ac.rw

Abstract

Stock markets play an important role in providing investment opportunities as they offer investors a means to maximize wealth for an acceptable level of risk. The Rwanda Stock Exchange (RSE) has been operational since 2008 but it is still under-developed and so it is not attractive enough for many potential investors whose investment decisions are subject to certain factors that have to be identified and understood so that they can be given special consideration by RSE's authorities for the sake of better development. The aim of this study is to explore which economic, psychological, social and demographic factors determine investment decisions in RSE the most. The study adopts an explanatory design combined with a survey design. A sample of 187 respondents was selected from a population of 350 active investors operating in RSE. Data was collected using various techniques including a structured questionnaire for investors, semi-directed interviews with brokers and a documentary review. The collected data was analyzed using SPSS and a factor analysis. The research findings show that economic factors were the most influential with an average mean of 4.05, followed by psychological factors with an average mean of 3.96 and then social factors with an average mean of 3.64 whereas demographic factors were ranked last with an average mean of 3.08. The five most influential factors were two economic factors (expected corporate earnings and ownership structure) and three psychological factors (irrational thinking, get-rich-quick and cognitive bias). The five least influential factors were four demographic ones (income, education, age and gender) and one psychological factor (over-reaction). It is, therefore, recommended that RSE's authorities should reshape the stock exchange by focusing attention on the identified influential determinants of investment decisions with more emphasis on economic and psychological factors and less emphasis on social and demographic ones.

Key words: Stock exchange, stock price, capital market, Investment decision, determinants of investment decisions.

1. Introduction

With eight listed companies including four local companies (Bralirwa, Bank of Kigali, Crystal Telecom, and I&M Bank) and four cross-listed companies (the Nation Media Group, Equity Bank, the Kenya Commercial Bank and *Uchumi* Supermarket Limited) the Rwanda Stock Exchange (RSE) has been operational since 2011. Since the initial public offers (IPOs) of these companies their stock prices have been fluctuating. While stocks were over-subscribed at the time of the IPOs and the capital market experienced a tremendous growth from 2011 to 2013, subsequent years were characterized by a downward trend.

Bralirwa's shares were issued at RWF 136 which increased up to RWF 880 in 2013. After it granted share bonuses in 2014, its share price declined to RWF 440 and currently its shares are selling at RWF140. Bank of Kigali's (BK) share price has also been fluctuating since 2011 but not as much as Bralirwa's. BK's shares were issued at RWF125 and increased up to RWF 300 in 2015 and are currently selling at RWF 240. The stock prices have decreased because the number of sellers is larger than the number of buyers. In RSE, the total number of transactions amounted to 1,720 in 2011 but declined to 1,565 in 2014 and then to 998 in 2016.

Considering the value of traded securities, the capital market's operations experienced tremendous growth as their value increased by 141 per cent from 2011 to 2013; but afterwards the market experienced a downward movement as the value decreased on average by 45 per cent per year. According to statistics, the Rwanda stock market dropped by 69.6 per cent in the first six months of 2016 compared to the same period in 2015 (RSE Annual Statistics, 2011-16).

As stocks are traded in the capital market and are subject to the laws of supply and demand and the number of investors is still small, stock prices have been decreasing since 2013. Although RSE along with the Rwanda Capital Market Authority (CMA) undertook a public education and awareness program to sensitize the public on the opportunities and risks involved in capital market investments, RSE's challenge still is attracting investors and promoting the use of capital markets. The level of awareness among the general public is still low and stock market investments are not yet a deeply entrenched culture in Rwanda. Investments and trading in shares are still seen more as speculative ventures or the preserve of sophisticated investors, rather than as long-term investments and savings in financial assets (CMA, 2011, 2016). Given that potential investors are reluctant to invest in RSE, researching to find out the determinants of investment decisions in RSE becomes important.

Factors affecting investment decisions in stock exchanges have been subject to extensive studies. While some scholars (Ariful et al., 2015; Khan et al., 2015; Khaneman and Tverbsky, 1986; Malkiel, 2003) explain investment decisions by considering economic aspects, others (Awais et al., 2016; Hoang and Nguyen, 2014; Larrick and Bores, 1995; Talal et al., 2016; Yates, 1990) have carried out analyses taking into account socio-demographic or psychological factors in line with the behavioral finance theory. However, the novelty of our study is that it considers that investment decisions are a result not only of economic factors, but also psychological, social and demographic ones.

The first category of academic studies analyses investment decisions and maintains that investors are rational and utility maximizing. They hold stocks because they are willing to hedge against the inflationary erosion of purchasing power, and more importantly, because they expect long-term substantial capital growth and dividend yields. In this regard investments in the capital market can be undertaken by an investor for three basic objectives: wealth maximization; maintaining liquidity; and risk minimization. This implies that a rational investor is influenced by these objectives when making investment decisions (Reilly and Brown, 2011; Teweles and Bradley, 1998).

The second category of scholars argues that investment decisions are subject to irrational behavior. They contend that although much of economic and financial theory is based on the notion that individuals act rationally and consider all available information in the decision-making process, there is a surprisingly large amount of evidence which shows that this is not the case in many instances. Their findings reveal that there are biases in decision-making. These biases have implications on whether to invest in stock market related products, the extent of such investments and the nature of the investments. The biases could cause investors to take poor decisions or financial advisers to give poor advice (Bernstein, 1998; Elvin, 2004; Redhead, 2008).

If one considers existing research findings, the analyses so far have focused either on how economic or psychological factors affect investment decisions in stock exchanges in general. Little attention has been paid to the extent to which common economic, psychological, social and demographic factors influence investors to invest or disinvest in capital markets. Therefore, the contribution of our study is that it explores those factors among common economic, psychological, social and demographic factors which determine investment decisions in RSE the most. It has the following objectives:

- Identifying the determinants of investment decisions in the Rwanda stock market considering their classifications into common economic, psychological, social and demographic factors.
- Examining the extent to which the identified factors affect investments decision in the Rwanda stock market.
- Finding out the most influential determinants with regard to investment decisions in RSE.

2. Literature review

Investment decisions are considered one of the major aspects of finance. However, for an investment decision to be made, the determinants play different influential roles. Various guiding theories have been formulated with regard to investment decisions in the area of finance. It is important to indicate some of the theories relevant to our study here. According to Kam (1990) theories, hypotheses and models can be viewed as synonyms in the role that they play in explaining and predicting what happens in reality. Deemed relevant to our study are: one, a traditional finance theory known as the Efficient Market Hypothesis (EMH), and

two behavioral finance theories including prospective theory, regret theory and the anchoring and over-and under-reaction phenomena.

EMH which is based primarily on Fama's (1970) work and findings has influenced traditional finance. It is based on the belief that securities' markets are extremely efficient in reflecting information about individual stocks, about the stock market as a whole and has the view that when information arises, news spreads very quickly and is incorporated in the prices of securities without delay (Malkiel, 2003). This implies that investors carefully consider all the available information before making investment decisions. In our research we use this to check whether investors take into consideration all the available information when taking investment decisions.

The prospective theory, initiated by Khaneman and Tverbsky (1986) holds that when confronted with a situation of a gain or a loss, investors tend to take more risks to avoid losses than they take to realize gains. This theory helps our study to assess how investors in RSE are risk-averse.

The regret theory is concerned with how people react emotionally after they have made judgment errors (Larrick and Bores, 1995). They may choose to imitate a majority move to reduce or avoid possible regret caused by incorrect investment decisions. Our study relies on this theory to check if investors in RSE followed the crowd when taking investment decisions.

The anchoring and market over- or under-reaction are other major aspects of behavioral finance theories which are considered to have an effect on investment decisions. They are based on the assumption that in the event of absence of better information, investors are tempted to value recent experiences more than they should (Yates, 1990). Elsewhere, the market over- or under-reaction phenomenon is discussed by DeBondt and Thaler (1985). They maintain that investors tend to be overconfident or optimistic in the event that the market goes up and pessimistic when the market goes otherwise. These theories are used in our study to verify how investors in RSE behaved towards current prices and changes in the market. In addition to the use of these theories, there is also a need to review previous studies conducted in the same area and identify existing research gaps and hence justify the relevance of our study.

Mohammad (2014) did a review to determine the various factors influencing individual investor behavior as explored by several researchers in different countries. His study identified 31 factors including 18 common factors and 13 uncommon ones. Among the common factors, seven were classified as economic, five as psychological, four as demographic and two as social. The uncommon factors were unclassified. Other scholars including Reina (2014), Kishori and Dinesh (2016), Akhter and Ahmed (2013) and Ariful et al., (2015) carried out empirical studies on different stock markets and identified factors that may affect investment decisions. But as their studies are reviews, they do not show the statistical measures to determine the significance of the factors identified. Our study addresses this aspect by considering the classification of common factors.

Ariful et al., (2015) carried out a study of 125 investors selected from an undetermined population to explore the factors that investors in capital markets critically considered while

taking investment decisions in Bangladesh. Their study revealed 25 factors classified into seven categories: internal and economic, internal and supporting, internal and regulatory, company image, market information, external and market situation. Through a factor analysis, the study provides a statistical measure of the relevance of the factors under consideration. The study, however, does not indicate which factors were common. Our study adopts a different classification of common factors.

Aisha et al., (2015) who conducted a study to investigate the impact of behavioral factors, considered psychological factors on investment decision making. They selected a sample of 100, including equity fund managers and individuals who invested in banks insurance companies and in stock markets in Pakistan from an undefined population. The study focuses on four behavioral factors -- heuristics, risk aversion, use of financial tools and firm-level corporate governance. The correlational analysis helps reveal a positive and significant impact for the first two factors whereas the last one proves to have a negative and significant impact on investment decision-making. These findings agree with Qureshi and Hunjra (2012) findings who conducted a similar study. Their study not only failed to define the population but also considered only a limited category of factors. In comparison, based on a determined population our study focuses on the stock exchange and considers a broader range of factors.

Rahnuma and Sultan (2013) conducted a study of 225 selected individual investors to develop a framework about the behavioral aspects of individual investors for investments in the stock market in Bangladesh. They identified various factors classified into five categories -- a firm's image, accounting information, reliability, expert advice and investor action against specific issues. However, while their study was limited to behavioral aspects and considered individual investors, our study has a wider scope and considers all investors in RSE without distinction.

Vijaya (2014) conducted a survey of 200 individual retail investors residing in the twin cities of Hyderabad and Secunderabad in India to identify the factors influencing retail investors' behavior in the Indian stock market. The behavioral factors identified were classified into heuristic, prospect, herding and market factors. Heuristic and prospect factors have also been identified by Sayed and Sara (2011). While their study ignores economic, social and demographic aspects and limits itself to retail investors, our study also takes these aspects into consideration and while considering all investors without discrimination.

Talal et al., (2016) conducted a study to explore the behavioral factors influencing individual investors' stock investment decisions in the Saudi stock market by using a sample of 140 individual investors selected randomly from an unspecified population. Their results indicate that behavioral finance factors (loss averse, overconfidence and risk perception) had a significant effect on stock market decisions of individual investors, while 'herd' had an insignificant effect. Demographic variables (gender, age, education, income and experience) did not make any significant difference to investor decisions, except education that made a significant difference to investor decisions. This study ignores economic and social factors. Our study which is based on a specific population and a larger sample considers these factors in addition to psychological and demographic ones. Further, while Talal et al.'s (2016) study considers individual investors our study considers all investors without discrimination.

To find out the discrepancies among classified groups of investors in the Vietnam stock market, Hoang and Nguyen (2014) conducted a study considering such demographical factors as gender, age, education, investment experience, income and marital status. They selected a sample of 205 out of an unspecified population and used the Chi-square test for an analysis. Their results revealed that males were more willing to take investment risks; elderly investors were less inclined to take investment risks as compared to young investors; more five-year-or-more investors took higher risks than the others; and there were no differences with regard to risk for investors with different income levels while single investors tended to take higher risks than married investors. Whereas this study is limited to demographic factors and fails to give a clear methodology, our study also considers other categories of factors in addition to demographic factors and gives a clear methodology.

Omo and Mbadiugha (2012) conducted a study on a sample of 2,000 investors to investigate the factors influencing shares of quoted companies in Nigeria. The 20 factors investigated were classified into economic, cultural, social and psychological ones. Their findings revealed that the five most influential factors were two psychological factors (motivation by people and future financial security); two social factors (recommendations by reputed and trusted stock brokers and the management team of the company); and one cultural factor (awareness of the prospects of investing in shares). The five least influential factors were three psychological factors (insights into setbacks in the future); fear of anticipated career problems and motivations of financial security; and two cultural factors (friend's advice and a culture of a shared investment). While this study ignores the demographic factors, our study also considers this aspect.

A study of 168 respondents was conducted by Gunathilaka (2014) to identify the factors influencing equity selection decisions in the Colombo Stock Exchange. The results revealed 19 factors of which the five most influential ones were market awareness, company stability, performance, riskiness and economic impact while the five least influential factors were advice of colleagues, big-quick profit, social status, religious beliefs and trading experience. While Gunathilaka's (2014) study identifies the influential factors it fails to classify them. Our study on the other hand explores factors influencing investment decisions considering their classification into economic, psychological, social and demographic factors.

A sample of 270 investors was used by Khan et al., (2015) who conducted a study to investigate the factors that influenced share investment decisions in Khulna city in Bangladesh. It identified 13 factors classified into market, hedging and economic factors. The most influential factors included industry attractiveness, share price, financial indicators, historical data, expected dividends, financial statements and a firm's rank in the industry. While this study considered only 13 factors with reference to its classification, our study considers 18 common factors classified into economic, psychological, social and demographic factors.

Considering existing literature and empirical studies, it can be seen that investments in stock markets have been subject to extensive research. Investment decisions in any stock are influenced by certain factors: economic, psychological, social or demographic. So far, the few available researches in Rwanda in this area are limited to capital market potential (Kerosi et al., 2014); capital markets and SME financing (ADB, 2012) and challenges for

RSE (Kazarwa, 2015). Bearing in mind that this review is not exhaustive, it can be concluded that no prior research has been conducted in Rwanda to examine the determinants of investment decisions in RSE. Hence, there is a gap that needs to be filled.

3. Research methodology

3.1. Research questions

The research methodology aimed to answer the following questions:

- What are the determinants of investment decisions in the Rwandan stock market considering their classification into common economic, psychological, social and demographic factors?
- What are the levels at which identified factors determine investment decisions in the Rwandan stock market?
- What are the most influential determinants with regard to investment decisions in RSE?

3.2. Measuring determinants' influence levels

The determinants' influence levels were measured using a 6-point Likert scale ranging from the lowest scale of strongly disagree to the highest scale of strongly agree. Respondents were requested to indicate their position on the scale against all statements about various factors that were grouped into such categories as economic factors, psychological factors, social factors and demographic factors.

3.3. Scope of the study

The study focuses on the determinants of investment decisions. The determinants were examined considering common investment factors identified by Mohammad (2014) who classified them into economic factors, psychological factors, social factors and demographic factors. Geographically, our study was conducted on Rwandan territory considering only active investors in RSE that were represented by 350 brokers.

3.4. Data source, population and sampling

The study used both secondary and primary data. For secondary data collection, different books, the internet, reports, journals and government publications depending on their relevance to the research topic were used. A self-administered questionnaire was used to collect primary data from a sample of 187 respondents.

The sample size was determined from 350 brokers representing active investors out of a total 25,647 estimated investors. The sample size was calculated using Sloven's formula of

sample size determination. The formula is stated as: $n = \frac{N}{1+N(e^2)}$, where n representing the sample size was determined from N representing a given population at a 95 per cent confidence level and a 5 per cent margin of error (e) by means of a related statistical table. The calculation of the sample size was done as: $n = \frac{350}{1+350(0.05)^2} = 186.67$ rounded at 187.

The random sampling technique was used for sample selection. This technique helped select respondents from the population of the study randomly.

3.5. Statistical tools

The statistical tools used to analyze the collected data mainly included mean and factor analyses. Mean was used to describe data and rank the identified factors according to their levels of influence so as to be able to decide on which factors determined investment decisions in RSE the most. The factor analysis, through a principal component analysis (PCA), helped identify patterns of data and directed data by highlighting similarities and differences between related variables.

4. Data Presentation, Analysis and Discussion

4.1. Profile of the respondents

Table 1 shows that out of 187 surveyed investors a vast majority were men (70.6 per cent). This is in line with the demographics and characteristics of respondents presented by other scholars (Babajide and Adetiloye, 2012; Obamuyi, 2013) who are of the view that the capital market is sometimes perceived to be risky and men are risk takers while women are generally seen to be risk averse.

Insert Table 1 about here

More than 63 per cent of the investors were between 26 and 45 years old. This age corresponds to the period when people are mostly productive and are looking at saving for the future and see investing in stock markets as a long term investment. This is in line with Hafer and Hein (2007) who contend that most individuals working today participate in some type of retirement plan either through their employer or in a self-directed plan as they wish to have greater financial security in their future.

Descriptive statistics also show that 89.8 per cent of the investors were at least bachelor degree holders. In other words, a majority of the investors in RSE had a high level of education which means that those with better understanding of what the stock market is and how it functions were more likely to buy and hold stocks.

Moreover, more than 62 per cent of the investors had an average monthly household income of more than RWF 1,200,000. As investing in the capital market means committing funds for the long term, those who earn more are more likely to invest in RSE. An analysis of the

primary data also revealed that investors in RSE were from various employment sectors including the private sector, self-employed, the public sector and NGOs as they expect higher returns. As pointed out by White (2007), holding shares is only one of the many different investments and is one of the more risky ones. According to him, statistics show that over long periods an investment in shares outperforms all other investments, including in property.

Table 1 also shows that although RSE is in its infancy, 69.4 per cent of the investors had held stocks for more than two years. They had some experience in capital market activities. In line with Teweles and Bradley (1998) and Hafer and Hein's (2007) findings investing in the stock market is promising for investors as even though holding stock is risky it is done with the expectation of financial gain. The expectation is that if a stock is bought today, its price will be higher sometime in the future when it can be sold and capital gain realized.

Table 1 further shows that more than 50 per cent of the surveyed investors checked stock prices on RSE on a daily basis and more than 25 per cent did it at least once a week. This depicts how investors care about capital gains.

Finally, Table 1 depicts the timing on the stock market which refers to an investor's ability to know when to buy stocks and when to sell them and thereby increase capital gains (White, 2007). RSE started operating in 2011 and it can be noticed that more than 84 per cent of the surveyed investors bought or sold stock at least once and at most four times.

4.2. Descriptive analysis

It can be noted from Table 2 that the factors influencing investment decisions in RSE can be classified into economic, psychological, social and demographic factors. This agrees with Mohammad (2014) and Omo and Mbadiugha (2012) who also identified the same categories. Considering the mean ranks, it is noticeable that the ten most significant determinants of investment decisions are economic and psychological factors. These factors include expected corporate earnings, cognitive bias --- good/bad news, irrational thinking, get-rich-quick, ownership structure, risk factors, bonus payments, cognitive bias-profit maximization, dividends and over- and under-confidence with respective means of 4.51, 4.47, 4.28, 4.27, 4.24, 4.16, 4.12, 3.98, 3.89 and 3.82.

Insert table 2 about here

These findings agree with the Efficient Market Hypothesis suggested by Fama (1970) since investors in RSE relied on available information to take investment decisions. Our findings also concur with Khaneman and Tverbsky's (1986) prospective theory since investors in RSE take risks into consideration when making investment decisions and also with Aisha et al., (2015) and Talal et al., (2016), who point out risks; Khan et al., (2015) who indicate dividends; and DeBondt and Thaler (1985) and Talal et al., (2016) who indicate overconfidence as factors influencing investment decisions. Whereas these findings indicate get-rich-quick factors as one of the most influential ones, Gunathilaka (2014) classified the get-rich-quick factors among the least influential ones. Other factors such as past

performance and accounting information have also been identified by Rahnuma and Sultan (2013) and Khan et al., (2015).

It can also be observed from Table 2 that the four least important determinants of investment decisions in RSE were all demographic -- education, decrease in income, age and gender with means of 3.07, 3.03, 2.94 and 2.78 respectively. These findings are in line with Talal et al., (2016) and Hoang and Nguyen's (2014) findings who also identified income, age, gender and education as demographic factors influencing investment decisions in stock exchanges.

Notable in Table 2 are the social factors. These include herding -- friends or family members' decisions, experienced investors' decisions and influence of people's opinions. Their corresponding means are 3.34, 3.63 and 3.65 respectively. These findings confirm the regret theory suggested by Larrick and Bores (1995) and imply that investors in RSE followed the crowd to a certain extent when taking investment decisions. They also agree with Vijaya (2014), Omo and Mbadiugha (2012), Gunathilaka (2014) Rahnuma and Sultan (2013) and Sayed and Sara (2011) who also indicate friends or family members' advice and experienced investors' advice as herding factors influencing investment decisions in stock markets. Though a descriptive analysis made it possible to measure the influence level of the selected factors based on their mean, it did not help explore the data. Therefore, a factor analysis was done for this purpose.

4.3. Factor analysis

The principal factor analysis considered the KMO and Bartlett's anti-image correlation matrix, commonalities, variance explained, eigenvalues, the component matrix and the rotated component matrix.

Insert table 3 about here

Insert table 4 about here

The KMO measure helps verify the adequacy of the sampling for the analysis. According to Hutcheson and Sofroniou (1999) KMO equal to 0.712 is considered good as it is not less than 0.7. For individual items, all KMO values (as highlighted in green in Table 4) are greater than 0.530 therefore being above the acceptable limit of 0.5 as suggested by Field (2009). According to Bartlett's test of sphericity, $X^2(231) = 17,653.23$ and $p < 0.001$ indicate that relations between the items were sufficiently large for the principal component analysis.

Insert table 5 about here

In Table 5, the total variance explained by each factor is indicated by a corresponding eigenvalue. All the 22 variables or factors considered accounted for a total variance of 22.00 which equals to 100 per cent. The variable with the highest variance of 4.752 represents 21.600 per cent of the total variance calculated as $(4.752 \times 100) / 22$. The second variable with the highest variance of 3.113 represents 14.148 per cent of the total variance calculated as $(3.113 \times 100) / 22$. These two variables alone accounted for 35.748 per cent of the total variance. The factor with the lowest variance of 0.133 represents 0.604 per cent calculated as $(0.133 \times 100) / 22$. In addition, Table 5 also indicates six factors with variance greater than

1.00. These factors are considered in Table 6 so as to understand both their extraction and rotation sums of squared loadings.

Insert table 6 about here

From Table 6 it can be noted that the extraction sums of squared loadings show that the first six factors accounted for 64.739 per cent of the cumulative variance. It is worth noting that retained here are only factors with eigenvalues greater than 1.0. The model does not include other factors. The table also shows the rotation sums of the squared loadings for the extracted components. The rotation helps optimize the factor structure and therefore helps equalize the relative importance of the six factors. It can be observed that before rotation, factor 1 accounted for notably more variance (21.6 per cent) than the remaining five. Yet, with the help of rotation it accounted for 16.065 per cent of the variance. Table 7 highlights the major aspects of factor analysis.

All the variables in Table 7 have separate levels of variance explaining power. For instance, the first variable - accounting information- explains 68.7 per cent (as indicated in the extraction column) of the total variance via its contribution to six different components. This implies that the remaining 31.3 per cent is not explained by the indicated variable. This unexplained percentage is known as specific variance. Other variables can be interpreted in the same way.

Insert table 7 about here

The information in Table 7 reveals that variables reflected in the initial questionnaire is composed of six sub-constructs reflecting factors influencing investment decisions in RSE. One sub-construct might include seven variables loading highly on component one. Another sub-construct might have two variables loading highly on component two. Variables loading highly on component four and five might be classified into their own sub-constructs. Variable six does not need to be considered since according to Tabachnick and Fidell (2007), a factor requires at least three variables unless it has fewer variables which are highly correlated with each other ($r > .7$). This implies that the initial classification of variables by Mohammad (2014) into economic, psychological, social and demographic needs to be revised once examined by a factor analysis.

Therefore, based on Mohammad (2014) and Ariful et al., (2015) the following classification can be suggested: socio-demographic factors, psychological factors, internal and economic factors, internal-external and economic factors and demographic factors for the retained first five components in ascending order.

5. Conclusion and recommendations

This study identified the determinants of investment decisions in RSE considering common factors classified into economic, psychological, social and demographic factors. It also indicated the most influential determinants with regard to investment decisions in RSE. The research findings presented in this study reveal that various factors affected investment decisions in RSE. It found that the ten most important determinants of investment decisions

were economic and psychological factors. These factors, ranked in order of importance, include expected corporate earnings, cognitive bias-good/bad news, irrational thinking, get-rich-quick, ownership structure, risk factors, bonus payments, cognitive bias-profit maximization, dividends and over or under-confidence. Social and demographic factors had little influence on investment decisions in RSE. By identifying the most significant determinants of investment decisions in RSE, the study sheds light on the components that listed companies and RSE should focus on when attracting investors for capital market development.

Through a factor analysis, the KMO measure helped verify the sampling and prove that the sampling adequacy was good. It also helped confirm the acceptability of individual items and the sufficiency of relations between individual items for PCA. The first six factors extracted through the factor analysis explained 64.74 per cent of the cumulative variance. Further, this analysis helped in identifying such new clusters of factors as socio-demographic, psychological, internal and economic, internal-external and economic, demographic and news-induced psychological factors for the six components in ascending order. The findings led to a classification different from the classification that our study is based on though there are some similarities.

As information play a significant role in investment decisions in RSE, the stock exchange's authorities should ensure that RSE related information is relevant enough and is made available to existing and potential investors through appropriate communication channels. Care should be taken by investors to base their decisions on good or bad current news and after considering long term horizons since the current news may not favor their long term interests. Thus, investors in RSE should rely more on fundamental information and avoid basing their investment decisions on rumors. Potential investors who think they are not knowledgeable enough to invest in RSE should not consider that as an ultimate limitation but should instead seek advice from specialized brokers. Consequently, RSE's authorities should make sure that the brokers operating in RSE meet all the requirements to service investors who may seek their advice. As females are less inclined to invest in RSE compared to males, sensitization targeting this group should be done to help meet the objectives of women's empowerment. Other categories of people that policymakers should give particular attention to are indicated in the respondent profiles.

Since the study considered only active investors, further research can be conducted to include passive investors and find out the reasons why they are less attracted by investments in RSE. Moreover, as the study was limited to common factors, other studies may also include uncommon factors. Further, a comparative study analysis can be carried out to involve more than one stock exchange in the sub-region.

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Table 1: Profile of the respondents

Profile	Item	Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	132	70.6	70.6	70.6
	Female	55	29.4	29.4	100
Age	18-25	2	1.1	1.1	1.1
	26-35	75	40.1	40.1	41.2
	36-45	43	23.0	23.0	64.2
	46-55	33	17.6	17.6	81.8
	Over 55	34	18.2	18.2	100
Level of education	Secondary school	9	4.8	4.8	4.8
	Undergraduate certificate	10	5.3	5.3	10.2
	Bachelor Degree	48	25.7	25.7	35.8
	Master's	102	54.5	54.5	90.4
	PhD	18	9.6	9.6	100
Monthly Income	300,001 - 600,000	21	11.2	11.2	11.2
	600,001 - 900,000	9	4.8	4.8	16.0
	900,001 - 1,200,000	40	21.4	21.4	37.4
	More than 1,200,000	117	62.6	62.6	100
Employment sector	Public sector	50	26.7	26.7	26.7
	Private sector	59	31.6	31.6	58.3
	NGOs	21	11.2	11.2	69.5
	Other	57	30.5	30.5	100
Duration of investment	Less than 1 year	10	5.3	5.3	5.3
	1-2 years	47	25.1	25.1	30.5
	2-3 years	27	14.4	14.4	44.9
	3-4 years	41	21.9	21.9	66.8
	4-5 years	10	5.3	5.3	72.2
	Over 5 years	52	27.8	27.8	100
Frequency of checking prices	Daily	94	50.3	50.3	50.3
	Weekly	47	25.1	25.1	75.4
	Monthly	28	15.0	15.0	90.4
	Quarterly	1	0.5	0.5	90.9
	Semi-annually	17	9.1	9.1	100
Frequency of buying or selling stocks	1 - 2	67	35.8	35.8	35.8
	3 - 4	91	48.7	48.7	84.5
	5 - 6	10	5.3	5.3	89.8
	More than 6	19	10.2	10.2	100

Source: Primary data.

Table 2: Descriptive statistics

Factors	N	Minimum	Maximum	Mean	Std. Deviation	Ranking of Mean
Economic factors						
Accounting information	187	1	6	3.58	1.355	14
Past performance of the company	187	1	6	3.54	1.237	13
Ownership structure	187	1	6	4.24	1.425	5
Expected corporate earnings	187	1	6	4.51	1.546	1
Dividends	187	1	6	3.89	1.738	9
Bonus payments	187	1	6	4.12	1.430	7
Risk factors	187	1	6	4.16	1.512	6
Psychological factors						
Cognitive bias-good/bad news	187	2	6	4.47	1.170	2
Cognitive bias-profit maximization	187	1	6	3.98	1.182	8
Over- or under-confidence	187	1	6	3.82	1.265	10
Irrational thinking	187	1	6	4.28	1.328	3
Get-rich- quick	187	1	6	4.27	1.476	4
Over-reaction to bad information	187	1	6	3.32	1.384	17
Over-reaction to good information	187	1	6	3.23	1.180	18
Social factors						
Influence of people's opinions	187	2	6	3.65	1.012	11
Herdling- friends or family members' decisions	187	1	6	3.34	1.368	16
Herdling -experienced investors' decisions	187	1	6	3.63	1.307	12
Demographic factors						
Gender	187	1	6	2.78	1.493	22
Age	187	1	5	2.94	1.256	21
Increase in income	187	1	5	3.51	1.431	15
Decrease in income	187	1	5	3.03	1.309	20
Education	187	1	5	3.07	1.591	19
Valid N (list-wise)	0					

Source: Primary data.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.712
Bartlett's Test of Sphericity Approx. Chi-Square	17653.23
df	231
Sig.	.000

Source: Primary data.

Table: 4 Anti-image correlation matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22
V1	.761 ^a	.484	-.062	.001	-.136	-.068	.026	-.053	-.117	.088	-.045	-.073	-.004	-.138	.007	.075	-.037	-.042	.003	.009	-.069	.033
V2	.484	.652 ^a	.223	-.421	-.245	-.130	-.060	.114	-.023	-.082	-.105	-.011	-.083	-.075	.129	.119	-.057	-.140	.008	-.100	.015	-.028
V3	-.062	.223	.639 ^a	.268	-.479	-.435	-.177	.011	-.010	.062	-.001	-.082	-.010	-.098	-.035	.069	-.021	-.146	-.174	-.038	.071	-.155
V4	.001	-.421	.268	.732 ^a	.170	-.269	-.068	-.234	-.038	.097	.110	-.104	-.011	-.012	-.118	-.057	.118	.119	-.160	.101	.081	-.001
V5	-.136	-.245	-.479	.170	.670 ^a	.243	-.051	-.187	-.127	-.159	.046	.002	.062	.130	-.036	-.053	.024	.030	.076	-.013	.066	-.041
V6	-.068	-.130	-.435	-.269	.243	.539 ^a	.559	-.084	-.029	.051	-.009	.086	.055	.094	.062	-.011	-.040	.011	.030	-.052	-.077	.054
V7	.026	-.060	-.177	-.068	-.051	.559	.624 ^a	.016	-.096	.109	.024	.085	.105	-.017	-.077	-.040	-.053	-.008	-.016	.031	.012	.088
V8	-.053	.114	.011	-.234	-.187	-.084	.016	.585 ^a	.332	-.039	-.018	.014	-.184	-.100	.052	-.010	.134	-.045	-.033	-.009	-.077	.102
V9	-.117	-.023	-.010	-.038	-.127	-.029	-.096	.332	.654 ^a	.439	.158	.068	-.124	-.098	-.118	-.033	.118	.109	.062	.069	-.154	.019
V10	.088	-.082	.062	.097	-.159	.051	.109	-.039	.439	.690 ^a	.436	-.065	.084	-.240	-.166	.031	-.040	.057	-.049	.195	-.162	.038
V11	-.045	-.105	-.001	.110	.046	-.009	.024	-.018	.158	.436	.757 ^a	.283	-.117	-.069	.027	.126	.064	.044	.031	.099	-.045	-.174
V12	-.073	-.011	-.082	-.104	.002	.086	.085	.014	.068	-.065	.283	.757 ^a	.221	.245	.129	-.148	-.150	-.051	.050	-.112	.128	-.072
V13	-.004	-.083	-.010	-.011	.062	.055	.105	-.184	-.124	.084	-.117	.221	.747 ^a	.572	-.316	-.193	-.332	-.068	.067	-.014	.111	-.016
V14	-.138	-.075	-.098	-.012	.130	.094	-.017	-.100	-.098	-.240	-.069	.245	.572	.723 ^a	.072	-.380	-.236	.056	.195	-.082	.157	.003
V15	.007	.129	-.035	-.118	-.036	.062	-.077	.052	-.118	-.166	.027	.129	-.316	.072	.832 ^a	.207	-.229	-.064	-.059	-.084	-.034	.200
V16	.075	.119	.069	-.057	-.053	-.011	-.040	-.010	-.033	.031	.126	-.148	-.193	-.380	.207	.768 ^a	.248	-.549	-.114	-.010	.016	.021
V17	-.037	-.057	-.021	.118	.024	-.040	-.053	.134	.118	-.040	.064	-.150	-.332	-.236	-.229	.248	.756 ^a	.098	-.255	.123	.015	.049
V18	-.042	-.140	-.146	.119	.030	.011	-.008	-.045	.109	.057	.044	-.051	-.068	.056	-.064	-.549	.098	.752 ^a	.286	.144	-.133	.103
V19	.003	.008	-.174	-.160	.076	.030	-.016	-.033	.062	-.049	.031	.050	.067	.195	-.059	-.114	-.255	.286	.785 ^a	-.091	-.085	-.063
V20	.009	-.100	-.038	.101	-.013	-.052	.031	-.009	.069	.195	.099	-.112	-.014	-.082	-.084	-.010	.123	.144	-.091	.586 ^a	-.175	-.192
V21	-.069	.015	.071	.081	.066	-.077	.012	-.077	-.154	-.162	-.045	.128	.111	.157	-.034	.016	.015	-.133	-.085	-.175	.532 ^a	-.219
V22	.033	-.028	-.155	-.001	-.041	.054	.088	.102	.019	.038	-.174	-.072	-.016	.003	.200	.021	.049	.103	-.063	-.192	-.219	.674 ^a

Measures of Sampling Adequacy (MSA)

Source: Primary data.

Chapter Seventeen

Monetary Transmission Mechanisms in Rwanda

Thomas RUSUHUZWA KIGABO

National bank of Rwanda, and
College of Business and Economics,
University of Rwanda, Kigali, Rwanda.
E-mail: thkigabo@yahoo.fr

Abstract

This paper assesses monetary transmission mechanisms in Rwanda. By first analyzing their key determinants the paper highlights the good progress accomplished in increasing the National Bank of Rwanda's (BNR) independence, flexibility in the current monetary policy framework and financial sector development. However, the banking sector continues to show persistent short-term liquidity, the size of the formal financial sector remains small and banks are more competitive in the deposit rather than in the loan market. Thus, the interest rate pass-through to the lending rate remains very weak and this limits the impact of monetary policy actions on the cost of banking loans. The exchange rate channel has started improving after the introduction of more flexibility in the exchange rate policy and a decline in foreign resources. There is clear evidence that the monetary aggregates channel is active in Rwanda. A shock to M3 as well as changes in the available amount of credit as a result of BNR's actions appears to have a very rapid, significant and persistent effect on output which peaks after around 5 quarters. This may be a reflection of the increasing monetization of the Rwandan economy that has taken place. The effect of a shock to M3 on prices is positive and significant but appears late, after more than two years. More efforts are needed to support further development of the financial markets and extending the formal financial sector to all sectors of the economy.

Keywords: Monetary policy, transmission mechanism, Rwanda.

JEL Classification Codes: E52.

1.1. Introduction

Monetary policy plays a fundamental role in price stability which is a precondition for sustainable growth in output and employment over the long-run. Although ineffective in the long-run, monetary policy is a powerful tool in influencing economic activity in the short-run. It has an impact on economic activities and inflation through several transmission mechanisms which describe how policy induced changes in the money stock or the short-term nominal interest rate impact aggregate demand. This explains why there has been an increasing interest in empirical studies on monetary transmission mechanism channels which are aimed at understanding how these channels work by describing their relative dominance, importance and spread in propagating effects (time-lag).

This is important for central banks because the efficacy of monetary policy depends on how monetary authorities make accurate assessments of the timing and the effects of their policies on economic activities and prices. In general, specific channels of monetary transmission operating through the monetary policy effect interest rates, exchange rates, equity and real estate prices, bank lending and firm balance sheets (Mishkin, 1995). The focus of our study is on the interest rate channel, the bank lending channel and the exchange rate channel which are working in developing countries.

International experience shows that the effectiveness of monetary transmission mechanisms varies across countries depending on the extent of financial intermediation, the structure of the financial system and structural economic conditions (see Checetti, 1999; Creel and Levasseur, 2005). The link between monetary policy instruments under the direct control of a central bank (like short-term interest rates and reserve money) and variables that affect the conditions in the non-financial sector (like lending rates, deposit rates, the exchange rate and asset prices) depend on the depth and structure of the financial system. This explains why monetary transmission mechanisms are fundamentally different in low-income countries and in advanced economies (Mishri et al., 2010) and why monetary transmission mechanisms are still weak in emerging and developing economies.

The interest rate channel is very active in advanced countries due to their well-functioning financial systems. Changes in the policy rate by the central bank significantly impact aggregate demand and price level (see, for example, Mojon and Peersman, 2001). This transmission channel is hampered in emerging and developing countries as their financial systems are not developed. Their bond markets are under-developed or they do not exist, their banking sectors are not competitive and their informal finance sectors are very large (see, for example, Buigut, 2009; Lungu, 2008; Moreno, 2008; Saxegaard, 2006).

Exchange rate offers an additional transmission mechanism for monetary policy in a small open economy where consumer price inflation is directly affected by changes in the exchange rate through the effect of import prices and aggregate demand. Thus, in an open economy inflation is influenced by how its determinants adjust to exchange rate movements (Adolfson, 2001) and this explains why this channel varies across countries. In low income countries where exchange rate flexibility tends to be restricted, the scope for an exchange rate channel is reduced (Adam Mugume, 2011; Cheng, 2006). In general, the exchange rate pass-through to domestic prices is higher in countries using exchange

rate to anchor inflation than in countries using inflation targeting as a framework for implementing monetary policy (Soffer, 2008).

Some studies have found that the bank lending channel of monetary policy transmission is dominant in low-income countries (Lungu, 2008; Uanguta and Ikhide, 2002) but others have found mixed evidence for this channel. The bank lending channel depends on the link between monetary policy actions and the availability and cost of bank credit and that between availability and cost of banking credit and aggregate demand (Ciccarelli et al., 2015). These links depend on the health of the banks' balance sheets, market conditions, competition in the banking industry and the size of the formal financial sector.

While there is consensus that the existence of a credit channel influences credit supply, the key issue is identifying whether credit change is due to a shift in credit supply or a change in credit demand. Different researchers have found that loan supply is more sensitive to monetary policy shocks than loan demand (Ciccarelli et al., 2015; Havro and Vale, 2011) and that monetary policy affects aggregate loan supply through changes in maturities of new loans, particularly for large banks (Black and Rosen, 2009).

The credit channel is affected by financial market conditions specifically when there is a decrease in market liquidity. About bank balance sheet conditions, different researches conclude that well-capitalized banks with well-balanced maturity structures are less likely to ration credit. In addition, balance sheet conditions of both banks and firms play an important role in extension credit (Jimenez et al., 2010).

In sub-Saharan African countries, the bank lending channel is also hampered by the small size of and imperfections in the financial sector. Credit market frictions make bank deposits with the central bank, government bonds and foreign securities much closer substitutes among themselves than with credit to the private sector (Mishri et al., 2010; Sacerdoti, 2005).

There is no published research on monetary transmission mechanisms in Rwanda. Our study fills this gap by first focusing on selected aspects of monetary transmission mechanisms such as interest rate pass-through and exchange rate pass-through before assessing channels of monetary transmission in a unified empirical framework using the vector auto regressive (VAR) model.

Understanding monetary policy transmission mechanisms in Rwanda is essential for the National Bank of Rwanda (BNR) to design, manage and implement its monetary policy. Currently, BNR conducts its monetary policy under the monetary targeting regime with the broad monetary aggregate M3 as the intermediate target and reserve money as the operating target. M3 is composed of the currency in circulation out of the banking system, the demand and time deposits in Rwandan francs and deposits in foreign currencies. Reserve money (RM) is composed of the currency in circulation out of the central bank and banks' deposits with the central bank.

In this framework, the monetary transmission mechanisms are set out from the quantity of monetary base (B) as an operational target and move towards inflation through money supply (M3). The framework is based on two important assumptions: the stability of money demand to ensure the existence of a strong and reliable relationship between M3 and inflation and the stability of money multiplier to ensure the controllability of M3 via reserve money. However, recent studies (Kigabo, 2014; Kigabo and Mutuyimana, 2016) show that money multiplier and velocity of money in Rwanda are not stable and that

there is a structural change in the long run relationship between M3 and RM on the one side and between M3 and nominal GDP on the other. This limits the efficiency of the current monetary policy framework in Rwanda.

These structural changes are mainly due to changes introduced in the monetary policy framework such as the use of the key repo rate (KRR) to signal the monetary policy stance since 2008 and the use of the reserve money band since 2012 instead of targeting one value of reserve money. This has contributed to improving liquidity management and promoting more flexibility in money market rates. In addition, different financial innovations have also been introduced in the banking system in the last decade including the establishment of new financial institutions, extension of the banking sector's network and the introduction of new financial products such as automated teller machines and mobile and internet banking. Further, the capital market was created in 2008 and it has been becoming progressively active since 2014 after BNR and the Ministry of Finance and Economic Planning decided to issue treasury bonds on a quarterly basis.

Consequently, like other central banks in the East African Community (EAC) countries BNR is also planning to move from reserve money programs to more policy based monetary policy frameworks by 2018. It is planned that all EAC central banks will start using interest rate as their operating objective by 2018. It is crucial today for BNR to have a clear understanding of monetary transmission mechanisms so that it is able to anticipate the impact (and the time lag) of changes in the central bank's rate on aggregate demand, because BNR will not rely on just controlling M3 assuming that this will help achieve price stability.

2. Literature review on monetary policy transmission mechanisms

In general, analyses of monetary transmission mechanisms have been done using the VAR framework which explicitly recognize the simultaneity between monetary policy and macroeconomic developments. A VAR analysis is considered as a particularly useful tool to investigate monetary policy transmission in developing economies with short data series and structural changes complicating the use of structural models.

A few studies have used a simple single equation to analyze specific channels of transmission mechanisms such as exchange rate pass-through and interest rate pass-through as the first stage of the interest rate channel (Borio, 1997; De Bondt, 2002; Tieman, 2004).

It can be concluded from empirical literature that in developed countries the interest and exchange rate channels are the most important in the transmission of monetary policy actions to influence aggregate demand and affect the central bank's ultimate objectives such as price stability, but that these vary from one country to another. Coudert and Mojon (1995) analyzed transmission mechanisms in four countries of the European Union (Germany, France, Italy and the United Kingdom) using the VAR model and found that a change in interest rate had varied effects in the different countries.

Angeloni et al., (2002) analyzed 12 countries in the Euro zone (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain) using VAR models and show that interest and exchange rate channels are present in almost all the countries and the role of the credit channel varied from one country to

another. Loayza and Schmidt's (2002) study on Australia, Canada and the United Kingdom came up with similar findings.

Hericourt and Matei (2005) did an empirical evaluation of transmission mechanisms of monetary policy in eight central and eastern European countries (Czech Republic, Hungary, Poland, Slovak Republic, Estonia, Lithuania, Latvia and Slovenia) and concluded that for countries which had maintained a fixed exchange rate regime, monetary aggregate channels were active while countries with a flexible exchange regime had heterogeneous behavior profiles.

Empirical studies on exchange rate pass-through to domestic prices conclude that in emerging economies the exchange rate pass-through is higher than it is in developed countries. In general, the pass-through is higher in countries using the exchange rate to anchor inflation than it is in countries using inflation targeting as the framework for implementing monetary policy (Soffer, 2008).

Moreno's (2008) study analyzed monetary policy transmission in emerging markets using short-term rates as operating instruments. It estimated a VAR model to assess the importance of domestic policy and foreign factors in influencing long term rates. The study concluded that with some exceptions, external long rates were better predictors of long term yields in these countries than short term interest rates.

Disyatat's (2010) study on the bank lending channel shows that greater reliance on market based funding enhanced the importance of this channel and that banks could act either as absorbers or amplifiers of shocks originating in the financial system depending on the strength of the banks' balance sheets.

Studies on African countries show different results. Cheng (2006) studied the impact of a shock in the monetary policy on production and prices in Kenya and found that a monetary shock had a very significant impact on production (GDP) and inflation and that a shock in the interest rate had short-term effects on the nominal exchange rate and prices but not on production.

Buigut (2009) concluded that changes in policy interest rates had small and not statistically significant effects on output and inflation in Kenya, Tanzania and Uganda and that the monetary transmission mechanisms were weak in these countries.

Mishra et al., (2010) did a study on monetary transmission mechanisms in low-income countries (LIC) and found that the bank lending channel should be the dominant channel in these countries, the effectiveness of the exchange rate channel depended on the exchange rate regime adopted by a country and that their interest rate channels were weak.

Adam Mugume's (2011) study shows that there was no support for credit and exchange rate channels in Uganda; however, changes in the amount of credit available resulting from changes in the monetary policy stance had an impact on inflation. Innovation to M2 had no significant effect on output growth and inflation. The interest rate channel remained weak in Uganda.

IMF's (2007) study examined transmission mechanisms in Egypt and shows that the exchange rate channel was active, bank lending and asset price channels were weak and the interest rate channel was under-developed but appeared to be strengthening since the introduction of the interest rate corridor in 2005. Applied to Mauritius, the VAR analysis concluded that a change in the policy interest rate had an impact on inflation and not on

output and that monetary aggregates and exchange rate channels were active (Tsangarides, 2010).

Uanguta and Ikhide (2002) analyzed monetary transmission mechanism channels in Namibia and found that changes in the South African reserve bank's policy rate (Namibia has a currency pegged to the South African rand) had an impact on lending rates in Namibia as well as on private investments. However, Sacerdoti (2005) concluded that the transmission mechanisms through the bank lending channel were weak in many sub-Saharan African countries due to credit market frictions.

3. An Analysis of some key drivers of monetary transmission in Rwanda

There is consensus about key drivers of monetary policy transmission mechanisms which explain why channels of monetary transmission mechanisms are fundamentally different in low-income countries and in advanced economies. These include country institutional frameworks in which financial intermediation is conducted, independence of central banks, level of liquidity in the banking sector, development of the financial market, degree of international capital mobility and level of flexibility in the exchange rate regime (Mishri et al., 2010).

3.1. Institutional framework

Macroeconomic and political stability

A stable macroeconomic environment is conducive for business and can reduce banks' risk aversion and the price mark up. The macroeconomic environment in Rwanda has been healthy, stable and sound since 2000 with high real economic growth of 8 per cent on average, low and stable inflation (4.1 per cent in the last 5 years) and a stable exchange rate (depreciation of 3.9 per cent against the US dollar for the last 5 years).

In addition, political stability can affect the whole economic environment and banks' investments, assets and profitability. Hence, it definitely affects banks' pricing behavior. Rwanda is favorably ranked by the World Bank in terms of good governance, according to the Worldwide Governance Indicators (WGIs). In terms of corruption perceptions, Rwanda was ranked the second least corrupt country in Africa after Botswana in 2012 and in 2013. At the global level, Rwanda was ranked 50th and 40th in 2012 and 2013 respectively out of 177 countries. In 2015, Rwanda was ranked the 2nd easiest place to do business in Africa with the most efficient government in Africa (the World Bank, 2015) and the 7th most efficient globally.

Legal environment

The legal right index as measured by the World Bank has also been strengthening in Rwanda since 2010, reflecting on-going improvements in this area. Normally, this should reduce loan risks and subsequently the lending rate (Table 1).

Table 1: Evolution in strength of the legal rights index in Rwanda (0=weak to 12=strong).

Index	2010	2011	2012	2013	2014
Strength of legal rights index (0= weak to 12 strong)	7	7	7	9	11

Source: The World Bank reports.

3.2. Monetary policy framework in Rwanda

BNR is an independent central bank with the following missions: ensuring and maintaining price stability, enhancing and maintaining a stable and competitive financial system without any exclusion and supporting the government's general economic policies without prejudicing its other missions (BNR law 55/2007, article 5).

BNR conducts its monetary policy under the monetary targeting framework, with the broad monetary aggregate (M3) as the intermediate target and reserve money (RM) as the operating target. M3 is composed of currency in circulation out of the banking system, the demand and time deposits in Rwandan francs and deposits in foreign currencies. Reserve money is composed of currency in circulation out of the central bank and banks' deposits with the central bank.

Targets of reserve money are achieved using open market operations conducted through the sale and purchase of government securities and other short-term instruments using repurchase agreements (REPO) with commercial banks. Others monetary instruments used by BNR are reserve requirements and rediscount facilities.

BNR introduced indirect monetary policy instruments in 1995 after abandoning the use of quantitative ceilings on bank credit, selective credit controls and administrated interest rates and exchange rate used before the economic and financial liberalization introduced in 1990. Open market operations (OMOs) were introduced in September 1997 when BNR launched money market operations (short term liquidity sale/purchase through the auction system) with the objective of influencing monetary aggregates using indirect mechanism tools. The bank intervened once a week for a maturity duration of seven days to mop up or provide liquidity into the market.

Following external inflows from donors that the government benefited from after 2004 and high government absorption capacity of capital inflows from aid¹ which created a permanent short-term excess liquidity in the banking system, BNR introduced an overnight facility at a fixed interest rate of 5 per cent as the floor of the corridor to smoothen the extra liquidity prevailing within the week and the high volatility in reserve money. In August 2008, BNR introduced repurchase agreement operations (REPO) to provide banks with a new reference for efficient management of liquidity by setting the central bank rate at 8 per cent per annum. This rate has been changed by the monetary policy committee (MPC) to signal the central bank's monetary policy stance. The discount rate, defined as penalty rate, has been introduced and is defined as equal to the central bank's rate plus a margin set in accordance with the economic fundamentals.

¹ The proper use of inflows from aid by the Government of Rwanda to finance development has translated into a high increase in BNR's sales of dollars to commercial banks which has contributed to reducing banking liquidity in the domestic currency. Another big portion of these inflows was externally sterilized and has not contributed to generate liquidity in the banking sector.

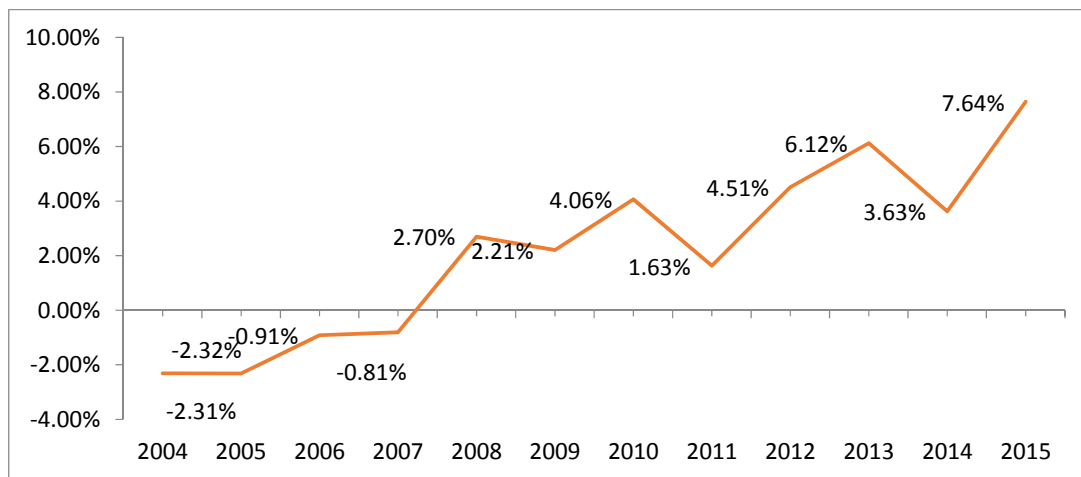
The reserve money program in Rwanda has been adjusted to introduce more flexibility in implementing the monetary policy. Prior to 2010, targets on reserve money were set using end period stocks which led to high fluctuations in money market rates as monetary policy actions were concentrated in programs' assessment periods, particularly end of quarters. To distribute policy actions over time, BNR adopted the average reserve money system in 2010. In a bid to improve monetary policy transmission mechanisms, increasing the effectiveness of its monetary policy and contributing to the development of the interbank market, BNR moved to a more flexible monetary targeting regime framework in October 2012 by introducing a reserve money band of plus or minus 2 per cent around a central reserve money target.

BNR also used its regular intervention in the foreign exchange market selling US dollars to commercial banks as a tool for managing banking liquidity. As a result, the Rwandan franc (Raff) was very stable between 2004 and 2012. However, after an aid cut in 2012 and a significant decline in export earnings due to poor global economic conditions, Rwf depreciated significantly by 7.6 per cent in 2015 and 9.8 per cent in 2016. This contributed to an increase in the exchange rate pass-through to domestic prices in Rwanda (Figure 1).

BNR adopted the reserve requirement system in 1990 as a measure to protect depositors before using it as a tool of liquidity management in 1995 and improving the banking regulatory framework to ensure the stability of the banking sector. The development of the money market created in 1997 and low inflation rates have allowed BNR to progressively reduce the reserve requirement ratio since May 1995 to 12 per cent in 1997, 10 per cent in 1998, 8 per cent in 2000 and 5 per cent since the first quarter of 2009.

BNR conducts its monetary policy with very limited fiscal dominance. Fiscal dominance refers to a situation where fiscal policies exert more power than the monetary policy over the macro-economy, in particular in the determination of inflation. One mechanism by which fiscal policy affects prices is if the government chooses to finance its expenditure by borrowing excessively from the central bank. By law, BNR is prohibited to grant direct advances or other loans to the State before it is approved by law.

Figure 1: The Rwf exchange rate's development



Source: BNR (2015).

The only facility that BNR provides to the treasury is overdraft to ensure the smooth functioning of the state treasury considering the gap that could occur between public revenue and public expenditure. The debit balance of the current account of the treasury cannot exceed 11 per cent of the state's current revenue collected during the previous financial year (BNR, 1997). To ensure BNR's independence in the choice and use of its monetary policy instruments, a treasure management committee was created and is composed of staff members from BNR and the Ministry of Finance and Economic Planning. The main mandate of the committee is discussing government plans of issuing its securities in the domestic market to ensure that the issuance is in line with liquidity forecasts provided by BNR.

3.3 The financial system's development in Rwanda

The Rwandan financial system has undergone significant reforms since 1995 with the adoption of market based mechanisms, coupled with financial sector liberalization and economic reforms. For instance, lending rates and deposit rates are determined freely by the market and credit is no longer rationed by the government. The capital account was fully liberalized in 2009 and the exchange rate regime shifted from a fixed to a progressively more flexible regime.

The financial sector in Rwanda is dominated by the banking sector composed of 17 commercial banks (up from five banks before 1994) and the banking sector has significantly extended its network across the country by opening bank branches and agents' banking.

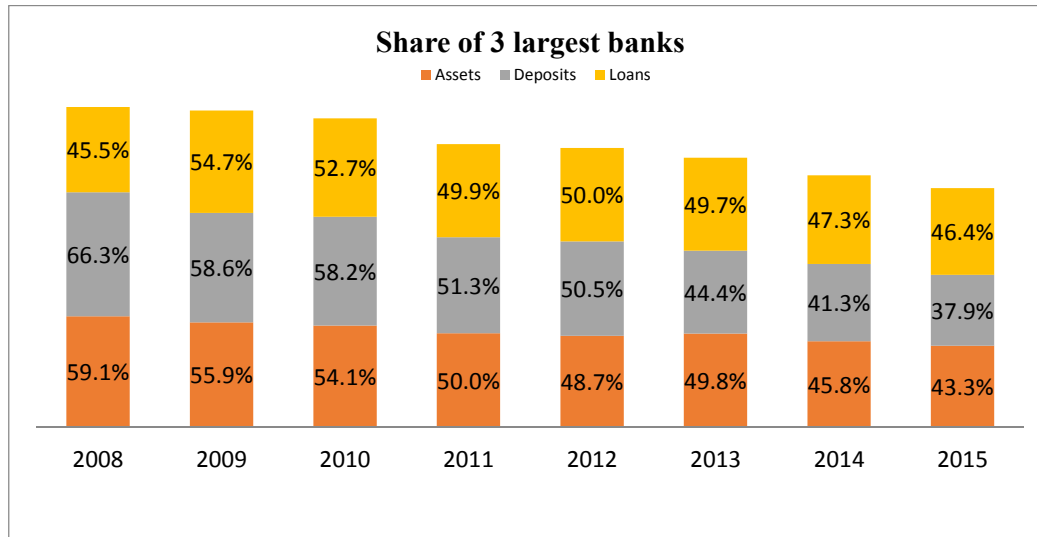
These reforms have generated positive results in many important respects including in particular, a rapid expansion of the banking system (financial deepening) and an even faster expansion of bank lending to the private sector. The ratio of broad money (M3) to GDP rose from 17.1 per cent in 2004 to 24.1 per cent in 2019. Over the same period, the ratio of private sector credit to GDP increased from 10.9 per cent to 19.2 per cent while deposits as a percentage of GDP increased from 13.8 per cent to 21.2 per cent (Table 2).

Table 2: Development in financial development indicators

	2004	2005	2006	2007	2008	2009	2010
M3/GDP	17.1	17.1	18.5	20.3	17.5	17.2	18.3
CPS/GDP	10.9	11.5	12.1	12.4	12.8	11.7	11.8
Depos/GDP	13.8	13.8	15.4	17.3	14.5	14.6	15.6
	2011	2012	2013	2014	2015	2016	
M3/GDP	20.0	19.8	20.9	22.4	24.9	24.1	
CPS/GDP	13.0	15.2	15.4	16.6	19.8	19.2	
Depos/GDP	17.4	17.4	18.5	20.2	22.5	21.9	

Source: Calculated based on monetary survey data and GDP published by NISR.

Figure 2: Development in banking concentration in Rwanda

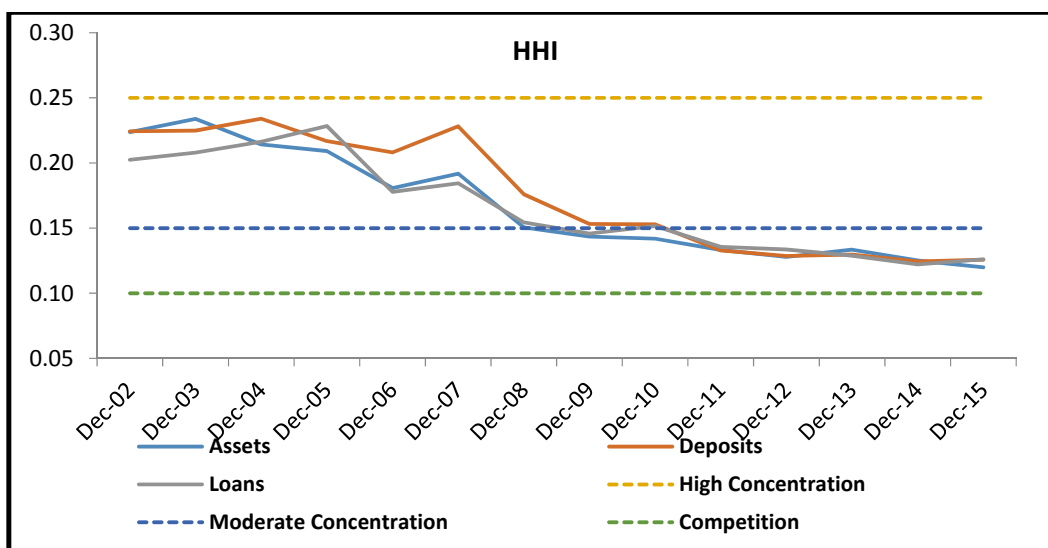


Source: BNR, Financial Stability Directorate (2015).

In addition, concentration in the banking sector has been decreasing over time showing an improvement in the banking sector's competitiveness. The share of the three biggest banks in loan and deposit markets has been declining over time from 54.7 per cent and 58.6 per cent in 2009 to 46.4 per cent and 37.9 per cent in 2015. The share of the three biggest banks in total assets of the banking sector also declined from 55.9 per cent to 43.3 per cent in the same period (Figure 2).

The Herfindahl index (HI), generally used to assess structural changes in an industry has been reducing over time from high concentration between 2002-10 to moderate concentration since 2011 in loan and deposit markets and also for banks' assets (Figure 3).

Figure 3: Herfindahl index's development in the Rwandan banking sector



Source: BNR, Financial Stability Directorate (2015).

In addition, the introduction of digital financial services in 2010 such as mobile payments, mobile banking and internet banking contributed to expanding financial services between 2012 and 2016. According to a FINSCOP survey 2015, the use of digital financial services boosted access to formal non-bank financial services to 42 per cent in 2015 from only 19 per cent in 2012, with 74 per cent of the adults in Rwanda (2.8 million) using mobile money in 2015.

Despite these positive developments in the banking industry, the sector has been characterized by persistent short-term liquidity as the financial market in Rwanda is not yet well developed and there is a need for liquidity as generated by the extension of banks' networks across the country. High excess liquidity in the banking industry in Rwanda has limited BNR's policy rate to opportunity cost of holding liquidity by banks instead of reflecting the margin costs of funding. In addition, the size of the formal financial sector in Rwanda remains small as shown by key indicators of financial sector development. Thus, effects of monetary actions on aggregate demand are limited.

4. Methodology

We first analyze the interest rate pass-through and exchange rate pass-through in Rwanda before discussing monetary transmission mechanisms using the VAR model.

Interest rate pass-through

An assessment of interest rate pass-through is generally based on a marginal pricing model which considers that a bank set an interest rate equal to the marginal cost of funding approximated by a market interest rate and a constant mark-up (see for example Borio, 1997; De Bondt, 2002; Tieman, 2004).

$$(1) \quad i_t^m = \alpha + \beta i_t^p + \varepsilon_t$$

where β is the pass-through parameter. Under perfect competition and complete information $\beta=1$. It is less than 1 if the markets are imperfect and in the presence of asymmetric information.

The degree of pass-through highly depends on the level of the demand for deposit and loan elasticities to the deposit and lending rates respectively in such a way that elasticity less than 1 results in an incomplete pass-through. Different factors contribute to the lower level of demand elasticities including imperfect substitutions between bank deposits and other investment facilities with the same maturity like money market funds and T-bills on the one hand and between bank lending and other types of external finances like equity or bond markets on the other, high concentration of the banking sector which can lead to a monopolistic market and the cost of changing banks (see, for example, Tieman, 2004).

Equation 1 gives a long-term relationship between these variables and does not take into consideration the fact that in developing countries market rates will not react instantly to changes in the policy rate. In practice, there is a gradual adjustment of market rates to the new policy rates which is modeled by considering Equation 1 as the long run relationship around which short term dynamics abound. This corresponds to error correction models (see, for example, Engle and Granger, 1987) linked to the cointegration concept:

$$(2) \quad \Delta i_t^m = \gamma_1 + \gamma_2 \Delta i_{t-1}^m + \gamma_3 (i_{t-1}^m - \beta i_{t-1}^p - \alpha) + \nu_t$$

In such an ECM, the coefficient γ_3 indicates the speed of adjustment of short run dynamics to the long run equilibrium relationship. A high level of this coefficient indicates a faster market response to the policy rate.

Exchange rate pass-through

We assess the exchange rate pass-through using the structural VAR approach by defining the exchange rate pass-through as the impulse response of domestic prices to an exogenous exchange rate shock. The estimated basic SVAR is given as:

$$(3) \quad \alpha_0 X_t = n_t + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + \dots + \alpha_p X_{t-p} + u_t$$

With X composed of the exchange rate and the price index in Rwanda.

VAR model

The specified VAR model describing the Rwandan economy is:

$$(4) \quad H(L)Y_t = K(L)X_t + \varepsilon_t$$

With $VAR(\varepsilon_t) = \Lambda$

The corresponding reduced form is:

$$(5) \quad Y_t = A(L)Y_{t-1} + B(L)Z_t + \mu_t$$

Where Y_t is a vector of endogenous variables and Z_t is a vector of exogenous variables. Y_t consists of constant GDP (y), price 2001, consumer price (p) index CPI, nominal effective exchange rate (e), monetary aggregates (or total credit) and short-term interest rates such as repo rates and T-bill rates. $A(L)$ corresponds to matrices of coefficients to be estimated, with lag lengths determined by standard information criteria. The vector Z_t consists of exogenous variables used to control for changes in the global economy. We use international oil prices because the Rwandan economy does not have an impact on their determination. All data is expressed in natural logs, with the exception of interest rate. The estimation is conducted on quarterly data from 2000 Q1 to 2016 Q1.

We adopt the following order of endogenous variables:

$$(6) \quad Y_t' = [y_t, p_t, m_t, i_t, e_t]$$

To characterize relationships between output, prices and policy related variables, we used the Augmented Dickey-Fuller (ADF). As in most VAR models of monetary transmission mechanisms, we did not perform an explicit analysis of the economy's long-run behavior because monetary transmission mechanisms are a short-run phenomenon. Using the estimated VAR model, we can analyze short-term dynamics based on variance decomposition and impulse response over the short to medium term. By estimating the VAR in levels, we implicitly allow cointegration relationships in the data.

All data is from BNR except data on GDP which is from the National Institute of Statistics of Rwanda (NISR) and data on oil prices is from IMF's international statistics.

Based on the estimated VAR model we examined the effect of a one standard deviation shock to interest rates, monetary aggregates and the exchange rate on both output and prices. We also estimated the reduced form by computing the Cholesky factorization of the reduced form VAR covariance matrix. In this framework, it is assumed that in the order of variables in the VAR model (given by Equation 6) a variable has no immediate effects on the preceding variable.

The relation between the reduced form errors (μ) and structural disturbance (ε) can be presented as:

$$(7) \quad \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^p \\ \varepsilon_t^m \\ \varepsilon_t^i \\ \varepsilon_t^e \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ e_{21} & 1 & 0 & 0 & 0 \\ e_{31} & e_{32} & 1 & 0 & 0 \\ e_{41} & e_{42} & e_{43} & 1 & 0 \\ e_{51} & e_{52} & e_{53} & e_{54} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^y \\ \mu_t^p \\ \mu_t^m \\ \mu_t^i \\ \mu_t^e \end{bmatrix}$$

The number of lags to be included in the model is determined using information criteria such as the Akaike information criterion and the Schwartz criterion. To check the robustness of our results, we also used the generalized impulses (Pesaran and Shin, 1998) which is less restrictive than Cholesky's and is invariant to the ordering of variables in the VAR model:

$$(8) \quad y_t = [y_t, p_t, r_t, e_t, m_t / cps_t]$$

5. Empirical evidence

As mentioned earlier, we first analyzed some aspects of monetary transmission mechanisms (MTMs) such as interest rate pass-through and exchange rate pass-through before using a VAR model.

Interest rate pass-through in Rwanda

Based on an assessment of specific features of the Rwandan financial system (low degree of monetization, under-developed financial markets) it was expected to have incomplete interest rate pass-through. We estimated the pass-through from money market rates (repo rates, the interbank rate and the T-bill rates with different maturities: 91, 182 and 364 days) to deposit and lending rates. First, we performed unit root tests on all the data series, using the standard augmented Dickey-Fuller test at the 5 per cent uncertainty level and found that all the used variables were integrated of order 1. The results of the Engle-Granger cointegration test on a pair of series confirmed that deposit rates in Rwanda can be explained by policy rates to the same extent, with long run elasticity varying between 0.25 and 0.33 for all money markets.

The coefficient C(3) in ECM which measures the speed of the pass-through to deposit rates from money market rates was as expected negative and significant. It varied

between -0.45 for repo rates to -0.8 for T-bills of 182 days. This is an indication on how fast deposit rates in Rwanda react to changes in money market rates. For the lending rate, the pass-through was not significant. Cointegration was found only between the lending rate and the repo rate and between the lending rate and interbank rate but all coefficients (short term and long term) were not significant.

These results might be due to more competition in the market for deposits as compared to loans. The share of the three largest banks in deposits significantly declined by 20.7 per cent from 58.6 per cent in 2009 to 37.9 per cent in 2015 while the share of loans declined only by 8.3 per cent in the same period from 54.7 per cent to 46.4 per cent (Table 3).

Table 3: Estimation of deposit rates on money market rates.

Long-term	Coefficient	R ²	DW	Short-term	Coefficient	R ²	DW
Repo rate	C(1) = 7.24 C(2) = 0.33*	0.37	1.2		C(1) = 0.01 C(2) = - 0.3 * C(3) = - 0.45*	0.4	2.07
Interbank rate	C(1) = 6.7 C(2) = 0.3*	0.48	1.5		C(1) = 0.02 C(2) = - 0.22* C(3) = - 0.65*	0.47	2.08
Tb91	C(1) = 7.01 C(2) = 0.25*	0.47	1.5		C(1) = 0.02 C(2) = - 0.2** C(3) = - 0.67*	0.49	2.09
Tb182	C(1) = 6.7 C(2) = 0.28*	0.56	1.7		C(1) = 0.01 C(2) = - 0.1 C(3) = - 0.8*	0.52	2.09
Tb364	C(1) = 6.07 C(2) = 0.33*	0.50	1.5		C(1) = 0.02 C(2) = -0.2* C(3) = - 0.7	0.48	2.1

Note: Long-run equation: $DR = C(1) + C(2) * Policyrate$

Short-term: $D(Dr) = C(1) + C(2) * DDr(-1) + C(3) * e(-1)$

Source: Author's estimations.

Exchange rate pass-through in Rwanda

We assessed the exchange rate pass-through using the structural VAR approach as defined by Equation 3. As shown in Table 4, the degree of pass-through was computed as the elasticity of prices to the exchange rate's initial shock and was found to be 0.30 in the period running from the first quarter of 2006 to the last quarter of 2014. It increased to 0.43 when we extended the sample to include 2015 and the first quarter of 2016, when Rwf experienced the highest depreciation in its history. The result points to the existence of the exchange rate channel in Rwanda though the pass-through remains incomplete.

Table 4: Exchange rate pass-through in Rwanda

Period in quarters	2006Q1 -2014Q4			2006Q1 -2016Q1		
	Exchange rate initial shock	D(LCPI) Estimates	Degree of pass-through	Exchange rate initial shock	D(LCPI) Estimates	Degree of pass-through
A	B	C	D	E	F	G
1	2.350692		D= C/B	2.451123		G= F/E
2		0.322237	0.137081761		0.383004	0.156256540
3		0.429397	0.182668338		0.614316	0.250626346
4		0.518272	0.220476353		0.783062	0.319470708
5		0.713977	0.303730561		1.000188	0.408052962
6		0.717240	0.305118663		1.045897	0.426701149

Period	D(LCPI)	D(LNEER)	Period	D(LCPI)	D(LNEER)
1	0.000000 (0.00000)	2.350692 (0.28935)	1	0.000000 (0.00000)	2.451123 (0.28116)
2	0.322237 (0.33227)	2.162124 (0.55218)	2	0.383004 (0.30000)	2.597868 (0.56218)
3	0.429397 (0.57527)	1.639962 (0.66436)	3	0.614316 (0.51459)	2.179956 (0.71699)
4	0.518272 (0.72199)	1.699195 (0.61832)	4	0.783062 (0.66123)	1.976343 (0.70014)
5	0.713977 (0.77023)	1.690035 (0.64554)	5	1.000188 (0.72995)	1.857784 (0.66121)
6	0.717240 (0.75044)	1.619743 (0.67246)	6	1.045897 (0.73294)	1.805769 (0.65293)
7	0.661235 (0.73135)	1.516896 (0.64149)	7	1.021953 (0.72127)	1.744996 (0.63498)
8	0.636187 (0.70201)	1.619904 (0.58273)	8	0.981053 (0.70119)	1.820001 (0.60019)
9	0.635242 (0.66847)	1.704487 (0.57264)	9	0.948757 (0.67763)	1.902917 (0.59200)
10	0.606136 (0.64277)	1.698092 (0.58823)	10	0.905869 (0.65606)	1.931718 (0.60311)

VAR model analysis

Before estimating the VAR model, we tested for unit root in all series using ADF tests. The results of the ADF tests suggest that all series were integrated of order 1 in levels, that is, they were I(1) (Table 1, Appendix A). As in most VAR models of monetary transmission mechanisms, we did not perform an explicit analysis of the economy's long-run behavior because monetary transmission mechanisms are a short-run phenomenon. Using the estimated VAR, we can analyze short-term dynamics based on variance decomposition and impulse response over the short to medium term (Favero, 2001). Descriptive statistics of the data is reported in Table 5.

Table 5: Descriptive statistics

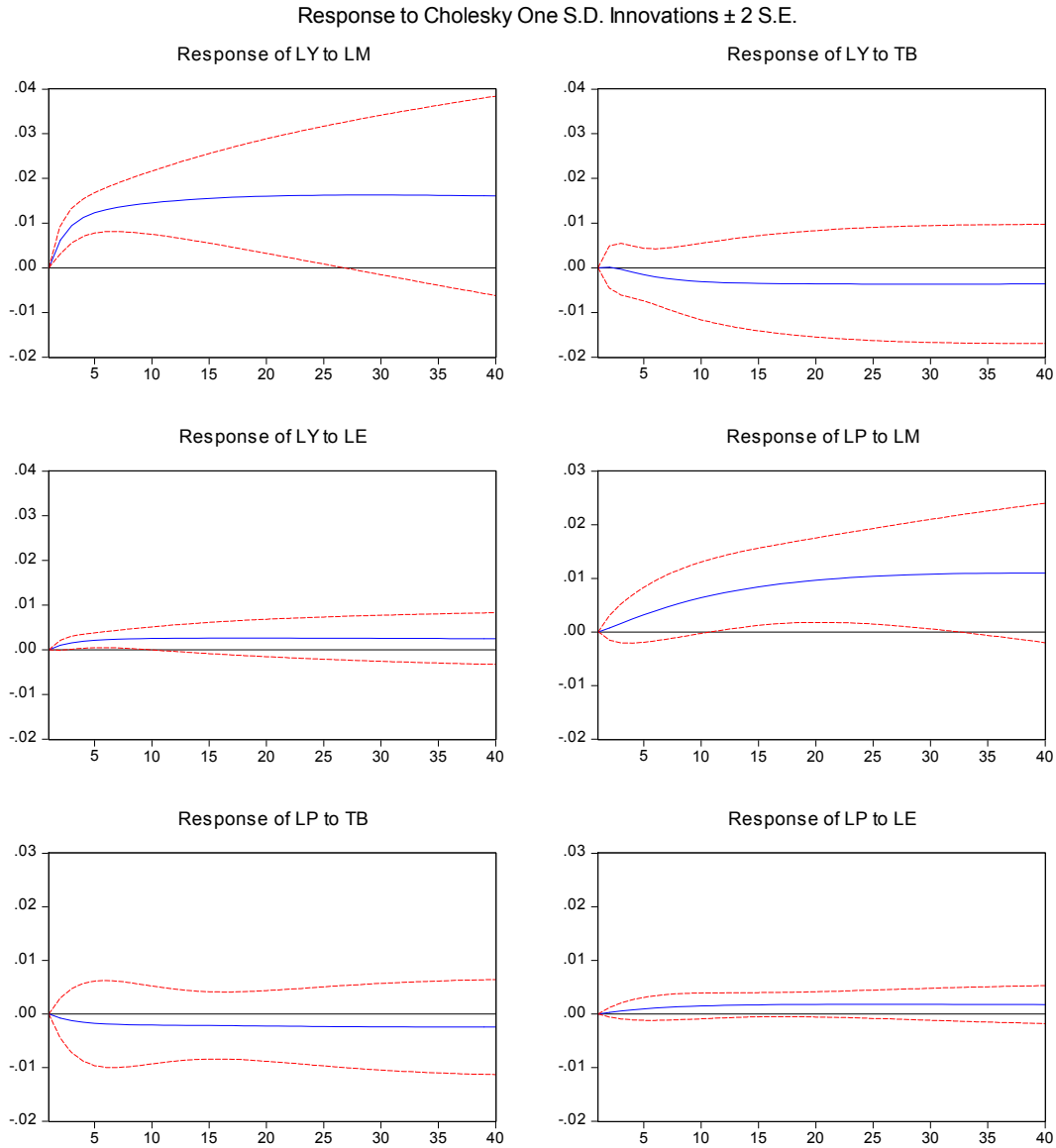
	LY	LP	LM	TB	LE
Mean	6.599806	4.199976	5.929448	8.618462	6.333081
Median	6.609349	4.223910	6.041444	8.700000	6.341593
Maximum	7.175490	4.657763	7.306397	12.800000	6.631475
Minimum	5.973810	3.637586	4.633758	4.000000	5.897429
Std. Dev.	0.359192	0.351422	0.828475	2.208994	0.152020
Observations	65	65	65	65	65

Lag length criteria indicate the use of 1 lag (Table 1, Appendix B) when the VAR is stable (Table 2 in Appendix B). The residual diagnostic tests in Tables 3 and 4 in Appendix B suggest well-behaved residuals. In summary, the analysis for modelling the data suggests that the VARs were empirically well behaved and with good residual diagnostics.

Figure 4 gives the impulse response functions indicating the impact of policy-related variables on output and prices, with the dotted lines representing 95 per cent confidence intervals. The results indicate that a 1 standard deviation shock to T-bill rates is associated with a drop in output and inflation. While the shape of the response function is consistent with the findings of different studies, the effect in Rwanda is not statistically significant. In addition, the results also indicate that the exchange channel is not active.

A shock to M3 appears to have a very rapid, significant and persistent effect on output which peaks after around 5 quarters. This is consistent with the real effects of monetary aggregates found in different studies in emerging and developing economies. In Rwanda it may be a reflection of the increasing monetization of the economy that took place over the period under review. This result indicates that changes in M3 resulting from changes in the monetary policy stance have an impact on output and inflation.

Figure 4. Impulse Response to One SD Innovations (± 2 S.E.)



In recent years Rwf has depreciated significantly leading to an increase in the exchange rate pass-through to domestic prices. In addition, significant changes were introduced in the reserve money program in Rwanda in 2010 and digital financial services were introduced in 2010 which also contributed to expanding financial services between 2012 and 2016. We estimated the impulse response function in the sub-sample starting with the first quarter of 2010 to analyze if those changes had an impact on monetary transmission mechanisms in Rwanda. Figure 5 shows that shock on monetary aggregates had an impact on both GDP and prices. In addition, prices and output reacted to changes in the nominal effective exchange rate, indicating that the exchange rate channel has been strengthening in recent years. Figure 6 shows impulse response to one SD innovations using credit to the private sector.

Figure 5. Impulse Response to One SD Innovations (± 2 S.E.)

Response to Cholesky One S.D. Innovations ± 2 S.E.

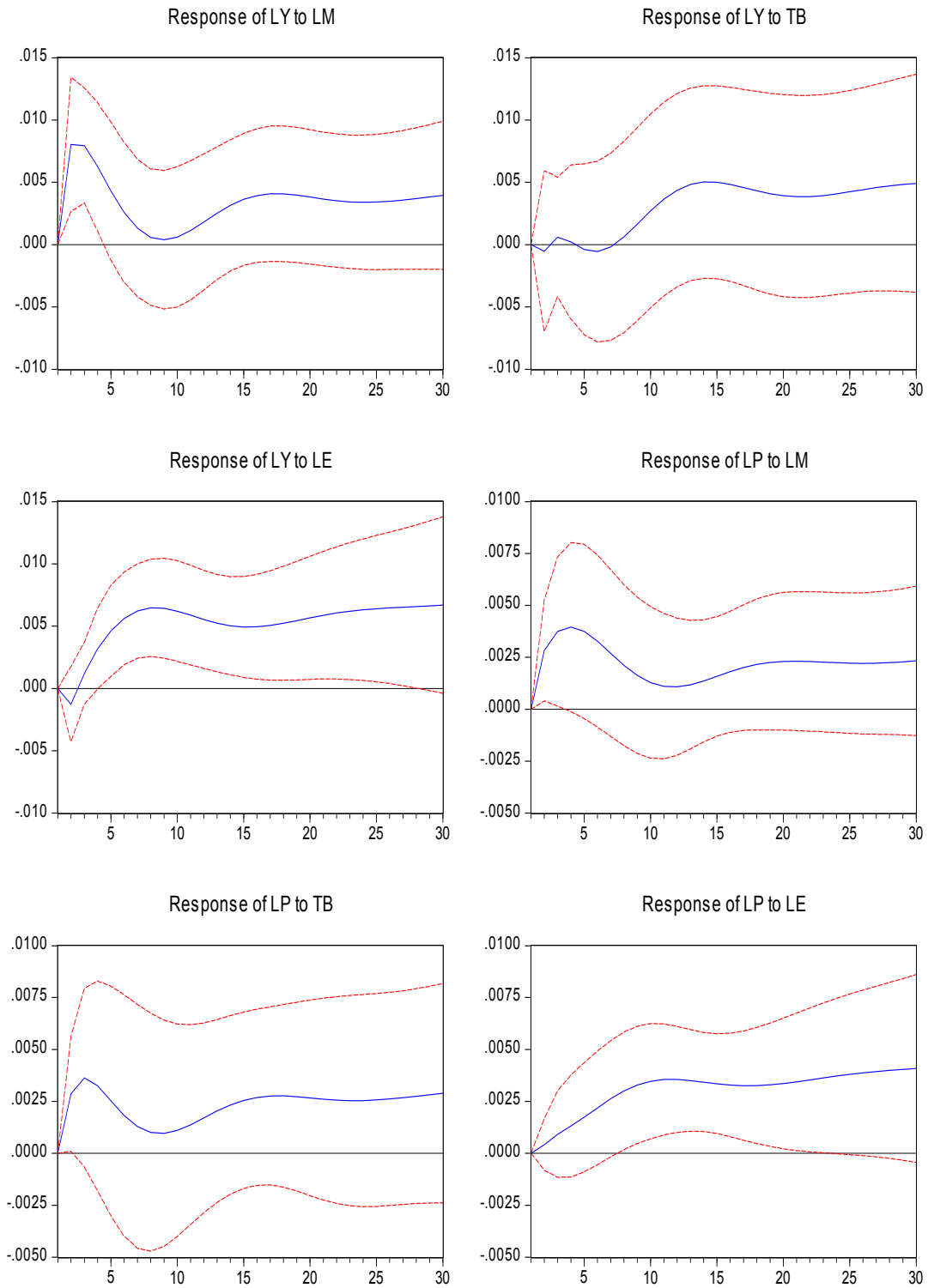
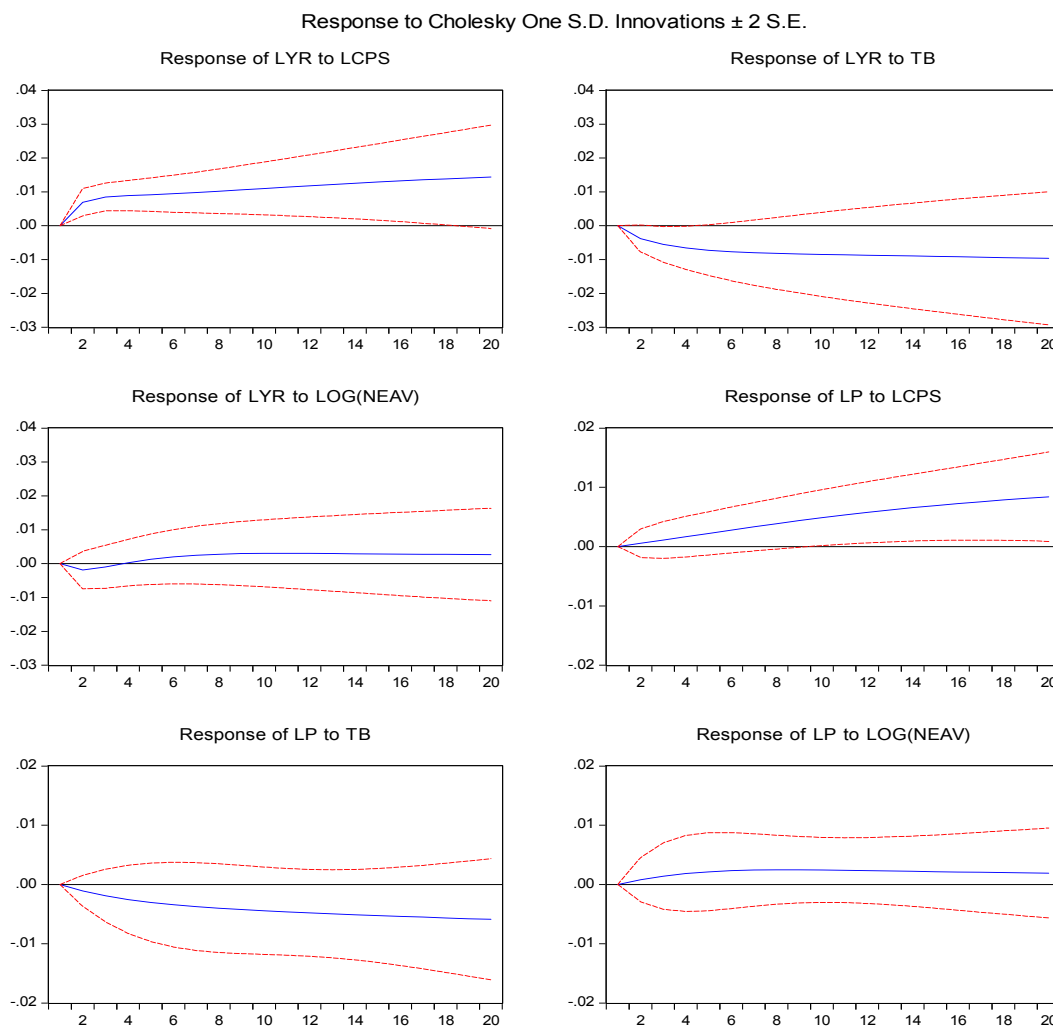


Figure 6. Impulse Response to one SD Innovations (± 2 S.E.) using credit to the private sector



6. Conclusion and policy recommendations

The objective of this paper was to assess monetary transmission mechanisms in Rwanda. We first analyzed their key determinants in Rwanda including BNR's monetary policy framework and conditions under which financial intermediation is conducted, the independence of the central bank and level of development of the financial system.

BNR is an independent central bank not allowed to grant direct advances or other loans to the state. To ensure BNR's independence a treasure management committee was created which had the mandate to ensure that the issuance of government securities was in line with liquidity forecasts provided by BNR. In terms of monetary policy, the current reserve money program in Rwanda was adjusted to introduce more flexibility in the implementation of the monetary policy. The main changes included the adoption of the average reserve money system in 2010 and the introduction of a reserve money band in 2012.

In addition, important developments were noted in the financial sector such as the entry of regional banks in the Rwandan banking sector, extension of the banking network across the country and the introduction of new financial products like mobile payments and mobile and internet banking which significantly contributed to expanding financial services between 2012 and 2016. As a result, the concentration in the banking sector has been decreasing over time; this is also indicated by the increase in the shares of the three largest banks in loans, deposits and total shares as well as the Herfindahl index developed for the Rwandan banking sector.

However, despite these good developments, the banking sector continues to show persistent short-term liquidity mainly due to the not yet well-developed financial market, particularly the interbank market and the market for government securities. In addition, these developments have not contributed much to increasing the size of the formal financial sector in Rwanda. This explains why the interest rate pass-through to lending rate is very low. However, the results indicate a significant pass-through to deposit rates with corresponding coefficients ranging between -0.45 for repo rates and -0.8 for treasury bills of 182 days.

Weak pass-through to the lending rate is also due to limited substitution between bank lending and equity and other debt securities as the capital market in Rwanda is very nascent. Total investments in T-bills and bonds in Rwanda represented 5.5 per cent of GDP in 2015 up from 3.4 per cent in 2013. These results clearly indicate that the interest rate channel in Rwanda is not working properly and that the impact of monetary policy actions on the cost of banking loans is also very low. If the bank lending channel exists, it works through the impact of monetary policy actions on the availability (amount) of bank loans.

The exchange rate channel was weak till recently. Following increased external inflows, BNR regularly intervened in the FX market selling US dollars to commercial banks. This contributed to the stability of the Rwandan franc between 2004 and 2012. However, after the aid cut in 2012, there was a significant decline in export earnings due to poor global economic conditions and the introduction of more flexibility in the exchange rate framework and Rwf depreciated significantly by 7.6 per cent in 2015 and 9.8 per cent in 2016. This development contributed to the strengthening of the exchange rate channel.

Results from an estimation of impulse response functions confirm that the interest rate channel in Rwanda is weak with a one standard deviation shock to the T-bill rates (used as an indicator of monetary policy actions) associated with a drop in output and inflation. While the shape of the response function is consistent with the findings of different studies, this effect is not statistically significant in Rwanda. In addition, the results also indicate that the exchange rate channel is weak, but it has been improving in recent years.

There is clear evidence that the monetary aggregates channel is active in Rwanda. A shock to M3 (or changes in the available amount of credit), as a result of BNR's actions, appears to have a very rapid, significant and persistent effect on output which peaks after around 5 quarters. This may be a reflection of the increasing monetization of the Rwandan economy that has taken place over the period under review. The effect of a shock to M3 on prices is positive and significant but appears late, after more than two years. In recent years, Rwanda has experienced rapid money growth while inflation has remained relatively low. We estimated the impulse response function in the sub-sample starting in Q1 2010 to analyze if different changes introduced in the financial sector in

Rwanda and developments in the foreign exchange market had an impact on monetary transmission mechanisms. Our results show that not only did a shock in monetary aggregates have an impact on both GDP and prices but prices and output also reacted to changes in the nominal effective exchange rate.

As a policy recommendation, to ensure a smooth transition to the use of interest rate as the operating objective by 2018, BNR and other stakeholders will need to support the current trends in the development of financial markets to increase the: (i) substitution between bank deposits and T-bills by increasing the participation of households and non-bank institutional investors in treasury bills of different maturities; (ii) substitution between bank lending and other types of external finance like equity or bond markets by developing capital markets (both primary and secondary markets); (iii) increase competition in the banking sector not only by reducing concentration but also by diversifying financial products in the sector; (iv) extend the formal financial sector by helping banks to extend loans to key economic sectors which remain less financed by the banking sector such as the agriculture sector; and (v) allow more flexibility in the exchange rate policy.

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Appendix A

Table 1: Unit root tests

	Level		First differences	
Variables	Lag	ADF	ADF	Conclusion
Y	1	-2.74	-2.88***	I(1)
P	1	-2.64	-4.89*	I(1)
M3 ²	0	-1.80	-10.3*	I(1)
T-bill rates	0	-2.90	-7.45*	I(1)
Repo rates	0	-0.96	-7.90	I(1)
Deposit rate	0	-0.32	-7.90	I(1)
Lending rates	2	-0.06	-8.01	I(1)
E	1	-2.06	-3.08**	I(1)
Cps	0	-2.97	-9.03*	I(1)

*: significant a 1%; **: significant at 5% and ***: significant at 10%.

Appendix B

Table 1: VAR Lag Order Selection Cri

Endogenous variables: lry lp lm tb lne

Exogenous variables: C OIL

Lag	LogL	LR	FPE	AIC	SC	HQ
0	126.1943	NA	1.52e-09	-6.115488	-5.684544	-5.962162
1	290.5240	268.1170	1.01e-12	-13.44863	-11.94033*	-12.91199
2	327.9223	51.17653*	5.78e-13*	-14.10117*	-11.51551	-13.18121*
3	350.7444	25.22443	8.15e-13	-13.98655	-10.32352	-12.68327

Table 2: Roots of Characteristic Polynomial

Endogenous variables: lry lp lm tb lne

Exogenous variables: C OIL

Root	Modulus
0.983234	0.983234
0.869303	0.869303
0.634919 - 0.037241i	0.636010
0.634919 + 0.037241i	0.636010
-0.070706	0.070706

No root lies outside the unit circle.

VAR satisfies the stability condition.

Table 3: VAR Residual Heteroskedasticity

Tests:

Joint test:		
Chi-sq	df	Prob.
182.2901	180	0.4383

Tab 4: VAR Residual Normality Tests

Orthogonalization: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Component	Jarque-Bera	df	Prob.
1	1.072675	2	0.5849
2	0.669157	2	0.7156
3	1.268359	2	0.5304
4	10.72069	2	0.0047
5	1.410507	2	0.4940
Joint	15.14139	10	0.1270

Table 5: Variance decomposition

GDP						
Period	S.E.	LOG(RY)	LOG(CPI)	LOG(M3)	TB52	LOG(NE1)
1	0.025521	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.037670	56.26283	14.25988	28.66367	0.325971	0.487646
3	0.045957	46.31827	15.27432	37.58089	0.220103	0.606404
4	0.052994	41.63202	14.25481	43.17826	0.175998	0.758909
5	0.059276	39.11747	12.65157	47.13083	0.154607	0.945525
6	0.065079	37.62918	11.00417	50.08731	0.134685	1.144655
7	0.070554	36.67955	9.522879	52.34811	0.115112	1.334345
8	0.075783	36.02907	8.279474	54.09010	0.101204	1.500148
9	0.080814	35.55147	7.281413	55.43369	0.097845	1.635580
10	0.085669	35.17742	6.507242	56.46786	0.107476	1.740007
Price						
Period	S.E.	LOG(RY)	LOG(CPI)	LOG(M3)	TB52	LOG(NE1)
1	0.014483	2.958831	97.04117	0.000000	0.000000	0.000000
2	0.020708	1.887186	95.67815	1.947113	0.487404	0.000150
3	0.024662	1.926598	93.27041	3.438881	1.357493	0.006621
4	0.027508	2.314643	90.30165	5.147461	2.174418	0.061825
5	0.029679	2.961453	86.93502	7.111209	2.801310	0.191011
6	0.031427	3.824868	83.25380	9.323492	3.209899	0.387940
7	0.032914	4.865908	79.34036	11.74268	3.422146	0.628906
8	0.034248	6.040020	75.28845	14.30575	3.479304	0.886479
9	0.035496	7.299182	71.19762	16.93962	3.426166	1.137409
10	0.036704	8.596513	67.16300	19.57175	3.303108	1.365628

Table 5: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.752	21.600	21.600	4.752	21.600	21.600
2	3.113	14.148	35.748	3.113	14.148	35.748
3	2.158	9.809	45.557	2.158	9.809	45.557
4	1.812	8.235	53.793	1.812	8.235	53.793
5	1.373	6.240	60.032	1.373	6.240	60.032
6	1.035	4.707	64.739	1.035	4.707	64.739
7	.978	4.445	69.184			
8	.923	4.194	73.377			
9	.783	3.559	76.936			
10	.721	3.277	80.213			
11	.672	3.054	83.267			
12	.600	2.726	85.992			
13	.497	2.260	88.253			
14	.466	2.118	90.370			
15	.406	1.848	92.218			
16	.378	1.720	93.938			
17	.320	1.453	95.391			
18	.244	1.109	96.499			
19	.240	1.090	97.589			
20	.207	.940	98.530			
21	.191	.867	99.396			
22	.133	.604	100.000			

Extraction Method: Principal Component Analysis.

Source: Primary data.

Table 6: Factors with eigenvalues greater than 1.0

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.752	21.600	21.600	3.534	16.065	16.065
2	3.113	14.148	35.748	2.908	13.219	29.284
3	2.158	9.809	45.557	2.894	13.155	42.439
4	1.812	8.235	53.793	1.922	8.737	51.176
5	1.373	6.240	60.032	1.776	8.072	59.248
6	1.035	4.707	64.739	1.208	5.491	64.739

Extraction Method: Principal Component Analysis.

Source: Primary data.

Table 7. Rotated Component Matrix^a

	Component					
	1	2	3	4	5	6
Herding -experienced investors' decisions	.807					
Herding- friends or family members' decisions	-.779					
Influence of people's opinions	.734					
Gender	-.704					
Age	.694					
Over-reaction to good information		.487				
Over –or under-confidence		.835				
Irrational thinking		-.716				
Cognitive bias profit maximization		-.658				
Get-rich-quick		.619				
Over-reaction to bad information		-.581				
Past performance of the company			-.847			
Accounting information			.813			
Ownership structure			.762			
Expected corporate earnings			-.754			
Dividends			.495			
Risk factors				.836		
Bonus payments				-.815		
Education					.757	
Increase in income					.719	
Decrease in income					.535	
Cognitive bias- good/bad news						.694

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Source: Primary data.

Chapter Eighteen

Excess Liquidity and Rwanda's Monetary Policy

Thomas Kigabo RUSUHUZWA

BNR, CBE, University of Rwanda

E-mail: kthomas@bnr.rw

and

Ananias Gichondo

Economic Research and Financial Stability Analysis Division, BNR

E-mail: agichondo@bnr.rw

ABSTRACT

This study examines the potential determinants of precautionary excess liquidity in the Rwandan banking system during the period 2004-16 and its optimal level above or below which excess liquidity becomes a constraint in monetary policy transmission. The study uses the FMOLS autoregression approach to estimate the determinants of precautionary excess reserves. However, for ease in interpreting the coefficients, the study also estimates the sum of coefficients using the dynamic least squares (DOLS) method with the lag operator set to 1. For the optimal excess liquidity level it uses the Kernel density estimation to estimate the probability density of the estimated precautionary excess liquidity. To avoid sample dependence on the optimal level obtained it uses the bootstrap method to obtain a confidence interval of the values computed. The results obtained from the regressions suggest that the reserve requirement, change in demand for cash proxied by the output gap and the lagged value of excess liquidity are important determinants of precautionary excess liquidity in the Rwandan banking system. Using the summation of coefficients, the lagged values of the cash-to-deposit ratio, discount rate and foreign exchange exposure are also found with significant positive relationships. Considering the first and second conditions of liquidity minimization, the study finds the optimal level of excess liquidity at around Frw 34 billion. On an average of five years, the excess reserves should be around Frw 14.3 billion. The estimations are based on the assumption that the existing reserve requirement is optimum. The findings can be used as a base for the central bank to improve its liquidity management for an effective monetary policy.

Keywords: Excess liquidity, monetary policy, Rwanda.

JEL Classification Codes: E51; E52; O55.

1. INTRODUCTION

In the last decade Rwanda achieved high economic growth averaging around 7.5 per cent in a stable macroeconomic environment characterized by low levels of inflation and a stable exchange. Economic stability, improvements in the business environment and significant budget support from international partners contributed in creating excess liquidity in the banking sector leading to high growth of broad money (M3) by 18 per cent on average between 2000 and 2016. Banking reserves exceeding the statutory requirements increased from 17 per cent between 2004-08 to 38 per cent in 2009-12 and 46 per cent in 2013-16.

There is consensus among central bankers and academicians about the impact of high liquidity in the banking sector on the effectiveness of monetary policy. First, improvements in demand conditions may lead banks to expand their lending to the private sector, which may create inflationary pressures. Second, significant banking liquidity may limit the monetary policy's ability to influence aggregate demand in the economy. If banks hold liquidity in excess of requirement, the central bank's actions aimed at stimulating aggregate demand (by lowering the central bank rate or increasing reserve money) by increasing liquidity will be ineffective. In other words, excess bank liquidity weakens the monetary policy transmission mechanism (see, for example, Agénor et al., 2004; Nissanke and Aryeetey, 1998). Another way in which excess liquidity limits the effectiveness of monetary policy is linked to its impact on the good functioning of the interbank market, which is key for a price based monetary policy.

In Rwanda, the banking sector has been characterized by high excess reserves. This has contributed to weakening the interbank market and making the BNR rate an opportunity cost of holding reserves rather than a cost of central bank funds. A shallow or non-liquid interbank market has contributed to limiting the effectiveness of money market operations in Rwanda by distorting a key aspect of the interest rate transmission channel.

Two categories of excess liquidity can be distinguished: excess bank liquidity held for precautionary purposes and reserves held above that level (called involuntary excess reserves) which could limit transactions between commercial banks and the central bank and weaken the central bank's ability to influence the interest rate and credit growth in the market.

Gichondo and Nizeyimana (2010) were the first to identify the causes of the observed excess liquidity during 2004-08 and its impact on the effectiveness of monetary policy in Rwanda.

Our study has two objectives. First, we identify the potential determinants of precautionary excess liquidity in the Rwandan banking system extending the period used by Gichondo and Nizeyimana up to 2016. Second, we estimate the optimal level above which excess liquidity becomes a constraint in the transmission of monetary policy. This is very important as BNR is planning to move from a monetary aggregate framework to a more price based monetary policy. The new framework requires a liquid interbank market and a strong interest rate pass-through which will depend on proper banking liquidity management by BNR using open market operations. The findings of our study can guide BNR's daily money market interventions to influence liquidity in the banking system.

2. LITERATURE REVIEW

Different studies have analyzed the implications of excess liquidity on central banks' capacity to impact aggregate demand in economies (Arestis and Demetriades, 1999; Caprio and Honohan, 1993; Freedman and Click, 2006; Gentil and Fatima, 2012; Nketcha and Samson, 2014; Saxegaard, 2006). Gentil and Fatima (2012) show that the persistence of excess liquidity for both precautionary and involuntary purposes is due to the inadequate development of financial markets, high level of risk aversion and high capital inflows. In such an economic environment, the accumulation of excess reserves raise distress on banks' profitability, lead to inflationary pressures and impact the monetary policy's transmission mechanism as also its effectiveness. Arestis and Demetriades (1999) show that low competition in the banking system can lead to the building up of excess liquidity in the banking sector. They show that under a perfect loan market, excess liquidity and bank loans become substitutes at a zero loan rate and that in developing economies, the substitution is at higher loan rates because of low competition in the banking system.

This build-up of excess liquidity in developing countries has been the subject of several studies such as those by Fielding and Shortland (2002, 2005) for Egypt; Aikaeli (2006) for Tanzania; Khemraj (2006) for Guiana; Saxegaard (2006) for CEMAC, Nigeria and Uganda; Moumni and Nahhal (2014) for Morocco; Gichondo and Nizeyimana (2010) for Rwanda.

Different studies, including Agénor et al., (2004) and Agénor and Aynaoui (2010) have identified two motives for banks holding excess liquidity: precautionary and involuntary. Existing literature classifies determinants of involuntary excess liquidity into structural and cyclical factors. Regarding structural determinants, Saxegaard (2006) and Agénor and Aynaoui (2010) assert that banks' demand for involuntary balances is a result of a low developed interbank market, high operational costs, an underdeveloped public bonds market and absence of remunerative alternatives for excess balances.

According to Mishkin (2001), banks decide to accumulate excess reserves for reasons related to safety measures against operational costs. He notes that the higher the costs related to deposit outflows, the more the excess reserves that are held. Other determinants of excess liquidity include huge capital inflows, rising inflation and an uncertain economic environment (Agénor and Aynaoui, 2010).

Empirically, different models have been used to estimate the level of excess liquidity for both precautionary and involuntary purposes and their consequences on the effectiveness of monetary policy. These models include the GMM estimator, TSLS, ARDL and VAR. Saxegaard (2006) used a non-linear structural VAR model to investigate the consequence of banks holding excess liquidity on the effectiveness of monetary policy in the CEMAC region, Nigeria and Uganda as an extension of the model developed by Agénor et al., (2004). His findings suggest that excess liquidity limited the effectiveness of monetary policy transmission leading monetary authorities to lose their ability to influence demand conditions in the economy.

Using the same model for Morocco, Moumni and Nahhal (2014) obtained the same findings. The particularity of this study is that for Morocco the effect was manifested in the long run. Gichondo and Nizeyimana's study (2010) on Rwanda found the same

results indicating that excess liquidity was one of the key factors limiting the impact of monetary policy authorities on banks' behavior in terms of lending to the private sector.

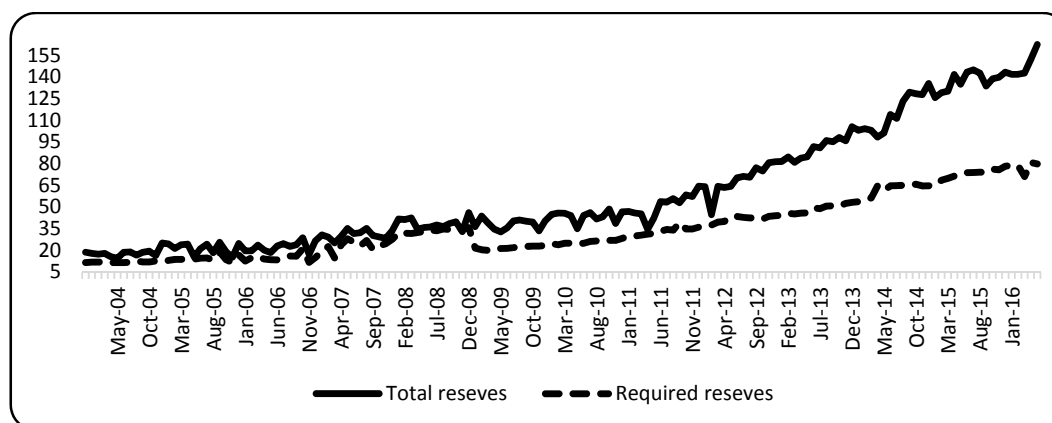
Using the same methodology, Gouteron and Szpiro (2005) found that liquidity did not explain variations in asset prices which complicate the role of monetary authorities as they cannot predict the changes in asset prices which in turn may affect the transmission of monetary policy.

Khemraj (2006) proposes two different hypotheses that work simultaneously to explain why non-regulated commercial banks in Guyana demanded large quantities of excess liquidity. One is the banks' desire for a minimum rate of interest at which loans and government securities are perfect substitutes and the second is the banks' intentions not to invest all excess reserves in safe foreign assets because the central bank creates foreign currency constraints by accumulating foreign exchange reserves.

3. Liquidity trends in the RWANDAN BANKING SYSTEM

The Rwandan banking sector has been characterized by increasing excess reserves -- from 17 per cent of the required reserves between 2004-08 to 38 per cent in 2009-12 and 46 per cent in 2013-16 -- mainly due to foreign aid, foreign direct investments (FDI) and less developed financial markets (Figure 1). Total disbursements for both budget and project support increased by 131.9 per cent between 2004 and 2015 and stood at US\$ 518.5 million in 2015 against US\$ 223.6 million in 2004. This contributed to significantly increasing the share of net foreign assets in broad money (M3) which averaged around 74.5 per cent during the period under review. Increasing remittances, FDI, debt relief under the highly indebted poor countries' (HIPC) initiatives in 2005, foreign aid and the country's privatization program for state-owned enterprises contributed to money creation through domestic government and household expenditure and played a major role in building high banking liquidity.

Figure 1: Total reserves and required reserves (in Frw billion)



Source: BNR (Financial Markets Department).

In the same period, deposits in the banking sector increased significantly and were dominated by demand deposits, averaging 41.6 per cent of the total deposits. This pushed banks to hold more precautionary cash deposits to withstand any unexpected withdrawals by their clients (Table 1).

Table 1: Development of monetary aggregates

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Share of Total M3													
NFA	84.6	90.4	88.8	82.6	86.6	84.1	84.3	86.2	62.4	72.3	56.4	43.4	46.4
NDA	15.4	9.6	11.2	17.4	13.4	15.9	15.7	13.7	37.6	27.7	43.6	56.6	53.6
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Share of Total Deposits													
Demand deposits	36.3	41.6	38.0	41.9	43.5	42.5	45.7	41.1	40.7	41.5	41.3	45.9	40.6
Time deposits	32.9	36.4	39.9	39.2	35.1	36.3	35.4	38.9	38.3	37.2	36.8	35.0	36.7
FX deposits	30.8	21.9	22.1	18.9	21.3	21.7	18.9	20.0	21.0	21.3	21.9	19.1	22.7
Total	100	100	100	100	100	100.4	100	100	100	100	100	100	100

Source: BNR (Statistics Department).

Since the 1990s, BNR has started using open market operations to implement its monetary policy: weekly tenders for liquidity injection or mop up and issuance of treasury bills. However, the management of liquidity in the banking system has become challenging over time, particularly after the 2003 presidential elections when business confidence and aid inflows increased significantly. This was further intensified by a US\$ 1.4 billion debt relief in 2005 under the HIPC initiative. BNR reduced the reserve requirement ratio in 2000 to 8 per cent from 10 per cent and the reserve requirement maintenance period was revised from one week to one month in 2001. The objective of these policy measures was to allow banks to finance the private sector and support the government's economic policies.

Owing to sound economic policies, sizable donor support and important economic financing by commercial banks, the Rwandan economy recorded good performance with real GDP rates ranging between 7.4 per cent in 2004 to 11.2 per cent in 2008 and 7.5 per cent on average in the last decade. The external position strengthened as foreign capital inflows offset the trade deficit allowing a build-up of international reserves to comfortable levels. Recent macroeconomic developments are given in Table 2.

Table 2: Recent economic developments

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Real GDP Growth (in per cent)	7.4	9.4	9.2	7.6	11.2	6.2	7.3	7.8	8.8	4.7	7.0	6.9
Exports (YoY, per cent change)	55.4	27.6	14.0	24.1	51.5	-28.0	32.0	52.4	24.5	18.7	4.7	-6.8
Imports (YoY, per cent change)	19.4	29.9	35.2	35.8	54.0	9.9	11.4	36.1	16.3	2.2	6.6	-3.2
Export cover	31.7	31.1	26.3	24.0	23.6	15.5	18.3	20.5	22.0	25.5	25.1	24.2
Months of imports	7.6	6.8	7.0	5.1	6.3	7.2	7.0	6.7	4.8	4.5	4.4	4.6
Total Grants (YoY, per cent change)	68.9	27.8	2.8	22.6	35.0	24.2	14.4	11.5	-22.0	32.9	-8.1	-11.2
Budgetary grants (YoY, per cent change)	77.6	20.2	-34.0	82.1	39.3	25.8	18.1	9.1	-49.8	52.2	-34.6	2.7
Capital grants (YoY, per cent change)	50.3	47.1	78.9	-22.8	27.2	20.9	6.8	16.9	36.9	18.0	18.3	-21.8
Public debt (y-o-y % change)	15.0	-10.3	-56.9	20.4	4.5	12.7	10.2	21.1	9.8	33.2	16.0	16.8
Public debt (% of GDP)	92.7	67.3	24.1	23.9	19.6	20.0	20.5	22.1	21.5	27.5	30.4	34.5
Inflation	10.2	5.6	12.1	6.6	22.3	5.7	0.2	8.3	3.9	3.6	2.1	4.5

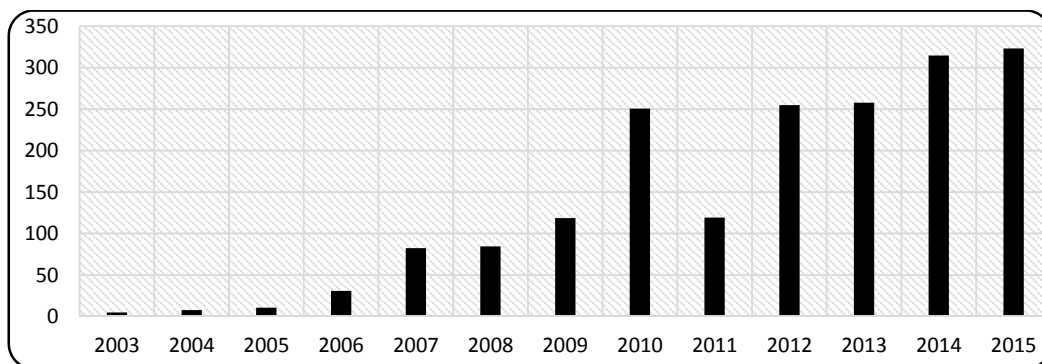
Source: Monetary Policy Directorate.

In end-2008, a number of factors plunged the banking system into a liquidity crunch which lasted for a few months. These include huge investments by the Rwanda Social Security Board (RSSB) in different projects and the global financial crisis. As a result,

deposits in the banking sector declined from Frw 400.5 billion in November 2008 to Frw 358.9 billion in February 2009 and some banks under stress used BNR's lender-of last resort facilities for the first time.

Different policy responses were implemented including a reduction in the reserve requirement from 8 per cent to 5 per cent in February 2009, introduction of a 3 to 12 month BNR liquidity facility while all T-bills were not rolled over at their maturities. In addition, a Frw 22.4 billion long term government facility for five years was given to seven banks to increase their capacities to finance long-term projects. As a result, the liquidity situation in the banking sector improved. Total deposits of commercial banks increased from Frw 366.6 billion in end March 2009 to Frw 783.1 billion in end December 2012. See Figure 2.

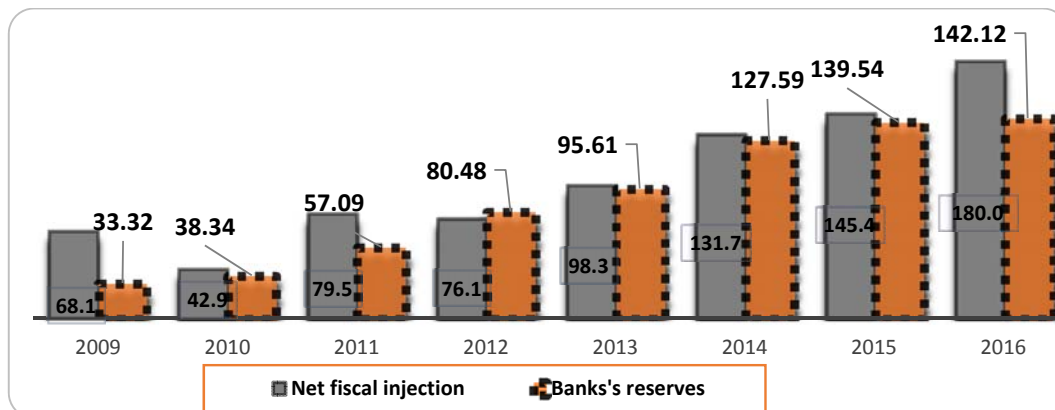
Figure 2: Evolution of Foreign Direct Investment (in USD million)



Source: BNR (Statistics Department).

During the second half of 2012, the suspension and delays in budget support led the total grants to contract by 22 per cent from an increase of 11.5 per cent in the previous year of which budgetary grants plunged by 50 per cent from a 9 per cent growth. Fiscal and monetary authorities responded to the aid shock by tightening policies and drawing reserves to mitigate the impact of aid suspension and cuts on the economy. This contributed to maintaining excess liquidity in the banking sector through government expenditure which was partly financed by increased domestic borrowings. Figure 3 shows how the net fiscal injection has been increasing over time.

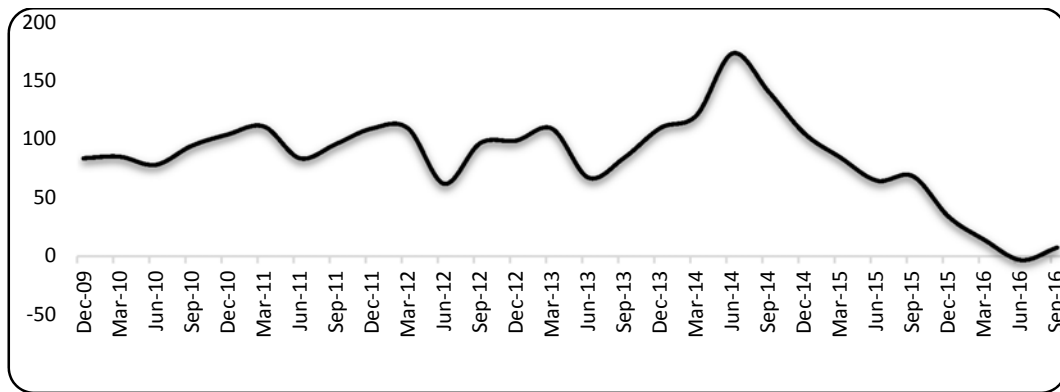
Figure 3: Net fiscal injections (in Frw billion)



Source: BNR (Statistics and Currency and Banking Operations Departments).

Increased domestic borrowings led to an increase in market interest rates and the use of reserves to mitigate growing pressures in the foreign exchange market contributed to a reduction of the reserve cover to 3.4 months of potential imports by end 2012. In addition, the slowdown in the global economy with a fall in commodity prices continued to exacerbate the trade deficit resulting in a progressive decline in forex inflows. This in turn intensified pressures on the domestic foreign exchange market. Further, commercial banks' net foreign assets fell by 92 per cent between December 2012 and September 2016 and banks were forced to hoard excess liquid assets large enough for safety measures against foreign exchange risks (Figure 4).

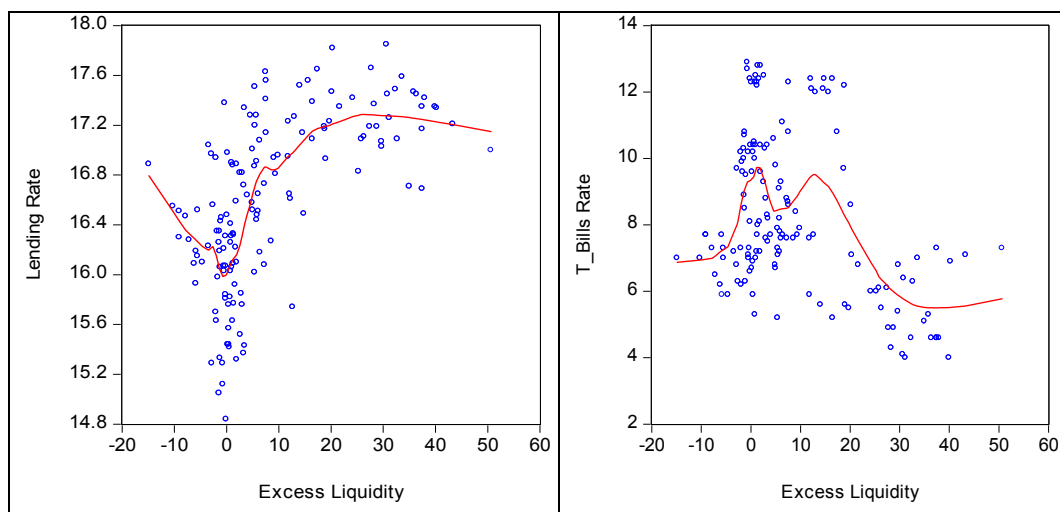
Figure 4: Trends in Commercial banks' net foreign assets (in Frw billion)



Source: BNR (Statistics Department).

In addition to these drivers of banking liquidity in Rwanda, weak completion in the banking sector also contributed to the build-up of excess liquidity. Using locally weighted polynomial regressions (LOESS) of degree one on monthly data ranging from 2004 to 2016, the liquidity preference against the lending and T-bill rates became flat at approximately 17.2 per cent for lending rate and 5.6 per cent for T-bills (Figure 5).

Figure 5: Excess reserves and the lending /T-bills rates LOESS fit (degree = 1 and span = 0.3).



Source: Authors' estimation using BNR data.

Figure 5 shows that excess reserves and lending rate as well as T-bills in Rwanda became substitutes at a high rate of interest, which is an indication of lack of competition in the banking sector. In competitive and pure concurrence loan markets, excess liquidity and loans are substitutes at a zero loan rate.

In the T-bills market, the substitute is at around 5.6 per cent, the minimum rate which banks demand before they bid for T-bills. This indicates the absence of a liquidity trap situation in which securities fall to zero and as a result money and government securities become perfect substitutes.

4. METHODOLOGY

We identified the determinants of precautionary excess liquidity in the banking sector in Rwanda before estimating its optimal level above which the banks' excess reserves become excessive.

4.1 Determinants of precautionary demand for excess liquidity

Following Agénor et al. (2004) we estimated demand for precautionary excess reserves by regressing excess liquidity on its hypothesized determinants. The conceptual framework is as follows: A bank has to decide the level of non-interest bearing reserve assets R and non-reserve assets which take the form of illiquid loans, L that are consistent for sustaining its profitability for a given level of deposits, D . The bank balance sheet is therefore given by:

$$(1) \quad R + L = D$$

where, reserves, R , are prerequisite as the bank is exposed to liquidity risks and deposit flows, u , occur randomly.¹

When net cash outflows surpass its reserves, a bank is exposed to illiquidity costs which are proportional to the reserve deficiency $\max(0, u - R)$. In such circumstances, the bank is obliged to borrow the missing reserves at a penalty rate q . In this case, the bank's profit is given by:

$$(2) \quad \Pi = r_L L - r_D D - q \max(0, u - R)$$

where, r_L is the interest rate on loans and r_D is the deposit rate.

Therefore, the bank's expected profit is:

$$(2A) \quad E(\Pi) = r_L L - r_D D - q \int_R^{U_H} (u - R) \phi(u) du$$

Using Equation 1 to eliminate L , Equation 2A becomes:

¹ U is a random variable which captures the net withdrawal of liquidity and its probability $Pu \in [u_L, u_H] = \int_{u_L}^{u_H} u \phi(u) du$.

$$(3) \quad E(\Pi) = (r_L - r_D)D - r_L R - q \int_R^{U_H} (u - R) \phi(u) du$$

So, the optimal level of reserves is determined by maximizing the expected profits $E(\Pi)$ and the necessary condition is given by:

$$(4) \quad \frac{\partial E(\Pi)}{\partial R} = 0 \Leftrightarrow -r_L + q[1 - \Phi(R)] = 0$$

$$(5) \quad R^* = \Phi^{-1}\left(\frac{q - r_L}{q}\right)$$

This equation shows that the marginal opportunity cost, r_L , of holding an extra unit of reserves is associated with a marginal reduction in liquidity costs. Hence, the optimal reserves are negatively related to the lending rate r_L but positively related to the penalty rate q .

By considering that the demand for loans L is negatively related to the lending rate r_L and positively related to the expected output Y^e while the supply of deposits D by the public is positively related to the deposit rate r_D as well as to the expected output Y^e , Equation 2 can be rewritten as:

$$(6) \quad \Pi = [r_L f(r_L) - r_D g(r_D)]Y^e + r_L R - q \max(0, u - R)$$

where, $L = f(r_L)Y^e$ and $D = g(r_D)Y^e$

To meet an unexpected demand for cash, a bank has two possible ways: borrow at a penalty rate, q , or use its excess reserves. So, the expected reserve deficiency may be written as $E\max[0, C - ((1 - \theta)D - L)]$ and this allows us to define the bank's expected profits as:

$$(7) \quad \Pi = [r_L f(r_L) - r_D g(r_D)]Y^e + r_L R - q E\max(0, ((1 - \theta)D - L)]$$

Among the developments which express commercial banks' behavior, Agénor et al. (2004), provides three essential propositions:

Firstly, a penalty rate has a positive relationship with deposits, lending rates and excess reserves held by commercial banks. This implies that for a high enough level of the penalty rate, excess reserves exceed expected withdrawals ($Z - u > 0$).

Secondly, the effect of volatility of output and liquidity shocks is ambiguous on the deposit rate, lending rate and excess reserves. But if the initial level of the penalty rate is high enough, a positive change in volatility positively impacts all the three variables.

Lastly, an increase in the reserve requirement rate has a positive effect on the lending rate and a negative impact on excess reserves. According to Agénor et al. (2004) combining the three assumptions the following demand function for precautionary excess reserves is derived:

$$(8) \quad \ln\left(\frac{EL}{D}\right) = a_1(L) \ln\left(\frac{EL}{D}\right) + a_2(L) \ln\left(\frac{RR}{D}\right) + a_3(L) CV_{C/D} + a_4(L) CV_{Y/YT} + a_5(L) \ln\left(\frac{Y}{Y_T}\right) + a_6(L)r + a_7(L) EXPO + v_t$$

where, v_t denotes the error term and L is the lag operator.

The dependent variable is the ratio of the logarithm of excess liquidity held by banks, EL to total deposits, D . The explanatory variables are current and lagged values of the logarithm of the dependent variable, logarithm of the ratio of required reserve assets, RR , to total bank deposits, D , coefficient of variation of the cash-to-deposit ratio, C/D and the deviation of output from trend, Y/YT ; discount rate, r , which corresponds to the penalty rate; and exchange rate exposure. In particular, the dynamics of adjustment of EL/D demand is captured by the lagged values of $\ln(EL/D)$ in the regression:

- $\ln(RR/D)$ captures the impact of the reserve requirement set by the central bank.
- $CV_{C/D}$ and $CV_{Y/YT}$ account for the impact of volatility and liquidity risk.
- The penalty rate, r , is proxied by two interest rates: the discount rate and the money market rate. The first accounts for the cost of the last resort facility for banks while the second captures the cost of liquidity in the market.
- $\ln(Y/YT)$ is used as a proxy for changes in banks' demand for cash. This implies that any cyclical positive shock will expect banks to anticipate high demand for currency by the public. This will therefore lead to an accumulation of their holdings of excess reserves. The lags account for the possibility of a gradual impact of funding costs and cyclical movements in output on the demand for excess reserves.
- $EXPO$ is used to capture the fact that banks that are exposed to currency depreciation may be tempted to hold more cash than required in anticipation of unexpected withdrawals to respond to the increase in the domestic-currency value of debt service payments. To capture this effect, $EXPO$ is defined as the difference between foreign-currency liabilities and assets over the total bank deposits times the rate of nominal depreciation.

4.2. Determining the banks' optimal level of liquidity

To estimate the optimal level of precautionary excess liquidity, we adopted the approach that Tinang-Nzesseu (2012) developed and applied to the CEMAC region to estimate the banks' optimal level of excess reserves desired by minimizing the cost function of each commercial bank as well as of the entire banking system.

Considering a financial system mainly dominated by commercial banks and under the control of the central bank, a commercial bank faces a net withdrawal of liquidity u from its customers which is a random variable with density function f and it holds a liquidity reserve stock (R) and security stock in the form of bonds (S).

By choosing an approach for cost minimization, Tinang- Nzesseu (2012) pointed out four scenarios that arise as a result of a change in net withdrawals of liquidity u during a given period:

- First, the net withdrawal of liquidity is negative, which is a net deposit of cash by customers. This deposit is then distributed by the bank between new loans, a fraction β is placed at the central bank in the form of bonds and another fraction α is kept as excess reserves, all with an opportunity cost $(\alpha r_c + \beta(r_c - \beta(r_c - r_s)u))$ which will be added to the initial opportunity cost $r_c R + (r_c - r_s)S$.
- Second, the net withdrawal of liquidity is positive but less than the amount of reserves held by a bank. In this case, a bank's reserves are used to meet customer demand, which reduces the opportunity cost incurred by the bank when holding such reserves $r_c(R - u)$. The opportunity cost of holding securities remains the same $(r_c - r_s)S$.
- Third, the amount of net withdrawals is positive, higher than the bank reserves but less than the sum of reserves and bank securities. The bank then sells its securities to meet customers' liquidity demands by undergoing an adjustment cost m which should be less than or equal to the cost of refinancing on the interbank market, otherwise it is better for the bank to use the interbank market. The total cost of this operation is $m(u - R)$.
- In the last case, net withdrawals are greater than a bank's sum of reserves and securities. The bank then uses all its reserves, sells all its shares and uses the central bank's facilities to meet customers' liquidity demands. The opportunity cost of holding reserves is then zero, but the adjustment costs associated with the sale of securities and loans with penalty from the central bank are added: $mS + r_p(u - R - S)$.

Thus, the total expected cost (TC) of a bank which accounts for opportunity and adjustment costs can be expressed as:

$$\begin{aligned}
 (9) \quad E(TC) = & \int_{-\infty}^0 [r_c R + (r_c - r_s)S - (\alpha r_c + \beta(r_c - \beta(r_c - r_s)u))]f(u)du \\
 & + \int_0^R [r_c(R - u) + (r_c - r_s)S]f(u)du \\
 & + \int_R^{R+S} m(u - R)f(u)du \\
 & + \int_{R+S}^{+\infty} [mS + r_p(u - R - S)]f(u)du
 \end{aligned}$$

The first order condition where the opportunity cost equals the adjustment cost is given by:

$$(10) \quad r_c P(u \leq R) + (r_c - r_s)S f(R) = mP(R < u \leq R + S) + r_p P(u > R + S)$$

Thus, the optimal level of reserves that a bank needs to hold in order to minimize the cost holding liquidity is that value of reserves which balance the opportunity cost of holding reserves to the adjustment cost incurred by the bank's demand for liquidity to cover customers' demand for cash.

To determine the optimal level of reserves, the estimation importantly adopts the probability function of the random variable of net withdrawal of liquidity by users, $(f(u))$. As

mentioned by Tinang- Nzesseu (2012), to estimate the density function we also opted for a non-parametric approach to estimate an empirical density function as:

$$(11) \quad \hat{f}(x) = \frac{1}{nh} \sum_{i=1}^n K\left(\frac{x - x_i}{h}\right)$$

where, h is the smoothing parameter or bandwidth and K is the Kernel estimator which gives the sum of individual bumps placed at the observations.

Using this approach we can derive the optimal level of excess reserves of the entire banking system by adding up all the individual commercial banks' optimal levels of excess reserves. Consequently, the amount of reserves held involuntarily by commercial banks can also be obtained by dividing the total reserves of each bank into three categories: the reserves required by regulation, precautionary excess reserves and involuntary excess reserves imposed through external shocks such as large capital inflows, government borrowings from the central bank and the undeveloped financial system.

5. EMPIRICAL RESULTS

5.1. Data and unit root test

We used monthly data from January 2004 to September 2016. Using the KPSS test, we accepted the null hypothesis of stationarity for all variables.

5.2. Estimating the demand function for precautionary excess liquidity

To estimate the demand for excess reserves we used the FMOLS approach and estimated the sum of coefficients by using the dynamic least squares (DOLS) method with lag one.

Tables 3 and 4 summarize the estimations of excess liquidity with results of the sum of coefficients and their probabilities using two measures of penalty rates: discount rates and interbank rates. In the two regressions, the estimated results are not different.

Table 3: Determinants of excess liquidity

		Estimation using	
		Discount rate	Interbank rate
LNELD(-1)	Coefficient	0.402059	0.488082
	Probability	0.0197	0.0004
LNRRD	Coefficient	-0.967941	-0.539797
	Probability	0.0490	0.0765
LNCD	Coefficient	-0.317147	-0.116556
	Probability	0.3120	0.5818
LNYC	Coefficient	-1.467120	-1.632213
	Probability	0.0054	0.0038
YGAP	Coefficient	0.018048	0.020210
	Probability	0.0349	0.0049
Penalty: DISC_RATE/Interbank rates	Coefficient	0.099925	0.019843
	Probability	0.3107	0.3777
EXPO	Coefficient	2.772586	0.781119
	Probability	0.6979	0.9174
C	Coefficient	-8.368315	-5.693429
	Probability	0.0206	0.0005

Source: Authors' computations, using data from BNR (Monetary Policy Directorate).

As expected, the reserve requirement (LNRRD) had a significant and negative impact on excess liquidity while the effect of lagged excess reserves ($\ln ELD(-1)$) and the volatility of output gap ($YGAP$) had a significant and positive effect.

The effect of volatility of $\ln YC$ as proxy of liquidity risk is significant and incorrectly signed. As pointed out by Agénor (2004), an increase in volatility of output and liquidity shocks has ambiguous effects on excess reserves. However, if the initial level of the penalty rate is sufficiently high, an increase in volatility has a positive effect on excess reserves.

Variation of the cash-to-deposit ratio ($\ln CD$) and $EXPO$ have expected signs but are not statistically significant. In an environment of persistent excess liquidity, the impact of liquidity risks on reserves is not very important and this can explain why the effect of these variables is not significant statistically. However, using the sum of coefficients and estimating an autoregression equation we found that coefficients of lagged variations of the cash-to-deposit ratio ($\ln CD(-1)$), the lagged discount rate ($DISC\_RATE(-1)$) and the exchange rate exposure ($Expo$) were statistically significant and positively related to excess liquidity.

Table 4: Determinants of excess liquidity

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNELD(-1)	0.433005	0.058887	7.353104	0.0000
LNRRD	-0.605881	0.210048	-2.884487	0.0046
LNRRD(-1)	-0.478544	0.208308	-2.297292	0.0231
LNCD	-3.409041	0.639835	-5.328004	0.0000
LNCD(-1)	2.876400	0.631820	4.552564	0.0000
LCY	-0.746923	0.572782	-1.304027	0.1944
LCY(-1)	-0.397785	0.558858	-0.711782	0.4778
YGAP	-0.011898	0.006037	-1.970936	0.0507
YGAP(-1)	0.010634	0.006068	1.752454	0.0819
DISC_RATE	-0.105502	0.085448	-1.234703	0.2191
DISC_RATE(-1)	0.279258	0.083369	3.349669	0.0010
EXPO	47.87552	18.36249	2.607246	0.0101
EXPO(-1)	-47.71602	17.23882	-2.767940	0.0064
C	-9.432783	1.407102	-6.703695	0.0000

Source: Authors' computations using data from BNR (Monetary Policy Directorate).

In brief, the results obtained from the two regressions suggest that the reserve requirement ($\ln RR$), change in demand for cash proxied by the output gap ($YGAP$) and the lagged value of excess liquidity ($\ln ELD(-1)$) are important determinants of precautionary excess liquidity. The effect of volatility as proxy of liquidity risk ($\ln YC$) is ambiguous with an incorrect sign. While using the summation of coefficients, the lagged values of the cash-to-deposit ratio

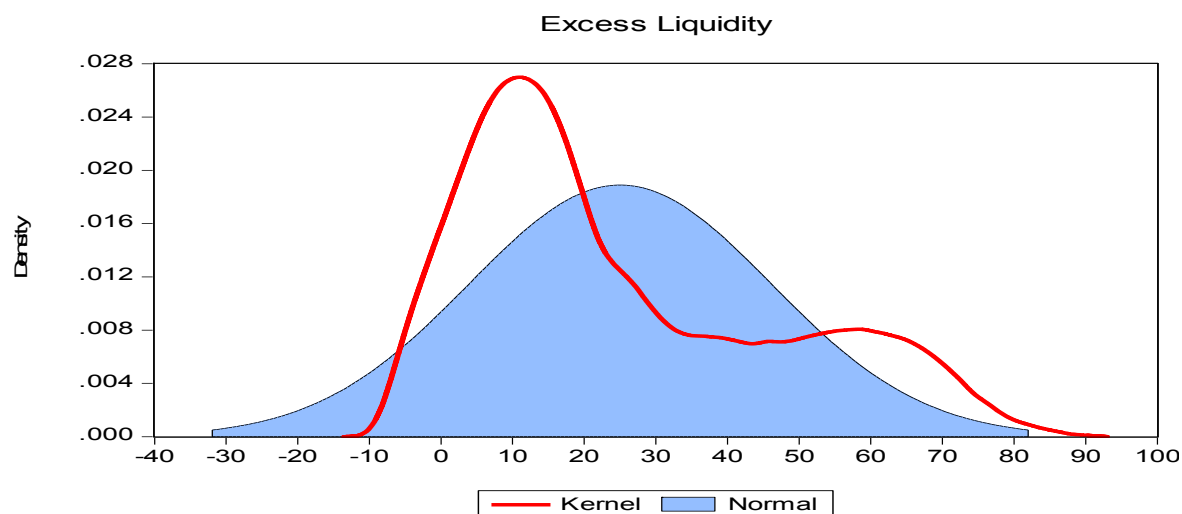
(lnCD (-1)), discount rate (DISC_RATE (-1)) and foreign exchange exposure (EXPO) are also positive and significantly related to excess liquidity.

5.3. Estimating the optimal level of precautionary excess liquidity

As pointed out by Saxegaard (2006) and Tinang-Nzesseu (2012) all the liquidity held by commercial banks beyond the reserve requirements cannot be considered as excessive and detrimental to the effectiveness of monetary policy especially if it is for transaction and precautionary purposes rather than for speculative or involuntary motives. So, for the effectiveness of monetary policy, monetary authorities need to measure the optimal level necessary for transactional and precautionary motives.

The key element for determining the optimal level of reserves as pointed out by Tinang-Nzesseu (2012) is the probability function of the random variable ($f(u)$) which captures the net withdrawal of liquidity. We implemented the proposed model using the estimated precautionary excess liquidity. To avoid the optimal level obtained by largely depending on the sample we simulated bootstrap samples to get a good approximation of the distribution of the test statistics and accurate inferences and confidence intervals for values computed. See Figure 6.

Figure 6: Kernel and normal distributions

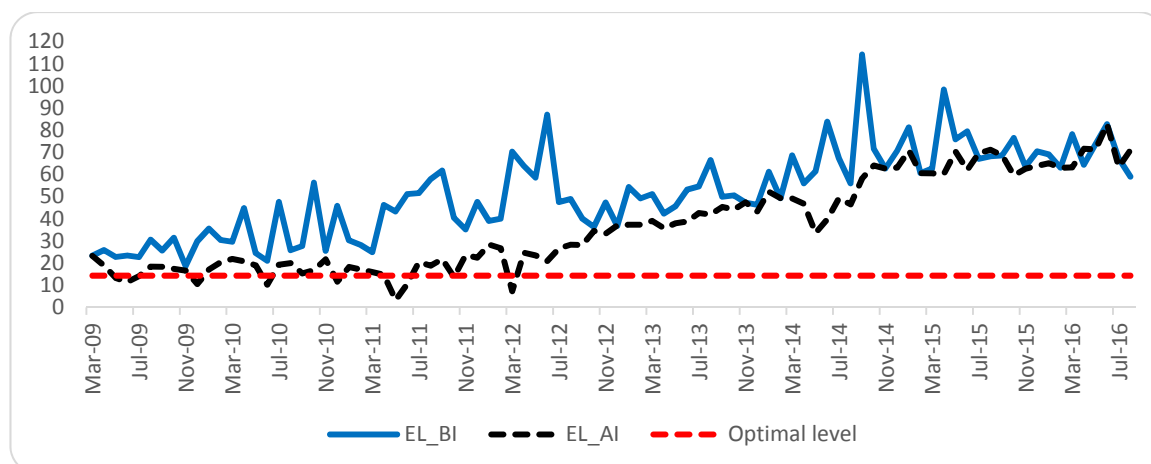


Source: Authors' computations using data from BNR (Monetary Policy Directorate).

Taking into account the first and second conditions of the minimization of the function, the monthly optimal level of excess liquidity in the Rwandan banking system is estimated at around Frw 34 billion but not exceeding Frw 61 billion. This optimal level of excess liquidity includes cash in vault which on average represents around 58 per cent of the total excess liquidity during the last five years. Therefore, the optimal required excess reserves by commercial banks at BNR which balance the opportunity costs of holding reserves to the adjustment cost incurred by the banks' demand for liquidity to cover customers' demand for cash should lie between Frw 14.3 billion and Frw 25.6 billion. As indicated in Figure 7

excess liquidity was significantly above the estimated optimal level. Persistent excess liquidity contributed to reducing transactions in the interbank market and also limited the BNR interest rate (KRR) to an opportunity cost for banks to hold excess liquidity rather than playing the role of cost of funds for commercial banks. For the central bank to influence the liquidity conditions in the economy, banks must borrow funds from it.

Figure 7: Net fiscal injections (in Frw billion)



Source: Authors' computations using data from BNR (Monetary Policy Directorate).

This situation was amplified by limited demand for government securities as indicated by high levels of subscription, averaging 187.3 per cent of the demand for T-bills between 2010 and 2016. This is an indication that banks in Rwanda need more opportunities to invest their short-term liquidity (Table 5).

Table 5: Levels of subscription in T-bills

	Subscription level in T-Bills
2010	313.4%
2011	275.6%
2013	175.5%
2014	167.1%
2017	165.3%
2012	144.8%
2015	138.1%
2016	118.3%

Source: BNR (Financial Market Department).

6. CONCLUSION AND POLICY IMPLICATIONS

Excess liquidity has been an important feature of the banking system in most developing economies. We examined the potential determinants of precautionary excess liquidity in the Rwandan banking system during 2004-16 and its optimal level above which the excess liquidity becomes a constraint to monetary policy transmission. We used two separate

econometric models. First, we used the FMOLS autoregression approach to estimate the determinants of precautionary excess reserves. However for ease in interpreting coefficients, the sum of coefficients was also estimated using the dynamic least squares (DOLS) method. For the optimal excess liquidity level, we used the Kernel density estimation to estimate the probability density of the estimated precautionary excess liquidity. To avoid sample dependence on the optimal level obtained we also used the bootstrap method to obtain the confidence interval of the computed values.

Our results suggest that the reserve requirements, change in demand for cash proxied by the output gap and the lagged value of excess liquidity are important determinants of precautionary excess liquidity. While using the summation of coefficients, the lagged values of the cash-to-deposit ratio, discount rate and foreign exchange exposure were also found to be positively related to excess liquidity. The effects of volatility as a proxy of liquidity risk were ambiguous. This is consistent with the proposition of persistent excess liquidity as stipulated by Agénor (2004), unless the initial level of the penalty rate is sufficiently high.

Secondly, taking into account the first and second conditions of liquidity minimization, our results show that the monthly optimal level of excess liquidity in Rwanda was around Frw 34 billion. This optimal level of excess liquidity includes cash in vault which on average represented around 58 per cent of the total excess liquidity during the last five years. Therefore, on average the excess reserves should be around Frw 14.3 billion which is far below the observed excess liquidity held by banks in Rwanda in the last eight years. This has important policy implications, particularly during this period of transition from a monetary aggregate to a more price based monetary policy. In this new monetary framework, BNR's objective should be influencing liquidity conditions in the economy through impacting market rates. This requires proper liquidity management for banks to borrow funds from BNR or from the interbank market.

The newly created Financial Market Operations Committee (FMOC) which meets every day to decide on BNR's interventions in the money market has been targeting excess reserves close to (but still above) the optimal level estimated by us. However, there is a need for improving the use of existing monetary policy instruments to keep minimum excess liquidity in the banking sector with the objective of supporting the development of the interbank market. In addition, the government treasury and BNR need to increase demand for T-bills and BNR bills to absorb unnecessary excess liquidity in the banking sector. High levels of subscriptions in investments in T-bills (averaging 187.3 per cent between 2010 and 2016) is an indication that banks in Rwanda need more opportunities to invest their short-term liquidity. Developing the government securities market will contribute to increasing the interest rate pass-through in Rwanda which is a key component in the monetary transmission mechanism.

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Part Eight. Labor Market and Employment

Chapter 19. Thomas R. Kigabo and Callixte Kamanzi, “Job creating growth and governance: The case of Rwanda”.

Chapter 20. Barham Muhire, “Employment in manufacturing and service firms in Rwanda”.

Chapter 21. Joseph Ndagijimana, Tharcisse Nzasingizimana and Almas Heshmati, “Analysis of determinants of youth employment in Rwanda”.

Chapter Nineteen

Job Creating Growth and Governance: The Case of Rwanda

Thomas Rusuhuzwa KIGABO¹ and Callixte KAMANZI²

¹National Bank of Rwanda and University of Rwanda,
College of Business and Economics, Kigali, Rwanda

Email: thkigabo@yahoo.fr

² National Bank of Rwanda.

E-mail: callixtekamanzi46@gmail.com

Abstract

This paper analyzes whether Rwandan economic growth is creating jobs. The World Bank's Job Generation and Growth Decomposition (JoGGs) tool reveals some interesting insights into the relationship between economic growth and job creation in Rwanda. Rwanda's growth profile for the period 2011-14 was job-creating; there was a 9.12 per cent change in per capita value added thanks to an increase in the employment rate. In addition, we also analyze the role of governance, particularly policies targeted at creating jobs. As seen from international organizations' reports, Rwanda has been improving and performing well in all governance indicators. Various government policies in favor of employment have been initiated and implemented including the National Employment Program that came up with different initiatives to promote employment; investment facilities as indicated by a good ranking in Doing Business reports are improving and so is access to finance. These have all created a business climate that attracts investments and fosters new enterprise creation that further boosts employment opportunities. As a result, there has been a remarkable increase (24.4 per cent) in the number of establishments accompanied by new jobs that increased by 34 per cent between 2011 and 2014. This can be linked to government policies implemented in that period. This makes us attribute job creating growth in Rwanda to good governance.

Keywords: Economic growth, job creation, governance.

JEL Classification Codes: E61; G38; J08;

1. Introduction

There have been growing concerns with ‘jobless growth’ (or economic growth that has not led to the creation of new jobs) as a major obstacle in the poor benefitting from the positive growth performance experienced by many countries. Today, jobless growth has emerged as a global phenomenon. In its outlook on the 2015 global agenda, the World Economic Forum (WEF) reported that deepening income inequalities and persistent jobless growth were two of the most pressing challenges currently confronting mankind.

In Rwanda’s case economic growth has remained high, averaging around 8 per cent over the last two decades (MINECOFIN, 2017). This may be attributed to a number of factors including adequate economic policies; improving the investment climate and attracting foreign direct investments; improving the quality of the labor force through universal primary and secondary education; completely eliminating red tape in the business environment in order to reduce the cost of doing business; political stability; and economic diversification. All these were a result of a visionary leadership committed to finding durable solutions, including job creation to Rwanda’s problems. The role of the government in addressing youth employment is very important as it provides an enabling environment for the youth to succeed and supports young entrepreneurs with proper skills.

There is consensus that economic growth is a basic and indispensable but not a sufficient condition to address high unemployment rates and poverty. It is recognized that only countries that have sustained economic growth accompanied by good policies have successfully created jobs and reduced poverty. Recently some countries have experienced periods of economic growth that did not translate into equivalent employment gains. Good political, social and economic policies have helped in increasing incomes and faster growth rates which have boosted job creation. A study by Grindle (2005) concluded that it is easy to understand how good governance boosts investments, improves government credibility and political stability and controls corruption which in turn lead to employment and the development of a nation.

The main objective of our study is to assess whether high economic growth in Rwanda has been job creating or jobless and link this outcome to governance through policy initiatives.

Two studies on economic growth and job creation in Rwanda have been done by the World Bank (2008) with data from the Integrated Household Living Conditions Survey (EICV1-EICV2) and Malunda (2013) with data from EICV2-EICV3. The World Bank’s study concluded that there was jobless growth while the study by Malunda concluded that there was meagre job creating growth. Our study uses the same methodology as used in these two studies but extends the sample to use more recent data from EICV4.

2. Overview of the Rwandan economy

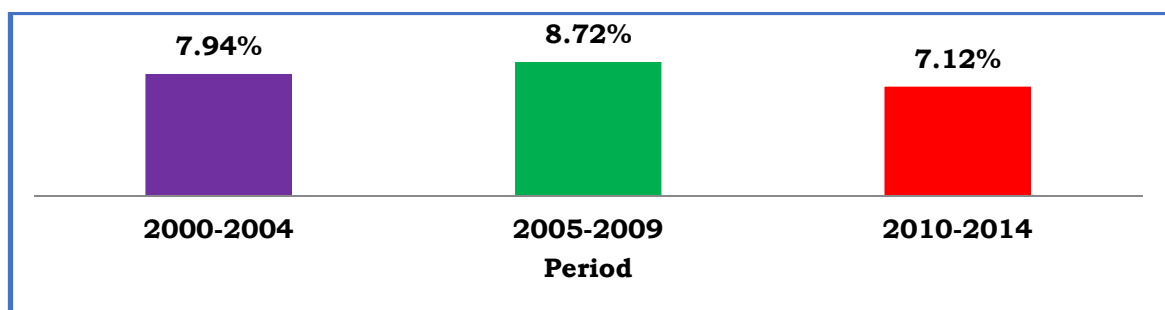
2.1 Economic growth

Two decades after the tragic genocide against the Tutsis in 1994, Rwanda has achieved and maintained high and inclusive economic growth. The government is devoted to attaining sustained economic growth coupled with employment opportunities for its people.

Rwanda has made notable progress in this time in different aspects including steady progress on structural transformation, high and inclusive growth, reduced poverty and gender inequalities and building an attractive business environment. This has been reinforced by strong macroeconomic policy management characterized by strategic public investments in growth-enhancing infrastructure, maintaining low inflation and taking measures to bolster domestic revenue mobilization. Growth in the last two decades averaged 8 per cent, driven by agriculture, services and industry sectors that contributed about 33 per cent, 47 per cent and 15 per cent of the total GDP respectively (BNR, 2014).

Various others factors led to sustained economic growth including implementation of structural reforms which pushed Rwanda up in the ranking of the world's top performers in the World Bank's Ease of Doing Business Index in 2010, the first sub-Saharan Africa country to achieve this distinction; there have also been sustained investments by the government which are expected to drive output growth in the coming years along with sound macroeconomic management and a robust fiscal discipline (MINECOFIN, 2014).

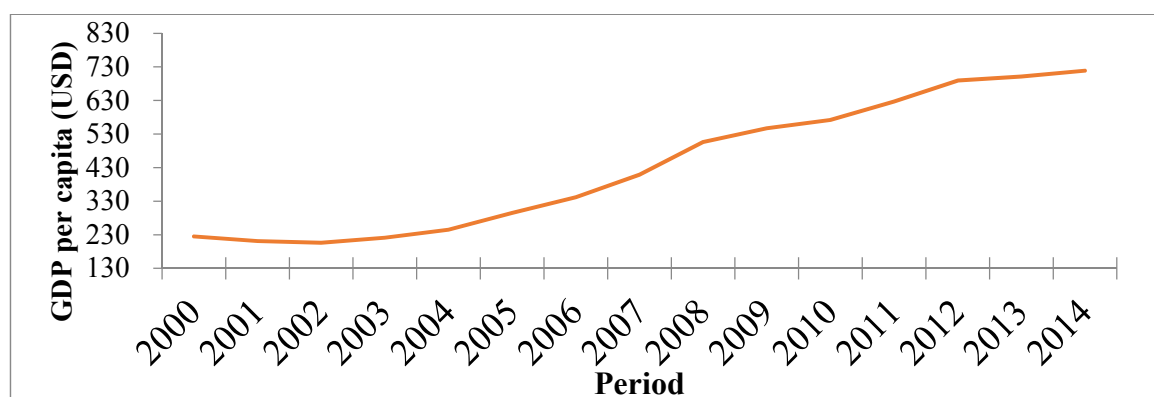
Figure 1: Average real GDP growth rate



Source: Authors' calculations using National Institute of Statistics of Rwanda (NISR) data.

GDP per capita increased from less than US\$ 200 in 1994 to US\$ 719 in 2014 (Figures 1 and 2). As a main measurement of the standard of living in different economies high per capita growth is linked to improvements in the living conditions of the Rwandan population.

Figure 2: GDP per capita 2000-14 (in US\$)



Source: Authors' calculations using NISR data.

2.2.1 Labor market and poverty status

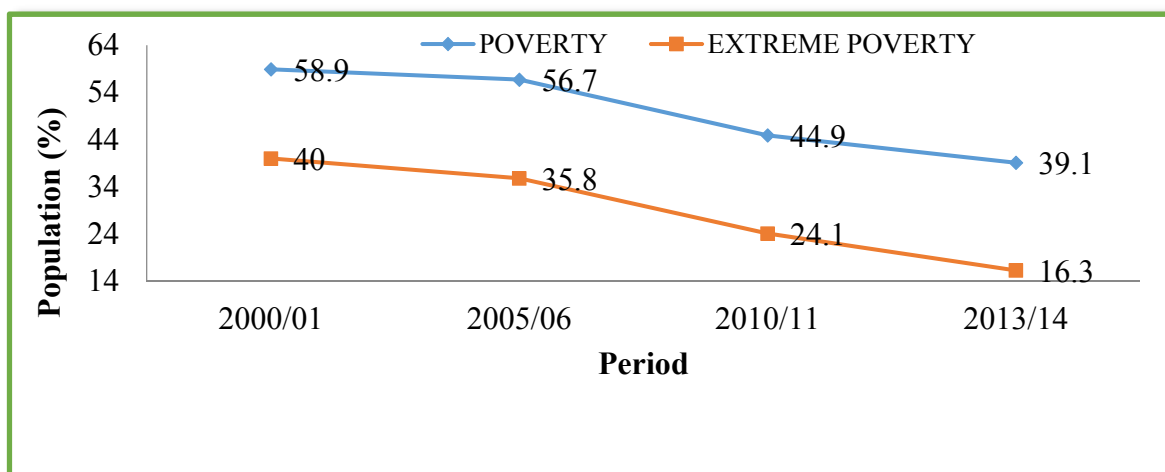
In the aftermath of the 1994 genocide against the Tutsi, the labor sector was one of the most affected. Major challenges in this important area of the national economy included limited employment opportunities leading to high unemployment and under-employment levels especially among the youth; high illiteracy rates; and under-representation of women in wage-earning jobs.

To face this challenge, Rwanda adopted various policies and programs such as Vision 2020 to address economic and developmental issues that the country was facing. Crucial for achieving Vision 2020 was improving education policies which are largely linked to economic development and labor policies. The labor market was to be increased through creating opportunities and enabling at least 7million (out of a projected 13 million) Rwandans access to off-farm jobs (MINECOFIN, 2000)

According to a survey conducted by the National institute of Statistics of Rwanda (NISR, 2014), about 250, 000 people graduated from poverty each year between 2011 and 2014. Using the 2014 poverty line, poverty reduced by 6.9 per cent between 2011 and 2014 representing a reduction of 2.3 per cent per year. The findings of the survey confirm that economic growth between 2011 and 2014 was pro-poor. Close to 60 per cent of this poverty reduction is attributed to growth while about 40 per cent was due to wealth redistribution from wealthy households to poorer ones.

The NISR report (2014) indicates that while overall poverty reduced, 17.4 per cent of the households that were poor in 2011 were not poor in 2014 and 10.4 per cent that were not poor in 2011 had descended into poverty by 2014 due to illnesses, loss of family members and poor harvests due to droughts and floods. Poverty reduction was driven by a combination of improved agriculture incomes, off-farm job creation, reduction in household sizes and public and private transfers (Figure 3).

Figure 3: Poverty status (in percentage)



Source: Authors' calculations using NISR (2016) data.

2.3 Governance and political developments

Rwanda continues to make significant progress in governance. Its World Governance Indicators (WGIs) show a positive trend with significant progress in rule of law, regulatory quality and taking anti-corruption measures. It is among the top-5 most improved African countries and is one of the two countries that have registered consistent overall governance improvements since 2000. Progress in anti-corruption measures is reflected in the Corruption Perception Index (CPI), with Rwanda's place being 49 (among 177 countries) in 2013. Under its zero tolerance policy on corruption, Rwanda is now ranked the 4th least corrupt country in sub-Saharan Africa (SSA).

Rwanda made considerable progress in streamlining an enabling business environment and improved its Doing Business rankings from 52 in 2012 to 32 in 2013. Although retaining the third place in SSA, recognizing its insufficient infrastructure and low secondary and university enrolment rates the Competitiveness Index of the World Economic Forum downgraded Rwanda from the 63rd (2012) to the 66th (2013) position. Service delivery in public and private sectors remains a concern. The Rwanda Governance Board's assessments highlight inadequate problem solving skills and poor customer service care as the main challenges in providing improved service delivery especially at the local government level.

3. Literature review

The current phenomenon of 'jobless growth' witnessed across several developing economies poses far-reaching challenges to the age-old economic assumption of GDP growth directly resulting in an increase in employment. Okun's (1962) pioneering and seminal contribution provides some evidence in this regard. In his study on the relationship between a country's unemployment rate and the economic growth rate, he found a positive relationship between output and employment. According to Okun's law, to achieve a 1 per cent decline in the unemployment rate, real GDP must grow by approximately 2 per cent. However, economic realities have since evolved and experiences show that in many developing countries economic growth has not necessarily been associated with job creation.

A strand of literature shows that the phenomenon of jobless growth is persistent in many countries (Melamed et al., 2011). Aryeetey et al., (2007) contend that in Ghana policies narrowly focused on achieving macroeconomic stability and accelerated growth without adequate employment led to jobless growth. Jobless growth has also been visible in recent times in India (Mehta et al., 2011) and it also exists in Latin America (Jemio et al., 2006).

Recent studies on Africa show that the continent's rapid growth over the last decade has so far not been able to create significant employment opportunities. Ancharaz (2010) concludes that growth in many African countries has been driven largely by commodity exports which do not necessarily translate into higher employment levels.

The World Bank (2005) in its study of 14 countries noted that only three countries which experienced pro-poor growth achieved more labor-intensive growth. In another country-specific study on eight Central and Eastern European Countries (CEE) employment was completely de-linked from output mostly in medium- and low-skilled sectors (Onaran 2008).

Bbaale's (2013) study on Uganda for the period 2006-11 concluded that its economic growth was jobless, showing that 36 per cent change in per capita value added emerged from a decrease in the employment rate.

There is consensus about the role played by governance or leadership in terms of policies and institutions in the socioeconomic development of countries though it is not the only input. Robust institutions include an effective administrative and civil service, responsible legislature, an independent judiciary, a vibrant private sector and a responsible press. Good leadership is also important for successful policy implementation, mobilization of the people towards the same developmental objectives and building consensus for policies through the politics of convergence and not divergence. According to the World Bank, successful sustained economic growth and development strategies and dynamics require an economic component dealing with which models of growth and development work best and right policies to support growth models; an institutional component dealing with the question of knowing which institutions enhance and facilitate economic growth and development and how those institutions come into existence and become stronger; and a component that deals with the politics of growth showing how countries deal with issues such as inequalities that are created by growth. These elements clearly indicate that good governance or good leadership involves seizing opportunities created by the dynamics of a political economy to institute changes in strategy, structure and direction (Brady and Spence, 2010).

4. Methodology

In recent years the World Bank has developed the Job Generation and Growth Decomposition (JoGGs) tool to link changes in employment, output per worker and the population structure at the aggregate and sectoral levels (the World Bank, 2010). Using Shapley decompositions, the methodology decomposes growth in GDP per capita in two consecutive periods in its employment, productivity and demographic components to disentangle the sources of output per worker growth. The JoGGs tool is an Excel based macro-spreadsheet that allows users to input their data and get all the decomposition results and tables.

The aim of this methodology is to understand how growth is linked to changes in employment, output per worker and the population structure at the aggregate level and by sectors. Additionally, the methodology helps decompose the sources of output per worker growth into total factor productivity (TFP) growth, movement of employment from one sector to another or changes in the capital-labor ratio.

There are several techniques for decomposing changes in GDP and attributing them to each component (employment, output per worker, capital and TFP) or to each sector as a share of total observed growth.

Our methodology uses the Shapley decomposition which is a simple additive method that links changes in a particular component to changes in total per capita GDP by taking into account the relative size of the sector or component and the magnitude of the change.

As per standard theory, the growth in per capita GDP is decomposed into changes in the employment rate, changes in output per worker and demographic changes as:

$$(1) \quad \frac{Y}{N} = \frac{Y}{E} \frac{E}{A} \frac{A}{N}$$

or

$$(2) \quad y = \omega * e * a$$

where, Y is total value added, E is total employment, A is the total population of working age and N is total population. Consequently, $Y/E=\omega$ is a productivity measure, E/A is a measure of the employment rate (that is, the share of working age population that is employed) and A/N is the share of the working age population in the total population. Further, ω , e , and a refer to labor productivity, employment rate and share of the labor force in the total population respectively. The summation of the growth in ω , e and a refers to the total change in GDP per capita. Thus, if $\bar{\omega}$, $\bar{e}$ and $\bar{a}$ denote the fraction of growth linked to each component then the growth rate of an economy can be expressed as:

$$(3) \quad \frac{\Delta y}{y} = \bar{\omega} \frac{\Delta y}{y} + \bar{e} \frac{\Delta y}{y} + \bar{a} \frac{\Delta y}{y}$$

and total growth as:

$$(4) \quad \Delta y = \bar{\omega} * \Delta y + \bar{e} * \Delta y + \bar{a} * \Delta y$$

where, $\bar{\omega} * \Delta y$ refers to the contribution of output per worker to the growth in output per capita while the employment rate e and the share of the working age population a remain fixed.

Similarly, $\bar{e} * \Delta y$ refers to employment's contribution to growth in output per capita while the productivity parameter ω and the share of the working age population a remain fixed. Finally, $\bar{a} * \Delta y$ refers to the contribution of demographic changes to growth in output per capita while the first two components remain fixed.

5. Empirical results

As mentioned earlier, two studies have been conducted on Rwanda using the World Bank's JoGGs tool. The World Bank's study covering the period 2000-06 and Malunda's study covering 2006-11 use data from EICV1-EICV2 and EICV2-EICV3 respectively. The findings of these studies show that Rwanda stepped from jobless growth in 2000-06 to meagre job creating growth in 2006-11.

We used the same methodology but covered the most recent data from EICV4. This helped us capture any recent changes in job creation and their impact on economic growth. As conditions have been improving over time we anticipated more job creating growth in Rwanda. Different policies were implemented in the last 10 years to attract more foreign

investors, facilitate private investments and support the establishment of businesses for youth and women.

Table 1 presents the main data used for the aggregate decomposition: Output, employment and population, as well as employment share, output per worker and the share of the working age population.

Table 1: Employment, Output, Productivity and Population in Rwanda (2011-14)

	2011	2014	% change
GDP (value added, billion FRW)	3,588	4,426	23.3
Total population	10,942,950	11,342,000	3.6
Total working age population	5,887,514	6,400,000	8.7
Total number of employed	4,961,000	5,479,000	10.4
GDP (value added) per capita	327,882	390,187	19.0
Output per worker	723,241	807,720	11.7
Employment rate	84.3	85.6	1.6
Share of working age population of	53.8	56.4	2.6

Source: The JoGGs decomposition tool using data from NISR and the World Development Indicators (WDIs).

As indicated in Table 1, Rwanda registered a growth rate of 19 per cent in per capital value added for the whole period. This growth was accompanied by an increase in output per worker, employment rate and an increase in the share of working age population of 11.7 per cent, 1.6 per cent and 2.6 per cent respectively.

This growth was accompanied by an increase in output per worker by 11.7 per cent, the employment rate increased by 1.6 per cent and the increase in the share of working age population was 2.6 per cent. The total number of employed increased by 10.4 per cent during the period but this was offset by a simultaneous increase in the number of new entrants in labor market. Table 2 gives the findings on job generation and growth decomposition to analyze whether Rwandan growth was either jobless or job creating during the period 2011-2014.

Table 2: Decomposition of aggregate growth in per capita

	2011 FRW	% total change in per capita value added growth
Total growth in per capita GDP (value added)	62,304.581	100
Growth linked to output per worker	39,549.112	63.48
Growth linked to changes in the employment rate	5,682.447	9.12
Growth linked to changes in the share of working age population	17,073.021	27.40

Source: The JoGGs decomposition tool with data from NISR and WDI.

As indicated in Table 2, 9.12 per cent of the change in per capita value added was linked to an increase in the employment rate, indicating that between 2011 and 2014 economic growth in Rwanda became more job creating than before as compared to the two previous studies. Our results show that changes in productivity or output per worker were the most important contributor to the change in per capita GDP growth in Rwanda accounting for 63.5 per cent. The results also show that 27.4 per cent of the change in per capita value added is linked to changes in the structure of the population while 9.12 per cent is linked to changes in the employment rate.

Comparison of current results with the findings of previous studies

The progress in job generating growth is shown in Table 3 which compares our findings to those of the other two studies conducted on Rwanda. The findings show that Rwanda stepped from jobless growth (2000-06) to meagre job creating growth (2006-11) and to a more improved job generating growth in 2011-14.

Table 3: Decomposition of Growth in per capita Value Added

	Per cent of total change in per capita value added growth		
	2000-06	2006-11	2011-14
Total growth in per capita GDP (value added)	100	100	100
Growth linked to output per worker	122	101.94	63.48
Growth linked to changes in employment rate	-36	0.89	9.12
Growth linked to changes in the share of the working age population	14	-2.82	27.40

Source: Authors' design with figures from the three studies.

With reference to a consensus about the impact of leadership in the link between economic growth and job creation, countries with transparency, zero tolerance for corruption, political stability, accountability and mobilization of the people towards the same developmental objectives and both foreign and domestic investments are expected to increase and create more jobs.

The World Bank's report shows that the Government of Rwanda has emphasized strengthening good governance as a precondition for poverty reduction and development as it recognizes that the country's institutions of governance exert an influence on stability, prosperity and the well-being of its citizens. It has implemented different policies that foster entrepreneurship while nurturing a more skilled workforce and promoting private sector investments. It facilitates and gives incentives to both local and foreign investors to help them make their businesses more profitable and thus create more jobs.

The World Bank ranks countries on different aspects related to governance and Rwanda has been performing well. Based on the World Governance Indicators (WGIs) developed by the World Bank Table 4 gives Rwanda's ranking in 2015.

Table 4: Rwanda's ranking in the World Bank's indicators of good governance

Indicator	Ranking		
	World	Africa	East Africa
Control of corruption	46 th	4 th	1 st
Regulatory quality	75 th	4 th	1 st
Rule of law	75 th	7 th	1 st
Government effectiveness	90 th	7 th	1 st
Political stability	105 th	13 th	1 st

Source: theglobaleconomy.com; the World Bank (govindicators.org).

In its Second Economic Development and Poverty Reduction Strategy (EDPRS 2) Rwanda set a vision to have half of its workforce employed in off-farm activities by 2020 and it called for the creation of 200,000 off-farm jobs per year. The findings of the EICV4 survey show that in 2014 the capacity of the Rwandan economy to create off-farm jobs was 146,000 jobs per year (NEP, 2014). To achieve this objective, the Government of Rwanda has implemented different policies and programs including the National Employment Program and it is also focusing on improving business conditions.

The Government of Rwanda decided to establish the National Employment Program (NEP), to optimize the impact of employment interventions with the following key objectives:

- Creating sufficient jobs that are adequately remunerative and sustainable across the economy;
- Equipping the workforce with vital skills and an attitude for increased productivity that are needed for private sector growth; and
- Providing a national framework for coordinating all employment and related initiatives and activities in the public and private sectors and in civil society.

NEP has been and is still implementing several interventions to facilitate the creation of jobs. The government is targeting 65 per cent of the learners to be enrolled in technical and vocational education and training (TVET) schools. It has therefore targeted skill training through TVETs. There has also been a shift towards the creation of incentives for investments in youth by private employers to scale up apprenticeships, internships and on-the-job training. During the last few years TVET has been an important component of Rwanda's policy to end poverty. After the reforms in 2008, TVET is getting increased attention from the government, the private sector and international donors. Developing a necessary supply of skills for a productively employed population has called for coordination with other sectors to ensure that education and skill development is practically applicable to the labor market.

Project-based learning through all levels of education; career focused courses in secondary schools, TVET and higher education; rapid response training responding to investor demands for specific skills, enhancement of career services and guidance, intensification of

part-time and distance learning; and operationalization of sector skills councils serving as platforms to adapt skill development to the specific needs of the private sector, increased productive internships and apprenticeships have all been brought to the fore.

For enterprises to increase investments in capital and technology through accessible and affordable finance, the government has ensured increased access to finance and technical training for household enterprises and MSMEs and scaled up MSME financing through BDF products including a SME guarantee (up to 75 per cent), grants to youth and women and quasi- equity finance; and proximity business advisory (BDA) services and provision of start-up toolkits to youth graduating from vocational training and apprenticeship.

The government is committed to establishing various community centers that specialize in processing dairy products, banana wine and Irish potatoes through public-private partnership arrangements where the district / cooperatives provide the land and building and the Government of Rwanda through MINICOM provides technology, equips the centers with appropriate equipment and technologies and ensures that effective management systems are in place.

Integrated craft production centers (ICPCs-Agakiriro) are being operationalized with the aim of establishing standardized and modern business centers to accommodate local craftsmen and artisans including TVET graduates and facilitating them to up-grade their skills and embrace innovations in all districts. Other government initiatives such as the electricity access rollout program (EARP) are feeding into the creation of new commercial activities that need energy in the country trade centers.

The World Bank's (2017) Doing Business report sheds light on how easy or difficult it is for a local entrepreneur to open and run a small to medium-sized business when complying with relevant regulations. It measures and tracks changes in regulations affecting 11 areas in the life cycle of a business: starting a business, dealing with construction permits, getting electricity, registering the property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency and labor market regulations.

Rwanda has been very active since 2008-09 and has made remarkable progress for which it has been acknowledged as among the top reformers in improving its business environment.

As shown in the table below, Rwanda has moved forward six places between 2016 and 2017 in the World Bank report of doing business in various countries, which is an indication of effort by the government of Rwanda to attract both domestic and foreign investors.

Table 5: Top 5 African countries

Country	Ranking in 2016	Ranking 2017	Change in rank
Mauritius	32	49	17
Rwanda	62	56	6
Morocco	68	75	7
Botswana	71	72	1
South Africa	74	73	1

Source: The World Bank (2017).

Rwanda now has a fully functional electronic portal that combines company registration, information on tax obligations and duties and value added tax registration, saving entrepreneurs two days on average and eliminating too many interactions with government officials.

The link between good performance and job creation is straightforward in the Doing Business reports. With various facilities in business, investors and new entrepreneurs are motivated to boost their activities, hence generating employment opportunities.

The Government of Rwanda has made heavy investments in hard infrastructure and in enhancing the private sector's capacity to innovate. Such a big push by the government has created strong incentives for the private sector to increase its investment rates.

Given the role of financial inclusion and access to finance in business development and job creation, the Government of Rwanda has taken an initiative of establishing savings and credit cooperatives in each administrative sector (UMURENGE SACCOs) that reach more people at a lower cost and lend small loan amounts with limited requirements. Its implementation started in September 2009. To date there are more than 416 UMURENGE SACCOs across the country with more than 2.4 million members. These SACCOs have reduced unemployment by creating jobs in different positions such as accountants, managers, loan officers, cashiers and recovery officers. The money that they borrow is used as investment by small and medium investors who in turn provide jobs in due course (RCAAFR, 2015).

UMURENGE SACCOs were established as a government initiative specifically aimed at increasing the accessibility of financial services to Rwandan citizens because banks and other financial institutions were more concentrated in urban areas whilst a majority of the Rwandan population lives in rural areas. Besides, banks and other financial institutions were not able to provide financial services that were ideal for serving the poor. According to FinScope's (2012) findings, 22 per cent of the Rwandan adults were UMURENGE SACCO members and 91 per cent of the adults lived within a 5-km radius of an UMURENGE SACCO. The percentage of adults that was served by non-bank formal institutions but not by commercial banks increased from 7 per cent in 2008 to 19 per cent in 2012.

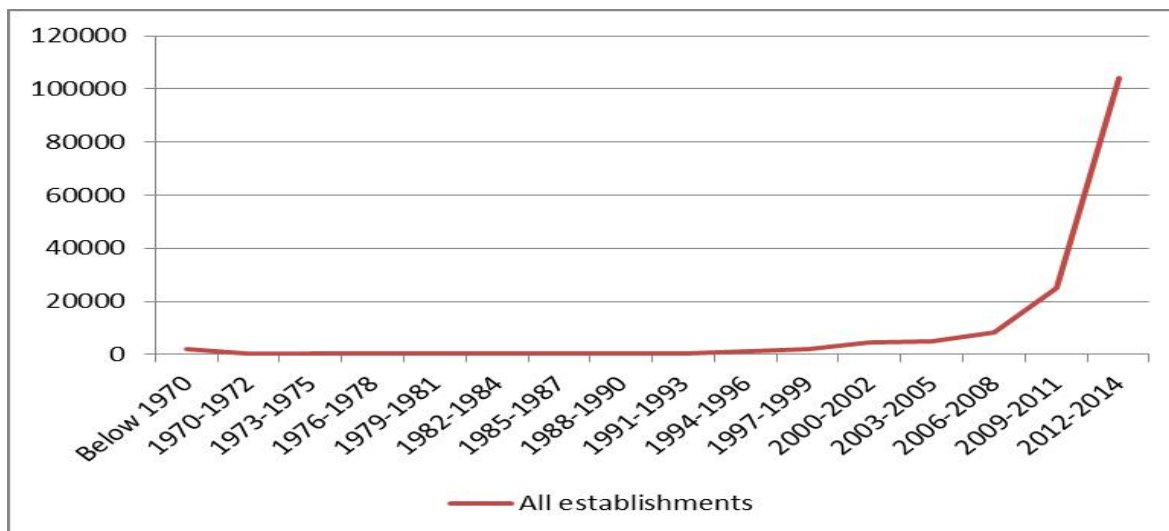
The findings of Finscope (2016) show that financial exclusion dropped by 17 percentage points between 2012 and 2016, with 89 per cent of the Rwandan adults having or using financial products or mechanisms. The survey confirmed that this increase in formal inclusion was caused by an uptake of products offered by non-bank formal financial institutions (such as mobile money and UMURENGE SACCOs).

The Government of Rwanda has also put in place a guarantee fund, the Business Development Fund (BDF) that provides guarantees and grants to farmers and other businesses, particularly those who face challenges in accessing loans from commercial banks. The fund gives up to 75 per cent loans to women and youth and 50 per cent to other clients. These policies have significantly contributed to an increase in access to finance which in turn has contributed to the creation of new businesses or expanding already operating businesses consequently leading to employment promotion.

The Establishment Census conducted by NISR reported in 2014 that these national policies had enabled the creation of new establishments and expansion of already existing ones along with employment generation. The survey also showed that some establishments had entered

the market in 1995 onwards but they achieved more development in terms of business and job creation in recent years (Figure 4).

Figure 4: Evolution of establishments in Rwanda



Source: Establishment Census, NISR (2014).

A comparison of the 2011 and 2014 establishment censuses shows that there was a growth of 24.4 per cent in the number of private and business oriented mixed establishments in the three-year period.

It is observed that a number of establishments have been created since 2008 which proves the role of government policies and programs in promoting investments. In these censuses, establishments are classified according to size which is determined based on the number of workers. The following four categories of establishments have been defined: Micro (1-3 workers), small (4-30 workers), medium (4-30 workers) and large (100 workers and more) (Table 6).

An increase in the number of establishments was observed in all categories with more increase in large establishments (102.9 per cent) followed by small establishments (28.2 per cent), micro (24.1 per cent) and medium sized establishments (19 per cent).

Table 6: Changes in establishment size (2011-14)

Size	Count		Percentage change
	2011	2014	
Total	119,270	148,376	24.4
Micro (1-3 workers)	111,204	138,039	24.1
Small (4-30 workers)	7,479	9,585	28.2
Medium (31-100 workers)	453	539	19.0
Large (100+ workers)	105	213	102.9

Source: National Institute of statistics of Rwanda, 2014

The increase in the number of establishments was accompanied by an increase in job creation due to the availability of new employment opportunities. Table 7 shows employment changes according to economic activities. In total, the increase in employment size (34.9 per cent) exceeded the increase in the number of establishments during the period under study (24.4 per cent). There was an increase in jobs in all categories with the percentage change ranging from 24.6 per cent for small establishments to 55.3 per cent for large establishments. Employment increased the most in large and micro establishments at 55.3 and 32.8 per cent respectively, while the increase was 24.6 per cent and 28.3 per cent in small and medium establishments respectively.

Table7: Employment changes in establishments (from 2011 to 2014)

Size	Count		Percentage change
	2011	2014	
Total	264,648	355,883	34.5
Micro (1-3 workers)	140,295	186,357	32.8
Small (4-30 workers)	57,909	72,153	24.6
Medium (31-100 workers)	21,539	27,624	28.3
Large (100+workers)	44,905	69,749	55.3

Source: National institute of Statistics of Rwanda, 2014.

5. Summary and Conclusion

Rwanda has achieved high economic growth in the two last decades averaging around 8 per cent. This paper analyzed whether that high economic growth was job creating or jobless and further examined the role of the leadership in job creation.

Two other studies have been conducted on Rwanda's growth profile by the World Bank covering the period 2000-06 and by Malunda covering 2006-11 using the World Bank's JoGGs tool. The findings of these two studies show that Rwanda stepped from jobless growth in 2000-06 to meagre job creating growth 2006-11 using data from EICV1-EICV2 and EICV2-EICV3 respectively.

Using the same methodology, we reassessed the relationship between economic growth and employment in Rwanda for the period 2011-14 covering the most recent data from EICV4. Our findings reveal interesting insights about the relationship between the two. Given that there was a 9.12 per cent change in per capita value added because of an increase in the employment rate it can be said that Rwanda's growth profile for the period 2011-14 was job creating.

In addition, we analyzed the role of governance, particularly policies in job creation. We analyzed some of the government's policies in favor of employment including the National Employment Program that came up with different initiatives to promote employment, investment facilities and access to finance which were a result of the creation of savings and

credit cooperatives in each administrative entity (UMURENGE SAACOs). All these created a business climate that attracted investments and fostered the creation of new enterprises that boosted employment opportunities.

UMURENGE SACCOs contributed to an increase in access to financial services particularly among the rural population. To date, 91 per cent adults live within a 5-km radius of an UMURENGE SACCO and 89 per cent of Rwandan adults have or use financial products or mechanisms due to the uptake in the products offered by non-bank formal financial institutions (such as mobile money and UMURENGE SACCOs). These SACCOs have reduced unemployment by creating jobs in different positions such as accountants, managers, loan officers, cashiers and recovery officers. The money borrowed is used for investment by small and medium investors who in turn provide jobs in due course.

There was a remarkable increase (24.4 per cent) in the number of establishments accompanied by new jobs that increased by 34 per cent between 2011 and 2014. As compared to the previous period, there was also a significant increase in the number of establishments created and expanded in the period when the government's policies were initiated and implemented.

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Chapter Twenty

Employment in Manufacturing and Service Firms in Rwanda

Barham MUHIRE

University of Rwanda
Collage of Business and Economics
Department of Economics
E-mail: mubarham@gmail.com

Abstract

This study analyzes employment and its determinants in the manufacturing and services sectors in Rwanda. As a growing economy in East Africa, it is very important for Rwanda to have good and quality employment in both manufacturing and services sectors as this will have an impact on its economic growth and improving welfare standards. The study also provides practitioners with a better understanding of employment in manufacturing and services sectors in Rwanda. Using the World Bank's Enterprise Survey's database for 2011, the study finds that firm size, the number of establishments that form a firm, wages and social payments and research and development are statistically significant for employment in manufacturing and service firms at the 0.05 per cent level of confidence. These factors can be used in forming public policy with the aim of using manufacturing and service firms as an engine for speeding up the shift from a low-income to a middle-income country as this is the way that the Rwandan economy is heading. The location of a firm, age square, managers' experience, females' experience, national sales and research and development have a positive but insignificant impact on employment in both manufacturing and services sectors. On the basis of these observations we make a number of policy recommendations for promoting the quality of employment.

Keywords: Formal employment, growth, development, manufacturing and services, Rwanda.

JEL Classification Codes: A10 ; D13 ; F01 ; J21 ; O12 ; O55.

1. Introduction

The informal sector refers to a sector which encompasses all jobs that are not recognized as normal or legal income sources and for which income taxes are not paid. While the formal sector encompasses all jobs with normal hours and regular wages where the jobs are recognized as income sources on which income tax must be paid. Our study investigates how this influences economic development, that is, an increase in real output per capita and reduction in poverty. There are two types of informal sector strategies: a) coping strategies (survival activities) which include casual, temporary and unpaid jobs and subsistence agriculture; and b) unofficial earning strategies (illegality in business). These unofficial business activities include tax evasion, avoidance of labor regulations and other government or institutional regulations by a company. We do not consider underground activities like crimes, corruption and activities not registered by statistical offices.

The pace of globalization is much more rapid in employment in manufacturing and service firms and employment in manufacturing and service firms is conceived as an avenue for economic transformation as not all countries have a competitive edge in manufacturing (UNECA, 2015). Employment in Rwanda is sub-divided into two categories -- formal and informal employment in manufacturing and services.

Many researchers have argued that employment in manufacturing and service firms has great implications for the growth and development of a country's economy. Among others, Singh and Kaur (2014) and Wu (2007) claim that India and China have recorded attractive economic growth that is closely associated with the dramatic development of their services sectors.

Within the competitive global village, the Rwandan economy has recorded an annual 8 per cent average GDP growth since 2001; its GDP per capita increased more than three-fold from about US\$ 211 per capita in 2001 to US\$ 718 in 2014. The services sector spearheaded this strong economic growth journey as it accounted for a bigger share of GDP by 2015 -- 47 per cent of GDP compared to 33 per cent by the primary sector (agriculture, forestry and fisheries) while the growth in manufacturing and service firms was impressive at around 9 per cent by 2014 against 7 per cent for industry and 4 per cent for agriculture.

The main sub-sectors in the services sector are wholesale and trade, transportation, storage and communication services. Trade and transport services contributed to the share of services in GDP at Rwf 159 billion in 1999 which increased to Rwf 784 billion in 2014 of which wholesale and retail trade had Rwf 615 billion in 2014.

Rwanda was ranked second after Mauritius in doing business in sub-Saharan African (SSA) countries in 2013-14; the services sector received a big share of foreign private investments. As a result, 41.4 per cent of foreign private investments were allocated to information and communication technology (ICT) and tourism (12.8 per cent), while others like mining received 13.8 per cent, manufacturing 10.8 per cent and other sectors received a significant 21.7 per cent share of private investments. Meanwhile, as is documented in the Rwandan Vision 2020, manufacturing and services are believed to be the engine for Rwanda's economic development with a growth rate of 13.5 per cent and a contribution of 42 per cent to GDP.

Empirically, our present study analyzes the development of employment in manufacturing and service firms and its determinants in Rwanda. Thus, the prime purpose of our study is analyzing trends in the expansion of manufacturing and service firms in Rwanda and pointing out the factors that are driving its development using survey data covering various parts of employment in manufacturing and service firms. Our findings can be used for initiating additional academic research; they also contribute to the body of knowledge about the role that employment in manufacturing and service firms plays in economic growth in developing countries of which Rwanda is classified as one. Further, our study also sheds light on Rwanda's ambitious target as listed in its Vision 2020 to holistically understand what to concentrate on while considering employment in manufacturing and service firms. Our study also contributes to a better understanding of the employment conditions in Rwanda and how different sectors of the economy contribute to national development and progress.

1.1 Problem Statement

Both formal and informal manufacturing and service firms face many similar issues that affect the end results of their operations. Despite a number of obstacles, the biggest challenge facing the manufacturing sector is lack of skilled trained labor and technology. The manufacturing sector has been beleaguered by obstacles where nearly every news outlet has covered the closing of manufacturing industries, labor disputes between manufacturing firms and their employees or reductions in labor force due to labor shifting off shore. The reputation of manufacturing firms has been marred by low wages and less than desirable working conditions.

2. Literature Review

A literature review shows that a number of researchers and international organizations have supported the role of employment in manufacturing and service firms as a key driver in the growth of an economy in both developed and developing countries. Recently, the United Nations Economic Commission for Africa (UNECA, 2015) affirmed employment in manufacturing and service firms as an avenue for economic transformation as not all countries have a competitive edge in manufacturing firms. Employment in manufacturing and service firms' development is also providing infrastructure which promotes productivity in manufacturing and agriculture sectors.

The services sector is expanding very rapidly. The extraordinary growth of this sector has brought attention to the challenges of effective management of service organizations and their operations which are vastly different from the challenges faced in the manufacturing sector. Due to rapid developments in information technology, globalization, changing customer needs and preferences and the changes in relative wealth between the developed and newly developing economies, the effective management of service systems addressing productivity and quality issues will become even more important in the coming years.

Two reviews in particular (Bryson, 2001; Knight, 1999) and four opinion-based conceptual papers (Clark and Rajaratnam, 1999; Grönroos 1999; Lovelock, 1999; Samiee, 1999) talk about the status of professional services' internationalization before the twenty-first century. Both Knight (1999) and Bryson (2001) ask for more conceptual research and theory building on services' internationalization. One major point that is evident in literature is the lack of a common services classification. Knight (1999) and Bryson (2001) stress the need for clear definitions and taxonomies to be able to discuss similarities and differences between theories and conceptualizations. Samiee (1999) points out that this absence of consensus prevents effective general theory building. One reason for this is the fact that there seems to be larger differences between service industries than between service and manufacturing in general (Nachum and Keeble, 1999).

2.1 Growth and development of the manufacturing and services sectors

The services sector's economic development is the only way of promoting economic structural adjustments and accelerating the transformation of economic growth (Zhou, 2015). A declining share of agricultural employment is a key feature in economic development (Alvarez-Cuadrado and Poschke, 2011). Structural formation usually coincides with a growing role for industry and services in an economy (UNECA, 2015). The growing size of the services sector and its impact on the other parts of the economy makes it all the more important to promote efficiency in the provision of services thereby boosting economy-wide labor productivity as witnessed in the Organization for Economic Cooperation and Development (OECD) member countries.

The slowdown in the services sector has brought down labor productivity in the entire economy from more than 4 per cent in 1976-89 to less than 2 per cent in 1999-2004 (Jones and Yoon, 2008). Acharya and Patel (2015) confirm that the services sector is the fastest growing sector in India, contributing significantly to GDP, economic growth, trade and foreign direct investment (FDI) inflows as the total share of this sector to India's GDP is around 65 per cent.

According to Park and Shin (2012), the general wisdom is that when a country industrializes, the share of industry and services sectors in both GDP and employment increases whereas the share of agriculture falls and when a country de-industrializes and moves into the post-industrial phase, the share of services increases while the shares of both industry and agriculture fall. They found that when computing the contribution of agriculture, industry and services to GDP growth, in general the services sector made the biggest contribution. Further, the lower the per capita GDP, the greater the scope for labor productivity growth in the services sector, which implies that there is still a lot of room for increased growth in the productivity of services.

Literature on this is comprehensive, but Hopenhayn (1992) provides a relatively tractable formulation. In his model, firms differ only in terms of their productivity levels, each of which evolves according to an exogenous Markov process. New firms enter when the distribution from which they draw their initial productivity levels is sufficiently favorable that their expected future profit stream, net of fixed costs, will cover the costs of entry. Firms

exit when they experience a series of adverse productivity shocks, driving their expected future operating profits sufficiently low that exit is their least costly option. All firms are price takers but the prices of their inputs and outputs depend on the number of active firms and their productivity levels.

This model shares a number of implications with other representations of industrial evolution developed by Jovanovic (1982) and Ericson and Pakes (1995). At any point in time, the distribution of firms with different sizes, ages and productivity levels co-exists and simultaneous entry and exit in the norm. Young firms have not yet survived a shakedown process, so they tend to be smaller and exit more frequently. Large firms are the most efficient, on average, so their mark-ups are the largest. Nonetheless, despite all the heterogeneity, equilibria in both Jovanovic's and Hopenhayn's models maximize the net discounted value of social surplus. Thus, market interventions like artificial entry barriers, severance laws or policies that prop up dying firms generally make matters worse.

2.2 The manufacturing and services sectors' contributions to the economy

The rapid expansion of the services sector is principal to contemporary global economic restructuring. This is proven by the fact that the increase in the services sector's share in the global workforce from 24 per cent to 35 per cent between 1965 and 1990 led to its share in the world's domestic product increasing from 50.6 per cent to 62.4 per cent between 1960 and 1990 (Berentsen, 1996).

Olofin et al., (2015) argue that 60-65 per cent of the population in West Africa is still engaged in farming and many are still food insecure. Research confirms a positive relationship between income growth and food security and researchers recommend putting in place policies and programs to ensure quality civil services. However, despite this in sub-Saharan Africa the services sector makes up nearly 60 per cent of GDP and is expected to grow as historical data shows that each 15 per cent increase in services' contribution to GDP is associated with a doubling of incomes per capita. The top-ten African countries by the services sector's share in GDP as reported by UNECA (2015) are Seychelles (81.1 per cent), Djibouti (77.0 per cent), Mauritius (71.5 per cent), Cape Verde (70.3 per cent), South Africa (69.1 per cent), Botswana (61.8 per cent), Senegal (60.1 per cent), Eritrea (60.0 per cent), Lesotho (60.0 per cent) and Gambia (60.0 per cent). Maroto-Sanchez and Cuadra-Ruara (2011) confirm that in the European region, several service industries have shown dynamic productivity growth rates, contributing more than expected to productivity growth.

UNECA (2015) has documented Rwanda's performance in the services sector which shows that service exports grew from US\$ 59 million in 2000 to US\$ 395 million in 2011. A growth of more than 10 per cent has occurred in wholesale and retail trade, education, finance and insurance and transport, storage and communications since 2007. Over 2000 and 2011, the ICT sub-sector received investments amounting to US\$ 552 million, exports of travel services were equivalent to 63 per cent of merchandise and services' exports in 2011. By 2011, FDI stocks in services were the largest at US\$ 640.2 million followed by US\$ 90.8 million in manufacturing. In the seven-year government program, tourism is expected to grow at a compound annual rate of 25 per cent and by 2014 Rwanda had received 1,137,000

visitors mostly attracted by the Rwanda mountain gorilla, generating US\$ 294 million (up from US\$ 62 million in 2000).

Employment and income distribution (increasingly, income distribution) are regarded as an essential dimension of national welfare and development (Jarvis, 1974). However, the reorientation of development strategies towards a fuller utilization of labor along the lines sketched earlier will not automatically settle problems of income distribution and will not automatically ensure that those who are able will have an opportunity to use their capacities in production. Participation in the distribution of benefits of growth does not necessarily mean participation in the production of those benefits. But the two are related and that relationship merits a brief exploration if only to ensure that neither is accepted as a proxy for the other in designing development strategies.

The manufacturing sector is often the darling of policymakers in less developed countries (LDCs). It is viewed as the leading edge of modernization and skilled job creation, as well as a fundamental source of various positive spillovers. Accordingly, although many LDCs have scaled back trade barriers over the past 20 years, their industrial sector remains relatively protected (Erzan et al., 1989; Ng, 1996; Schiff and Valdez, 1992: chapter 2). Governments also promote manufacturing with special tax concessions and relatively low tariff rates for importers of manufacturing machinery and equipment.

Chenery (1961) and Kasper (1978) found a secular view of resource allocations because of changes in income and tastes: as incomes increase the demand for primary goods fall so that the percentage of income spent on primary products falls. However, the secondary and tertiary sectors are developed at this stage at the cost of the primary sector. The structural change in Bacon-Eltis appeared because of the rapid growth of the public sector and the resources were shifted from the services sector because of the government's biasness towards services.

There is some evidence of spatial spillovers in private output growth in other countries. Pereira and Roca-Sagalés (2003) estimated a 5.5 per cent rate of return to public capital at the national level in Spain and a significantly positive return in 14 out of 17 Spanish regions. Like Munnell's (1992) findings about the US, they also found that the sum of regional estimates (based on within-region stocks on infrastructure) accounted for less than half of the total effect of public capital as estimated at the national level.

Services can be thought of as an entire industry which is not concerned with the production of manufactured goods. The service industry as a whole comprises of distinct segments such as financial services or telecommunications which are all different (Lovelock, 1983). Economists use this perspective to classify and report on activities in national statistics (Johns, 1999). From a management perspective, however, industry based classification schemes are of little help since they overlook the fact that services' operational characteristics often vary considerably within specific industries and even within organizations.

A service can be seen as an outcome, 'what the customer receives' (Mohr and Bitner, 1995: 239). It has been well documented that services' outcomes share four specific attributes, often referred to as IHIP that distinguish them from manufactured goods: intangibility,

heterogeneity (variability), inseparability of production and consumption and perishability (Sasser et al., 1978; Zeithaml et al., 1985). Although these characteristics are often regarded as the core paradigm in services marketing (Lovelock and Gummesson, 2004) their validity has been subject to heavy criticism (Johns, 1999; Lockyer, 1986; Lovelock and Gummesson, 2004; Sampson and Froehle, 2006; Vargo and Lusch, 2004).

Services can be described as a process (Fisk et al., 1993), 'the manner in which the outcome is transferred to the customer' (Mohr and Bitner, 1995: 239). Shostack (1984) claims that services are processes, 'series of interactions between participants, processes and physical elements' (Tax and Stuart, 1997: 107). As a result of the well-accepted view that manufacturing and service processes are differentiated by the extent of customer influence on the production process, it would seem that research on service operations has been biased towards service environments characterized by a high degree of customer contact (Slack et al., 2004).

2.3 Determinants of growth in the manufacturing and services sectors

Increasingly, contemporary literature on economic growth in economies underlines factors that contribute to the remarkable growth in the services sector. These factors include but are not limited to increasing foreign direct investments, openness of a country's economy, expansion of skill development, quality health services, applying information technologies and increasing consumption expenditure.

In terms of income levels and the business environment, the countries typically labeled developing are a very heterogeneous group. Nonetheless, looking across countries some distinctive features of the business environment become increasingly evident as one moves down the per capita income scale. At the risk of over simplifying, our study begins by mentioning the most striking and widely acknowledged among them.

Market size in some developing economies is quite large, while in most others it is small. Hence, in countries like Brazil, China, India and Indonesia, the size of the domestic market for manufactured products is relatively limited for the production capacity. Further, among the least developed countries, Engel effects (Tybout, 1998) favors basic subsistence needs over all but the most basic manufactured products hence. In this relation transport costs are significant and since OECD countries are distant, demand for more sophisticated manufactured goods is small.

Access to manufactured inputs includes domestically produced intermediate inputs and capital equipment which is also often limited in developing countries. Thus, producers who might easily have acquired specialized inputs if they were operating in an OECD country must either produce with imperfect substitutes or import the needed inputs at extra expense. The latter option is the dominant choice among smaller countries.

Human capital with low rates of secondary education and a scarcity of technicians and scientists also affects the mix of goods manufactured and the factor proportions used to produce them. Similarly, many argue that flexibility in production processes and the ability

to absorb new technologies are directly related to the stock of domestic human capital (for example, Evenson and Westphal, 1995; Keller, 1996; Nelson and Phelps, 1996).

Infrastructure like roads, ports, airports, communication facilities and access to power and water tend to be relatively limited in LDCs. Production techniques are directly affected as are the costs of servicing distant markets. Poor transportation networks are particularly limiting in the least developed, more agrarian economies, where consumers are spread throughout the countryside. In instances where infrastructure services are missing or unreliable, some firms must produce their own power, transport and communication services.

3. Rwandan Manufacturing and Services Sectors

The Rwandan economy is based largely on the rain-fed agricultural production of small, semi-subsistence and increasingly fragmented farms. The country's population is increasing. However, this increase in population steadily weakens poor households which depend solely on agriculture for their livelihood as most Rwandans are cultivators. The manufacturing sector is growing at a high rate. The government has created special economic zones where all manufacturing industries are located. The main services sub-sectors and contributors to the growth of the services sector are tourism, transport, banking services and telecommunications.

According to a report of the Ministry of Finance and Economic Planning (MINECOFIN, 2013-14), the manufacturing sector was growing at high rate due to the facilities that were made available. This is also a priority in 2017-18. The 2017-18 budget lays the ground for key areas for infrastructure development, promotion of Made in Rwanda products and manufacturing schemes in the country.

The 1994 genocide decimated Rwanda's fragile economic base, severely impoverished the population particularly women and temporarily stalled the country's ability to attract private and external investments. However, Rwanda has made substantial progress in stabilizing and rehabilitating its economy to pre-1994 levels. GDP has rebounded with an average annual growth of 7-8 per cent since 2003 and inflation has been reduced to a single digit. Nonetheless, according to government statistics, in 2015, 39 per cent of the population lived below the poverty line as compared to 57 per cent in 2006.

Rwanda is a land-locked country that is located in East Africa and is part of the East African Community (EAC). Rwanda joined EAC by aligning its budget, trade and immigration policies with its regional partners. Through manufacturing and service firms, the Government of Rwanda is seeking to become a regional leader in information and communication technologies. The government has embraced an expansionary fiscal policy to reduce poverty by encouraging manufacturing and services sectors in different fields like education, infrastructure, foreign and direct investment and pursuing market oriented reforms. In 2012, Rwanda completed the first modern special economic zone (SEZ) in Kigali; this is an industrial zone area. The SEZ seeks to attract investments in all sectors, but

specifically in agribusiness, information and communication, trade and logistics and mining and construction.

In the second quarter of 2016, Rwanda's GDP at current market prices was estimated to be Rwf 1,549 billion, up from Rwf 1,428 billion in the same quarter in 2015. The services sector contributed 48 per cent of GDP while the agriculture sector contributed 33 per cent of GDP. The industry sector contributed 13 per cent of the GDP and 6 per cent was attributed to adjustments for taxes and subsidies on products. In 2016 Q2, estimates in 2011 prices show that the GDP was 5.4 per cent higher in real terms compared to the same quarter in 2015. In this quarter, the agriculture sector grew by 3 per cent and contributed 0.9 percentage points to overall GDP growth. Activities in the industry sector decreased by 2 per cent and contributed -0.3 percentage points. The services sector increased by 9 per cent and contributed 4.4 percentage points to the overall GDP (NISR, 2016).

3.1 Development of manufacturing and services by economic activity

The distribution of businesses by economic activity in Rwanda shows that the manufacturing and services sectors achieved positive growth in both rural and urban areas. The main sub-sectors in the services sector that showed more than 30 per cent growth include accommodation and food services, human health and social work activities and art, entertainment and recreation activities. According to Singh and Kaur (2014) rapid urbanization is a key factor which contributes to the growth of manufacturing and services sectors and leads us to analyze this growth of the services sector in urban and rural areas in Rwanda in 2011-14.

According to NISR (2014) the services sector grew at a higher rate. The average growth of the services sector's sub-sector of accommodation and food was 34 per cent between 2011 and 2014 in private establishments and the business oriented mixed sector by economic activity. It is obvious that accommodation and food services as a sub-sector is growing faster in rural areas than in urban areas and the growth of this sub-sector contributed to the overall growth of the services sector.

Overall, Rwanda's economy grew at 7.5 per cent in 2010, 2 per cent higher than the East African Community's and even more than sub-Saharan Africa's. During 2010 the services and industrial sectors progressed in their growth recovery. Compared to most other African countries, manufacturing in Rwanda is small and includes firms with very different capabilities: small firms that cater to local markets and more modern large firms some of which also export. The share of manufacturing fell from 12 per cent in 1997 to 6.7 per cent in 2010. However, in 2006-09, this share was 6.8, 6.1 and 6.4 per cent respectively. In 2000-06, the share of employment in manufacturing increased from 1.7 per cent to 3.3 per cent to total employment (NISR, 2005-06).

The Rwanda Development Board's (RDB) mandate is to promote private sector development by promoting investments. To attract requisite investments, it is important to ensure that the country has the right quantity and quality of skills to support emerging and growing industries. The Human Capital and Institutional Development (HCID) Department

at RDB supports the private sector by developing mechanisms to ensure that there are adequate skills available which also have the right quality. The figures from the Establishment Census show the size distribution of firms (including manufacturing, construction and mining) across five categories of size. In all, there are 325 manufacturing firms in Rwanda with more than 10 employees.

3.2 Rwanda's GDP at current prices (in US dollars)

GDP measures the national income and output of a country's economy. GDP is equal to the total expenditure on all final goods and services produced within the country in a stipulated period of time.

Rwanda's GDP was US\$ 8.10 billion in 2015 which represented 0.01 per cent of the world economy. GDP in Rwanda averaged US\$ 2.03 billion from 1960 until 2015, reaching an all-time high of US\$ 8.10 billion in 2015 and a record low of US\$ 0.12 billion in 1961.

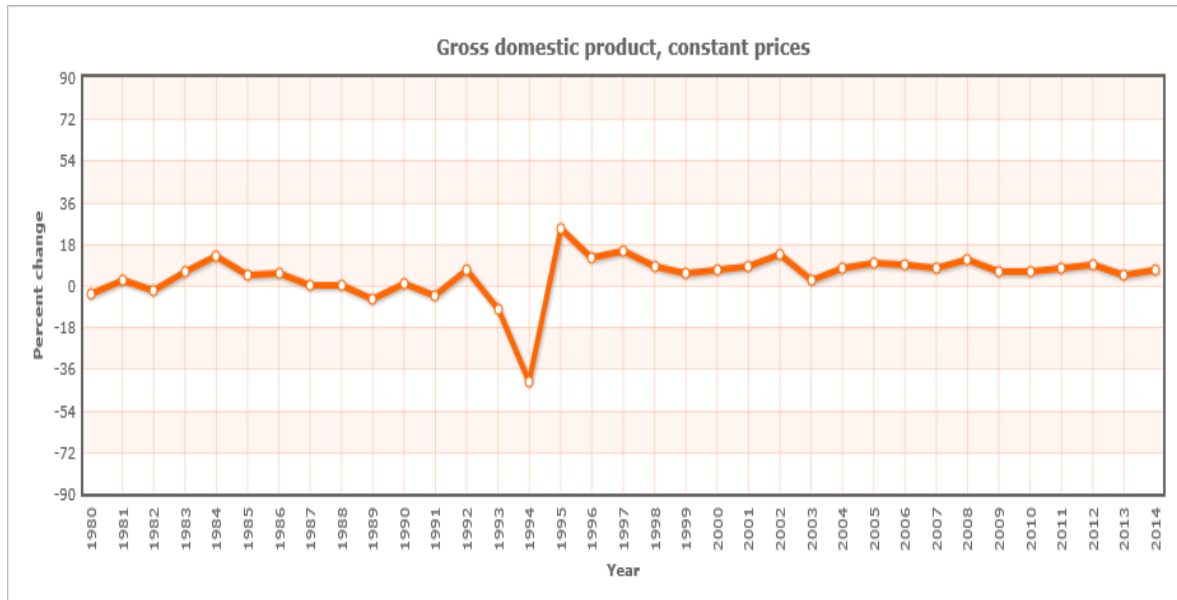
In 2006-16, Rwanda's GDP in current prices (in billion USD) increased at a high rate. Since Rwanda is looking at going forward in development, the private sector which is still largely informal, will have to play a bigger role in ensuring economic growth. Poor infrastructure and lack of access to electricity are some major constraints to private investments. As Rwanda's investments rely significantly on foreign aid, stable inflows of this are critical for keeping the current high investment rate at around 25 per cent of GDP (Figure 1).

Figure 1: Rwanda's GDP in current prices (in US dollars)



Source: Trading economics/The World Bank

Figure 2: GDP, Constant prices (1990-2014)



Source: International Monetary Fund, World Economic Outlook Database (April 2015).

The annual percentages of constant GDP prices are year-on-year changes; the base year is country specific. The GDP is at constant prices, the price was changed as percentage change. In 1980-88, the prices were 18 per cent. But in 1988-92, the prices started changing slightly to below zero (0). In 1992-94, there was an economic down fall due to the 1994 genocide in Rwanda. The prices went negative (– 40) and this led the economy into difficulties. After the genocide in 1994, the economy started growing in 1994-95 from almost zero with the support of internal and external donors. In 1995-2014 there were some changes in the economy with the support of funds from different sources including the African Development Bank, the World Bank, IMF and revenues from within the country (see Figure 2).

3.3 The Rwandan labor market and regulations

This section analyzes employment outcomes in manufacturing and service firms in Rwanda and how these vary for women and men and for youth employment rates, the extent and size of employment, the skill status of employed people and the earnings of those in paid employment both in manufacturing and service firms. Using current International Labor Organization (ILO) definitions, only 4.1 per cent of working age youth (between the age of 16 to 35 years), are considered unemployed (Laterite, 2015).

Many of those who are engaged in subsistence agriculture need to work in multiple jobs to earn enough. But the most pressing challenge faced by the youth is that of unemployment as two- third of the youth work less than 35 hours per week -- the threshold for under-employment in Rwanda. Their wages are significantly lower than adult workers and a higher

share of the youth population is employed in informal jobs. However, the new program Made in Rwanda in the manufacturing sector has reduced the rate of unemployment.

The labor law of 2009 regulates labor in Rwanda. It establishes fundamental rights at work, regulates various aspects of employment, general working conditions, salaried formal sector workers, leave, occupational safety and health, organization of workers and employers, collective agreements and labor disputes. The law also established the labor inspectorate, the Ministerial Labor Directorate and the National Labor Council. According to the law workers' representatives are to be elected in firms employing at least 10 workers.

3.4 Wages in Rwandan manufacturing and service firms

The Wage Indicator Data Report (Besamusca et al., 2012) gives the results of the face-to-face wage indicator survey conducted in Rwanda in 2012. The survey's aim was measuring in detail the wages earned by Rwandan workers for which 2,074 persons were interviewed in towns in all provinces in the country. The workers lived in households with four members including themselves on average. Almost half of the workers lived with a partner and children. Some 4 per cent of the workers had no formal education; two in 10 had stopped at elementary education; 44 per cent had completed secondary education; 6 per cent had reached post-secondary education; and 26 per cent had tertiary education. On a scale of 1=dissatisfied to 10=satisfied, workers rated their satisfaction with life at 5.9 on average.

In the sample, 29 per cent of the workers were self-employed, 24 per cent were employees with permanent contracts, and 24 per cent had fixed-term contracts and 23 per cent had no contracts. On average, the workers had worked for 9.5 years. Over half of the people had worked in an organization with 10 or fewer employees, one in three had worked in an organization with 11-50 employees, 7 per cent in businesses with 51 to 100 employees and 11 per cent in businesses employing over 100 people. Up to 55 per cent of the workers in the sample reported being employed as managers (business owners including micro-enterprises), 12 per cent were service and sales workers, 11 per cent had worked in elementary occupations and 10 per cent as clerical support workers.

Over four in 10 respondents worked in trade, transport and hospitality; 27 per cent in agriculture, manufacturing and construction; 18 per cent in the public sector; and 15 per cent in commercial services. On average, the respondents worked 60 hours per week or for 5.9 days. Some 42 per cent of the workers reported working shifts, 39 per cent worked evenings, 56 per cent worked Saturdays and 36 per cent worked Sundays. Some 39 per cent stated that they were entitled to social security, whereas 46 per cent contributed to social security. Less than two in 10 workers said that they had no agreed working hours, 60 per cent had agreed working hours in writing and 22 per cent had verbally agreed working hours. Up to 82 per cent of the workers reported receiving their wages on time, 53 per cent received wages in a bank account, 46 per cent got cash in hand and 1 per cent were paid in kind. On a 5-point informality-index, ranging from 1= very informal to 5= very formal, 39 per cent of the workers were in the lowest category in the index, whereas 18 per cent were in the highest category. (Besamusca et al., 2012, p.13).

The median net hourly wage of the total sample was 450 Rwf: 26 per cent of the workers earned less than 150 francs per hour, another 24 per cent earned between 150 and 450 francs, 29 per cent between 450 and 1,350 francs and the remaining 21 per cent earned more than 1,350 francs per hour. Employees with permanent contracts had the highest earnings by far (Rwf 1,008) whereas workers without contracts (Rwf 128) had the lowest earnings. At 565 francs, employees on fixed term contracts earned above average wages, whereas the self-employed earned far below it (Rwf 418). Managers had the highest median wages (Rwf 722). The lowest paid workers were skill service and sales workers (Rwf 128) and workers in elementary occupations (Rwf 139). The highest wages were earned in agriculture, manufacturing and construction (Rwf 667) and the lowest in commercial services (Rwf 202). At Rwf 270, workers in firms with less than 10 employees earned the lowest wages, whereas employees in firms with over 100 employees earned the highest wages (Rwf 1,210). Those on the lowest end of the informality index earned only Rwf 192 per hour, whereas those in the highest category earned 1,155 francs. Men had slightly higher wages compared to women and young workers had substantially lower wages than workers in the oldest age group. Workers with tertiary education earned Rwf 1,369, compared to Rwf 98 for workers without education (Besamusca et al., 2012: 11).

Only 49 per cent of the workers were paid on or above the poverty line of Rwf 118,000 per month. Workers without contracts were the most vulnerable: just one in 10 earned on or above the poverty line. In contrast, 79 per cent employees with permanent contracts, 57 per cent on fixed-term contracts and 44 per cent self-employed did. Workers in firms employing between 51 and 100 people were most often paid above the poverty line (86 per cent), compared to only 35 per cent workers in firms employing 10 people or less. Only 26 per cent of the most informal workers were paid on or above the poverty line compared to 84 per cent of the most formal workers. Men were slightly more likely to be paid above the poverty line than women (52 per cent versus 47 per cent). The older workers were more likely to be paid above the poverty line. Workers with tertiary education were paid on or above the poverty line in 92 per cent of the cases, compared to just 15 per cent workers without formal education. Up to 63 per cent of the managers were paid above the poverty line, whereas only 14 per cent of the workers in elementary occupations and 19 per cent service and sales workers were. Workers in commercial services were the most at risk of being paid poverty wages, while workers in agriculture, manufacturing and construction were the most likely to be paid on or above the poverty line. (Besamusca et al., 2012: 16).

Even though over the decades millions of more women have joined the workforce and made huge gains in their education attainments it is often assumed that the pay gap between them and the male workers is not evidence of discrimination, but is instead a statistical artefact of failing to adjust for factors that could drive earning differences between men and women which are often affected by gender biases. Those keen on downplaying the gender wage gap claim that women voluntarily choose lower paying jobs by disproportionately going into stereotypically female professions or by seeking out lower paid positions. However, leaving women in their current occupations and just closing the gap between women and men within occupations (for example, if male and female civil engineers were paid the same per hour) will close 68 per cent of the gap. This means examining why waiters and waitresses, for

example, with the same education and work experience do not make the same amount per hour.

4. The Conceptual Framework Model

4.1 Understanding the key concepts

We conceptualize employment in manufacturing and service firms' business activities in Rwanda. National accounting of GDP complies with the International Standard Industrial Classification (ISIC) of all economic activities. We also look at employment as people at work and persons involved in the production of goods and services. As production requires working time and human capital, firms and other organizations pay their employees providing them with a key component of their income. Low national employment rates in particular may signal a long-lasting depression and under-development.

Growth is conceptualized as formal sector growth measured as GDP. According to King and Levine (1993) financial development is robustly correlated to the future rate of economic growth, accumulation of physical capital and improvements in economic efficiency. Growth in foreign sales' contributes to a firm's growth if there is greater interaction among the management and a higher degree of joint decision making among the owners and managers of small manufacturing and service firms (Reuber and Fischer, 2002). Sustaining economic growth and improving living standards requires shifting labor into both manufacturing and service firms (Eichengreen and Gupta, 2011).

Growth is seen in terms of an increase in the products or services of manufacturing and service firms as their main business. This is related to sales of the products, increase in the number of new employed persons and the size of the establishment. Smith et al., (2006) found that in Denmark the proportion of women in top management jobs had a positive effect on a firm's performance and that this effect depended on the qualifications of female top managers. Dawkins et al., (2007) argue that both large firms and those which are highly specialized enjoy higher profit margins, whereas the more capital intensive a firm the lower its profitability.

4.2 Empirical findings in employment research

The domestic factors that we consider are household and government consumption, gross fixed consumption, labor participation, growth rate and literacy while the external factors include external total debt, foreign direct investments and trade liberalization measured by imports and exports divided by GDP. Our results show that total debt, population, investments and GDP growth had a negative effect on manufacturing and services sectors. In contrast, trade liberalization, labor participation, aggregate consumption and government spending had a positive effect on manufacturing and service firms.

5. Data and Method

5.1 Description of the Data

The data used in our study is from the World Bank's Enterprise Survey (ES). The World Bank collects data from key manufacturing and services sectors in every region of the world as part of this survey. The survey uses standardized survey instruments and a uniform sampling methodology to minimize measurement errors and to yield data that is comparable across the world's economies and is thus suitable for comparative economic studies. The initial dataset consisted of 174 firm level observations in Rwanda's manufacturing and services sectors in 2011.

ES covers factors which shape the business environment and is useful for both policymakers and researchers. The survey is conducted by the Word Bank and its partners across all geographic regions and covers small, medium and large companies. The sample is consistently defined in all countries and includes all manufacturing firms, the services sector and transportation and construction. The 2011 Rwanda Enterprise Survey covered 174 firms including 55 manufacturing firms and 119 services' firms.

The model of employment in manufacturing and service firms uses employment as the dependent variable and the variations across firms are explained by a set of independent variables (Table 1). Correlation matrix of the variables is reported in Appendix 1.

Table 1. Variables and their explanations

Employment	Dependent variable
Establishment part of a large firm	The establishment of firms (both manufacturing and services)
Firm size	Establishment of the firm is categorized into three -- large, medium and small
Number of establishments that form a firm	The number of firms that were established
Age	Age is the number of years since the firm was established
Formally registered	Firms registered formally
Managers' experience	The experience of the managers
Female managers	The number of female managers in the firm
Total sales	Total sales of the firm (both national and international)
Sales (main product)	Sales of the firm's main product (as percentage)
National sales	The total national sales of both manufacturing and services (as percentage)
Competition	Competition between the firm
Innovative new products or services	If a firm has introduced a new product or service (binary)
Research and development	Creating new ideas for a firm's development and growth
Wages and social payments	Payments made to the employees of the firm
Location	Where the firm is located (city)

5.2 Estimation method: The linear regression model

We used a linear analysis to explain employment in manufacturing and service firms in Rwanda and to understand the constraints and potential of their employees. This helped us study the statistical relationship of the dependent variable in relation to more than one determined variable. The linear regression model's structure captures the dependency of the outcome of an explained variable on an independent variable as a simple function, particularly when there are several explanatory variables. It allows the identification of model parameters and provides their significance.

6. The Empirical Model's Specifications, Estimation and Testing

In this section, we present the models used to empirically assess the factors determining manufacturing and service firms' development in Rwanda by considering employment. We also track the factors influencing the dependent variables and then estimate the models, present the outputs and then conduct and explain the tests for significance of coefficients.

6.1 Empirical models and their specifications

An empirical model refers to a model where the structure is determined by the observed relationship among experimental data. We used empirical models in an analysis of employment and its development in manufacturing and service firms and its determinants in Rwanda.

The individual factors that influence employment in manufacturing and service firms include managers' experience and female managers while the factors that influence a firm include age (years of the firm's existence), location of the firm, the wages the firm pays to its employees, the firm's competitiveness and total sales. Starting with the factors that influence employment in both manufacturing and service firms (Model 1), we construct this regression model. This model is specifically constructed for manufacturing and service firms combined together.

(1) Employment in manufacturing and service firms = $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{15} X_{15} + \varepsilon_i$
In this model, the dependent variable is 'employment in manufacturing and services' and the explanatory variables include X_1 which stands for location of the firm, X_2 stands for the establishment part of a large firm, X_3 stands for the size of the firm, X_4 stands for the number of establishments that form the firm, X_5 stands for the age of the firm which is continuous, X_6 stands for formally registered firms, X_7 stands for managers' experience, X_8 stands for female managers, X_9 stands for total sales of the firm, X_{10} stands for sales of the main product, X_{11} stands for national sales, X_{12} stands for competition, X_{13} stands for innovations of new products or services, X_{14} stands for research development, X_{15} stands for wages and social payments and ε_i is the error term.

The coefficients are presented with the symbol β with subscripts from 0 to 15 according to the independent variables. The null hypothesis, $H_0: \beta_i = 0$ that is $\beta_1, \beta_2, \dots, \beta_n = 0$. In this case

no independent variable has any effect on employment in both manufacturing and service firms. The alternative hypothesis is $H_1: \beta_i: H_1 \neq 0$ which means that the independent variables result in a change in employment in both manufacturing and service firms. The positive coefficient is interpreted as having a positive effect and a negative effect on employment. The main focus is on the properties of the factors that affect this change (the signs of the effects and their consistency with our expectations and the size of the effects and their statistical significance).

We used Model 2 to assess the factors that determine employment in manufacturing firms only.

$$(2) \text{ Employment in manufacturing firms} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{15} X_{15} + \varepsilon_i$$

In this model, the dependent variable is 'employment in manufacturing firms' and the explanatory variables include X_1 which stands for location of the firm, X_2 stands for the establishment part of a large firm, X_3 stands for the size of the firm, X_4 stands for the number of establishments that form the firm, X_5 stands for age the age of the firm which is continuous, X_6 stands for formally registered firms, X_7 stands for managers' experience, X_8 stands for female managers, X_9 stands for total sales of the firm, X_{10} stands for sales of the main product, X_{11} stands for national sales, X_{12} stands for competition, X_{13} stands for innovation of new products or services, X_{14} stands for research development, X_{15} stands for wages and social payments and ε_i is the error term.

For this model, the null hypothesis is $H_0: \beta = 0$ which implies that all the independent variables do not affect employment in manufacturing firms. And the alternative hypothesis, $H_1: \beta \neq 0$, suggests that the independent variables have an effect on employment in manufacturing firms.

We used model 3 to assess the factors that determine employment in service firms only.

$$(3) \text{ Employment in service firms} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{15} X_{15} + \varepsilon_i$$

In this model, the dependent variable is 'employment in service firms' and the explanatory variables include X_1 which stands for the location of the firm, X_2 stands for the establishment part of a large firm, X_3 stands for the size of the firm, X_4 stands for the number of establishments that form the firm, X_5 stands for the age of the firm which is continuous, X_6 stands for formally registered firms, X_7 stands for managers' experience, X_8 stands for female managers, X_9 stands for total sales of the firm, X_{10} stands for the sales of the main product, X_{11} stands for national sales, X_{12} stands for competition, X_{13} stands for innovations of new products or services, X_{14} stands for research development, X_{15} stands for wages and social payments and ε_i is the error term. The null hypothesis is $H_0: \beta = 0$ which implies that the independent variables have no effect on employment in service firms. The alternative hypothesis, $H_1: \beta \neq 0$, implies that independent variables have an effect on employment in service firms.

7. Estimation and testing

7.1 Linear regression model

Linear regression is an approach for modeling a relationship between the dependent variable (Y) and one or more explanatory variables (or independent variables) denoted as (X). The magnitude and direction relation are given by a parameter (β_1), and the intercept term (β_0) captures the status of the dependent variable when the independent variable is absent. A final disturbance or error term (u) captures the amount of variation that is not predicted by the slope and intercept terms.

The results of the linear regression model for both manufacturing and service firms are presented in Table 3, where at a 5 per cent confidence level interval, the firm size, the number of establishments that form the firm, wages and social payments are statistically significant on employment. Therefore, we reject the null hypothesis of employment. The other coefficients are statistically insignificant thus we do not reject the null hypothesis of employment. Location, age, age square, formally registered, managers' experience, female managers, total sales, sales of the main product, competition, innovations in new products or services, research and development, wages and social payments do not have any effect on employment.

The results of the linear regression model for the manufacturing sector are presented in Table 2, where at the 5 per cent confidence level of firm size (1) and firm size (2), total sales and research and development are statistically significant on employment and these leave other variables statistically insignificant meaning that they do not have any effect on employment.

The results of the regression model for the service sector is presented in Table 5, where at a 5 per cent confidence level, firm size, the number of establishments that form the firm, wages and social payments are statistically significant on employment and these leave other variables statistically insignificant meaning that they do not have any effect on employment.

Insert Table 2 about here

The Tobit model (also called a censored regression model), is designed to estimate linear relationships between variables when there is either left or right censoring in the dependent variable (also known as censoring from below and above respectively). Tobit regression coefficients are interpreted in ways similar to the interpretation of the OLS regression coefficients.

A one per cent increase in a firm's size results in a 2.2411 per cent increase in employment for both manufacturing and service firms, other things holding constant. A one per cent increase in the number of establishments that form a firm results in a 0.1588 per cent increase in employment for both manufacturing and service firms, other things holding constant. A one per cent increase in wages and social payments results in a 0.2053 per cent increase in employment for both manufacturing and service firms, other things holding constant. All these factors are statistically significant at the 0.05 per cent level of confidence.

Insert Table 3 about here

Estimation results of the linear regression of employment in both manufacturing and service firms' model indicate that firm size can positively change the employment rate. A 1 per cent decrease in firm 1's size results in a 2.2431 per cent decrease in employment in manufacturing and service firms and 1 per cent decrease in firm 2's size results in a 0.9142 per cent decrease in employment in manufacturing and services firms, other things holding constant. It is apparent that SMEs play an important role in all OECD economies; they make up 95 per cent of enterprises and account for 60 to 70 per cent of the jobs in most of these countries. The overall share of small firms in employment and output may be even higher given that establishments or firms in the services sector are normally of smaller average size as compared to the average size of manufacturing firms. The number of establishments that form a firm determines the number of employees that it should have.

OECD (1996) reports that a knowledge-based economy is marked by increasing labor market demand for more highly skilled workers who also enjoy wage premiums. Studies in some countries show that the more rapid the introduction of knowledge-intensive means of production, such as those based on information technologies, the greater the demand for highly skilled workers. Other studies show that workers who use advanced technologies, or are employed in firms that have advanced technologies are paid higher wages. A 1 per cent increase in the number of establishments that form a firm results in a 0.1591 per cent increase in employment, holding other factors constant.

A 1 per cent change in wages and social payments results in a 0.2032 per cent change in employment in both manufacturing and services firms. When wages and social payments are increased, the production of goods and services also increase, others things holding constant. As people age and gain work experience, their earnings are expected to continue to increase or at least remain stable until retirement. However, this does not appear to be the case with traditional age earning profiles. Age earning profiles are commonly used to describe the growth of earnings over the lifecycle (Thornton et al., 1997). Since the p-value of age and age square are greater than 0.05 per cent, this means that they are statistically insignificant to employment in both manufacturing and service firms.

We consider economic integration and the location of the firm before setting out the details of intermediate goods' production and outline the framework in which the effects of demand and cost linkages with the location of a single industry are analyzed. Consider a monopolistically competitive industry in which each firm produces its own variety of differentiated products.

Insert Table 4 about here

The results presented in Table 4 of the linear regression of the manufacturing sector model indicate that the coefficients of firm size 1, firm size 2, total sales and research and development are statistically significant at the 90 per cent, 95 per cent and 99 per cent confidence interval since their p-values are less than 0.05 per; 55 firms were estimated in the manufacturing sector.

As noted by Mazumdar (2003), the size distribution of Indian manufacturing enterprises is characterized by a missing middle whereby employment tends to be concentrated in small and large enterprises. A 1 per cent decrease in the firm size (1) results in a 2.3231 per cent

decrease in employment in the manufacturing sector and a 1 per cent decrease in firm size (2) results in a 0.7839 per cent decrease in employment in the manufacturing sector, holding other factors constant.

A 1 per cent increase in total sales results in a 0.3596 increase in employment, holding other factors constant. The changes in total sales of the manufacturing sector in Rwanda are attributed to processed and finished goods that are ready to be consumed like beans, chips and juices. Employment growth is expressed by the costs incurred by a manufacturing firm on employment and employees and developing and trying a new approach or idea about products' production, business processes, management or marketing.

A 1 per cent increase in research and development results in a 0.6345 increase in employment in the manufacturing sector. The process through which research and development promotes economic prosperity is complex and multi-faceted. Employees' development and research activities are positively correlated with a change in employment in the manufacturing and services sectors, holding other factors constant. Firms gain direct benefits if they make investments in research development.

Insert Table 5 about here

The results presented in Table 5 of the linear regression of the services sector model indicate that the coefficients of firm size 1, firm size 2, number of establishments that form the firm, wages and social payments are statistically significant at the 90 per cent, 95 per cent and 99 per cent confidence interval since their p-values are less than 0.05 per; 119 firms in the services sector were estimated.

A 1 per cent decrease in the firm size (1) results in a 2.3251 decrease in employment in service firms and a 1 per cent decrease in firm size (2) results in a 0.8944 per cent decrease in employment in service firms, other things holding constant. Rosen (1982) and Kremer (1993) suggest that human capital is positively correlated with firm size. Rosen (1982) considers a hierarchical organizational structure where improved labor productivity at any given level successively filters through all the lower levels.

The services sector includes activities where people offer their knowledge and time to improve productivity, performance, potential and sustainability; this is termed as affective labor. Services are also known as intangible goods which include attention, advice, access, experience and discussion. A 1 per cent increase in the number of establishments that form a firm results in a 0.1657 per cent increase in employment in the services sector, holding other factors constant.

As per a study on wage setting systems and minimum rates of pay applicable to posted workers in accordance with directive 96/71/EC in a selected number of member states and sectors a 1 per cent increase in wages and social payments results in a 0.2391 per cent increase in employment in the services sector. Wages differ between countries due to differences in the cost of living, productivity, the working environment and in the overall (im) balance between the supply of and the demand for labor. Sectoral minimum wages are typically the result of overall collective bargaining processes and are thus directly connected to overall wage developments. Employers' pay policies can contribute to a gender wage gap

if women are less likely to work in high paying firms or if women negotiate worse wages than men.

If service firms adapt innovative new products or services they can move to more dynamic business environments including greater openness to international competition. Hence, greater uptakes of advanced technologies and fostering innovative activities should be encouraged. In OECD work on benchmarking and innovations in knowledge based economies increasingly depend on a combination of entrepreneurship, ICT, innovation and human capital. Innovative new products or services are statistically insignificant for both manufacturing and services as they have a decreasing change on employment. Innovations in the services sector are particularly important for industries.

Increase in competition in local and global markets determines the importance of service innovations as a key source which supports firms' growth and development. OECD states that the importance of service innovation is well established but many firms are seeking new ways to develop the type of service innovation necessary for success in global value chains. Many service firms use delivery time guarantees to compete for customers in the marketplace. Demand is assumed to be sensitive to both price and delivery time guarantees, and the objective of each firm is to maximize its operational profits.

Insert Table 6 about here

The models in Table 6 were estimated by ordinary least squares (OLS) with robust standard errors. The regression models were specified and estimated using STATA. These differed by the generalization of the basic model of employment between manufacturing and service firms which was used to study the impacts of various factors affecting employment in manufacturing and service firms in Rwanda at the firm level.

The problem that heteroscedasticity presents for regression models is simple. Recall that the OLS regression seeks to minimize residuals and produce the smallest possible standard errors.

The serious problem associated with heteroscedasticity is the fact that the standard errors are biased. Because the standard error is central to conducting significance tests and calculating confidence intervals, biased standard errors lead to incorrect conclusions about the significance of the regression coefficients.

8. Usefulness of the Results and policy Recommendations

The goals of this study were to carry out an analysis of how manufacturing and service firms contribute to employment in Rwanda and identifying the factors that have contributed to the growth and development of manufacturing and service firms using data collected from the World Bank Survey (2011). Literature was reviewed to assess the similarities and dissimilarities in the findings all over the world. A descriptive analysis of the existing data and an empirical analysis of micro-data on manufacturing and service firms were used to understand the functioning of employment in Rwanda. The results are interesting and will

be useful for academics and both the private and public sectors in Rwanda and other parts of the world.

The results of factors influencing employment in manufacturing and service firms will be useful for the government because employment is a key to improved growth and development. In public sector management, employment in both manufacturing and service firms has a positive impact on the government through payment of taxes by employees. The government could use the findings of our study to scale-up employment activities in manufacturing and service firms and shape capacity building strategies and policies with our empirical findings.

Our study can also be used by academicians for future studies; it can also be of use to graduate students. Our findings on employment can form the basis for expanding research in economic growth and development since this forms a part of Rwanda's national policies in Vision 2020 and EDPRS II which will help Rwanda become a middle-income country.

8.1 Policy Recommendations

The Government of Rwanda should emphasize on its employment policy by targeting new entrepreneurs operating in both manufacturing and services sectors. With regard to the role of employee development in promoting production and innovations in both manufacturing and service firms, it is important for the government to put in place the mechanisms that will facilitate entrepreneurs (both employees and managers of firms) in promoting innovative new products or services in both manufacturing and service firms. Incentives can be given to both manufacturing and service firms' managers who want their employees to be sent abroad for training or for hiring international consultants to train locally on manufacturing and services related skills.

The government should also make innovation policies for manufacturing and services complementary with existing employment with emphasis on employees' development and enhanced training strategies. Innovative new products or services will help implement new policies that guide the production of goods and services in manufacturing and services sectors.

As the Government of Rwanda has decided to drive its economic growth through manufacturing and service firms and its aim is to become a middle-income country our study gives recommendations that can help in speeding up the process from a low-income economy to a middle-income economy through development and pursuing sustainable goals for manufacturing and service firms for their expansion. Rwanda's manufacturing sector has been experiencing steady growth. But every success has its own factors, which in Rwanda's case can be brought around one common denominator. If the number of establishments that form firms are formally registered this will increase the government's income through taxation.

It is also a good idea to have a positive relationship between research and development and firm productivity across all sectors but mainly in the manufacturing and services sectors as this will increase the productivity of goods and services.

National sales can be put in place for more emphasis on manufacturing and service firms that are ready to export their finished products by establishing more relationships with other countries, for example with countries in the East African Community (EAC) and COMESA to have standardized national sales that will increase revenues from outside the country leading to the development of local industries for better production.

The Government of Rwanda should continue encouraging both manufacturing and service firms that are unregistered to register themselves formally for better follow up. Registered firms get benefits for their businesses as they can benefit from legal and financial services provided by courts and commercial banks; these services are not available to unregistered firms.

Education and job training are good policies to pursue for wages and social payments. They will raise at least some workers' productivity and help increase their earnings in manufacturing and service firms. Higher minimum wage laws will provide higher wages for at least some workers. However, such policies could also increase unemployment. According to economists, this unemployment increasing effect is not huge if there is only a moderate increase in minimum wages. If the minimum wage is increased to a living wage as proposed for some activities its impact on unemployment will be much larger so a better way will be to minimize the wages for all activities in different sectors to reduce wage inequalities.

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Table 2. Tobit model Generalized (Manufacturing and service firms)

Variables	Coef.	Std. Err.	t	P>t	[95% Co	Interval]
Employment (ln)						
Location	0.6635c	0.3708	1.79	0.076	-0.0690	1.3960
Establishment part of a large firm	-0.2881	0.1954	-1.47	0.142	-0.6740	0.0977
Firm size 1	2.2411a	0.1876	11.94	0.000	1.8704	2.6118
Firm size 2	0.9126a	0.1152	7.92	0.000	0.6849	1.1402
Number of establishments that form a firm	0.1588a	0.0461	3.44	0.001	0.0676	0.2499
Age	-0.0046	0.0157	-0.29	0.770	-0.0357	0.0265
Age2	0.0001	0.0003	0.45	0.655	-0.0005	0.0009
Formally registered	-0.0765	0.1672	-0.46	0.648	-0.4068	0.2537
Managers' experience	0.0029	0.0056	0.53	0.600	-0.0082	0.0141
Female managers	0.0022	0.1279	0.02	0.986	-0.2505	0.2550
Total sales(ln)	0.0711	0.0460	1.55	0.124	-0.0197	0.1622
Sales main product(ln)	-0.0747	0.0949	-0.79	0.433	-0.2623	0.1128
National sales(ln)	0.0088	0.1877	0.05	0.962	-0.3619	0.3796
Competition	-0.0839	0.0920	-0.91	0.363	-0.2657	0.0979
Innovative new products or services	-0.0578	0.0996	-0.58	0.562	-0.2546	0.1389
Research and Development	0.0244	0.1039	0.23	0.815	-0.1809	0.2297
Wages and social payments	0.2053a	0.0578	3.55	0.001	0.0910	0.3195
Cons	-2.8433b	1.1788	-2.41	0.017	-5.1717	-0.5147
Number of Obs	174					

Note: a significant at 1% b at 5% and c at 10% level of significance.

Table 3. Linear regression (model 1) Manufacturing and Services and its determinants

Variables	Coef.	Std. Err.	t	P>t	[95% Interval]
Employment(ln)					
Location	0.5795	0.3813	1.52	0.131	-0.1735 1.3326
Establishment part of a large firm	-0.2882	0.2053	-1.40	0.162	-0.6937 0.1173
Firm size 1	2.2431a	0.1972	11.37	0.000	1.8535 2.6326
Firm size 2	0.9142a	0.1211	7.55	0.000	0.6750 1.1533
Number of establishments that form a firm	0.1591a	0.0485	3.28	0.001	0.0633 0.2549
Age	-0.0044	0.0165	-0.26	0.792	-0.0370 0.0283
Age2	0.0001	0.0004	0.41	0.680	-0.0006 0.0009
Formally registered	-0.0708	0.1756	-0.40	0.687	-0.4177 0.2761
Managers' experience	0.0028	0.0059	0.49	0.628	-0.0088 0.0146
Female managers	0.0051	0.1344	0.04	0.970	-0.2604 0.2706
Total sales(ln)	0.0712	0.0484	1.47	0.143	-0.0243 0.1667
Sales main product(ln)	-0.0734	0.0997	-0.74	0.463	-0.2705 0.1236
National sales(ln)	0.0094	0.1973	0.05	0.962	-0.3803 0.3991
Competition	-0.0854	0.0967	-0.88	0.379	-0.2764 0.1056
Innovative new products or services	-0.0614	0.1046	-0.59	0.558	-0.2681 0.1453
Research and Development	0.0245	0.1092	0.22	0.823	-0.1913 0.2403
Wages and social payments(ln)	0.2032a	0.0607	3.34	0.001	0.0832 0.3232
Cons	-2.7364b	1.2345	-2.22	0.028	-5.1749 -0.2979
Number of Obs	174				

Note: a significant at 1% b at 5% and c at 10% level of significance.

Table 4. Linear regression (model 2) Manufacturing sector and its determinants

Variables	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Employment(ln)						
Location	1.2535	0.7841	1.60	0.118	-0.3351	2.8422
Establishment part of a large firm	-0.2283	0.5881	-0.39	0.700	-1.4200	0.9633
Firm size 1	2.3231a	0.4529	5.13	0.000	1.4054	3.2408
Firm size 2	0.7839a	0.2956	2.65	0.012	0.1847	1.3831
Number of establishments that form a firm	0.5402	0.6499	0.83	0.411	-0.7766	1.8571
Age	-0.0109	0.0331	-0.33	0.743	-0.0781	0.0562
Age2	0.0001	0.0006	0.12	0.908	-0.0013	0.0015
Formally registered	-0.3801	0.4006	-0.95	0.349	-1.1918	0.4316
Managers' experience	-0.0135	0.0141	-0.97	0.340	-0.0421	0.0148
Female managers	0.1726	0.2784	0.62	0.539	-0.3915	0.7366
Total sales(ln)	0.3596a	0.1244	2.89	0.006	0.1076	0.6117
Sales main product(ln)	0.0625	0.2276	0.27	0.785	-0.3986	0.5237
National sales(ln)	0.0485	0.2295	0.21	0.834	-0.4166	0.5136
Competition	0.1191	0.2161	0.55	0.585	-0.3187	0.5570
Innovative new products or services	-0.0930	0.2046	-0.45	0.652	-0.5076	0.3216
Research and Development	0.6345b	0.2945	2.15	0.038	0.0376	1.2314
Wages and social payments(ln)	-0.0802	0.1603	-0.50	0.620	-0.4051	0.2445
Cons	-4.7313b	2.2087	-2.14	0.039	-9.2067	-0.2559
Number of Obs	55					

Note: a significant at 1% b at 5% and c at 10% level of significance.

Table 5. Linear regression (model 3) Services sector and its determinants

Variables	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]
Employment(ln)					
Location	0.6348	0.4856	1.31	0.194	-0.3286 1.5983
Establishment part of a large firm	-0.2839	0.2728	-1.04	0.300	-0.8251 0.2572
Firm size 1	2.3251a	0.2424	9.59	0.000	1.8442 2.8061
Firm size 2	0.8944a	0.1442	6.20	0.000	0.6084 1.1804
Number of establishments that form a firm	0.1657a	0.0492	3.37	0.001	0.0681 0.2634
Age	-0.0161	0.0223	-0.72	0.471	-0.0603 0.0281
Age2	0.0002	0.0006	0.41	0.680	-0.0009 0.0014
Formally registered	0.0271	0.2131	0.13	0.899	-0.3956 0.4497
Managers' experience	0.0048	0.0068	0.71	0.480	-0.0087 0.0185
Female managers	0.0185	0.1624	0.11	0.909	-0.3036 0.3406
Total sales(ln)	0.0015	0.0553	0.03	0.979	-0.1083 0.1113
Sales main product(ln)	-0.0524	0.1194	-0.44	0.662	-0.2894 0.1845
National sales(ln)	-0.2987	0.5231	-0.57	0.569	-1.3351 0.7383
Competition	-0.1068	0.1193	-0.90	0.373	-0.3434 0.1298
Innovative new products or services	0.0300	0.1259	0.24	0.812	-0.2198 0.2798
Research and Development	-0.1495	0.1303	-1.15	0.254	-0.4081 0.1089
Wages and social payments(ln)	0.2391a	0.0694	3.44	0.001	0.1014 0.3767
Cons	-0.8262	2.6658	-0.31	0.757	-6.1144 4.4621
Number of Obs	119				

Note: a significant at 1% b at 5% and c at 10% level of significance.

Table 6. Linear regression (model 3) Manufacturing and Services sectors White Heteroscedasticity test

Variables	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
Employment(ln)						
Location	0.5795	0.4849	1.19	0.234	-0.3784	1.5375
Establishment part of a large firm	-0.2882	0.2043	-1.41	0.160	-0.6917	0.1153
Firm size 1	2.2431a	0.2552	8.79	0.000	1.7389	2.7473
Firm size 2	0.9142a	0.1217	7.51	0.000	0.6736	1.1547
Number of establishments that form a firm	0.1592b	0.0736	2.16	0.032	0.0137	0.3044
Age	-0.0043	0.0182	-0.24	0.810	-0.0402	0.0314
Age2	0.0001	0.0004	0.38	0.704	-0.0007	0.0010
Formally registered	-0.0708	0.1831	-0.39	0.699	-0.4325	0.2908
Managers' experience	0.0028	0.0053	0.54	0.591	-0.0076	0.0134
Female managers	0.0051	0.1161	0.04	0.965	-0.2242	0.2345
Total sales(ln)	0.0712c	0.0402	1.77	0.078	-0.0081	0.1505
Sales main product(ln)	-0.0734	0.0831	-0.88	0.379	-0.2376	0.0908
National sales(ln)	0.0094	0.0974	0.10	0.923	-0.1830	0.2018
Competition	-0.0854	0.0968	-0.88	0.379	-0.2767	0.1059
Innovative new products or services	-0.0614	0.0988	-0.62	0.536	-0.2567	0.1339
Research and Development	0.0245	0.1181	0.21	0.836	-0.2088	0.2578
Wages and social payments(ln)	0.2032a	0.0581	3.50	0.001	0.0883	0.3180
Cons	-2.7364	1.1200	-2.44	0.016	-4.9487	-0.5241
Number of Obs	174					

Note: a significant at 1% b at 5% and c at 10% level of significance.

Appendix 1. Correlation matrix of manufacturing and service firms (N=174)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Employment	1															
Location	-0.002	1														
Establishment	0.128	0.034	1													
Firm size	-0.587	0.006	-0.139	1												
Number of establ.	0.295	0.024	0.204	-0.188	1											
Age	0.236	-0.086	0.104	-0.272	-0.003	1										
Formally registered	-0.077	0.105	0.005	-0.077	0.004	-0.007	1									
Managers' exp.	0.131	-0.161	-0.02	-0.162	-0.062	0.265	-0.059	1								
Female managers	-0.075	-0.173	0.006	0.087	-0.069	0.192	0.047	-0.088	1							
Total sales	0.196	-0.015	-0.025	-0.28	0.068	0.082	0.072	0.053	-0.034	1						
Sales main product	0.065	0.094	0.000	-0.067	0.081	-0.060	0.268	-0.103	-0.060	0.117	1					
National sales	-0.010	-0.015	0.048	0.025	0.034	-0.065	-0.026	0.016	0.052	0.005	-0.106	1				
Competition	-0.042	0.050	0.011	-0.008	0.019	0.055	-0.081	0.070	0.009	-0.048	-0.075	-0.018	1			
Innovative new products or sales	0.146	-0.007	-8E-04	-0.136	0.127	0.118	-0.086	0.131	0.027	0.017	-0.074	0.086	0.094	1		
Research and Development	0.180	0.000	-0.084	-0.130	0.000	0.117	0.027	0.096	-0.064	-0.028	-0.024	0.067	0.065	0.202	1	
Wages and social payments	0.574	-0.032	0.024	-0.523	0.054	0.252	0.005	0.160	0.000	0.477	0.082	-0.019	-0.05	0.016	0.180	1

Appendix 2. Descriptive statistics of determinants of employment

Variable	Obs	Mean	Std. Dev.	Min	Max
Employment	174	57.83264	133.5541	1	1009
Location	174	0.958506	0.1998	0	1
Establishment part of a large firm	174	0.049793	0.2179	0	1
Firm size	174	2.381743	0.6918	1	3
Number of establishments that form a firm	174	1.141079	0.8832	1	12
Age	174	11.11203	9.9595	1	52
Formally registered	174	0.875519	0.3308	0	1
Managers' experience	174	13.06639	9.0361	0	42
Female managers	174	0.19917	0.4002	0	1
Total sales	174	1.64E+09	6.73E+09	1300000	8.10E+10
Sales main product	174	68.86087	25.3762	7	100
National sales	174	98.37238	8.6563	5	100
Competition	174	0.493776	0.5010	0	1
Innovative products or services	174	0.614108	0.4878	0	1
Research and Development	174	0.307054	0.4622	0	1
Wages and social payments	174	1.49E+08	8.63E+08	96000	1.20E+10

Appendix 3. NESTED model of Manufacturing and services sectors

Variable	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]
Employment(ln)						
Location	0.5795	0.3813	1.52	0.131	-0.1734	1.3326
Establishment part of a large firm	-0.2882	0.2053	-1.40	0.162	-0.6937	0.1173
Firm size 1	2.2431a	0.1972	11.37	0.000	1.8536	2.6326
Firm size 2	0.9142a	0.1211	7.55	0.000	0.6750	1.1533
Number of establishments that form a firm	0.1591a	0.0484	3.28	0.001	0.0633	0.2549
Age	-0.0043	0.0165	-0.26	0.792	-0.0370	0.0283
Age2	0.0001	0.0004	0.41	0.680	-0.0006	0.0009
Formally registered	-0.0708	0.1756	-0.40	0.687	-0.4177	0.2761
Managers' experience	0.0028	0.0059	0.49	0.628	-0.0088	0.0146
Female managers	0.0051	0.1344	0.04	0.970	-0.2604	0.2706
Total sales(ln)	0.0712	0.0484	1.47	0.143	-0.0243	0.1667
Sales main product(ln)	-0.0734	0.0997	-0.74	0.463	-0.2705	0.1236
National sales(ln)	0.0094	0.1973	0.05	0.962	-0.3803	0.3991
Competition	-0.0854	0.0967	-0.88	0.379	-0.2764	0.1056
Innovative new products or services	-0.0614	0.1046	-0.59	0.558	-0.2681	0.1453
Research and Development	0.0245	0.1093	0.22	0.823	-0.1913	0.2403
Wages and social payment(ln)	0.2032a	0.0607	3.34	0.001	0.0832	0.3232
Cons	-2.7364	1.2345	-2.22	0.028	-5.1749	-0.2979

Number of Obs 174

Log likelihood = -156.06396

Note: a significant at 1% b at 5% and c at 10% level of significance.

Chapter Twenty One

An Analysis of the Determinants of Youth Employment in Rwanda

Joseph Ndagijimana¹, Tharcisse Nzasingizimana¹, and Almas Heshmati²

¹School of Economics,
College of Business and Economics
University of Rwanda, Rwanda,
E-mail: jndagijimana16@gmail.com

²Corresponding Author:
Jönköping International Business School (JIBS),
Jönköping University, Jönköping, Sweden
E-mail: almas.heshmati@gmail.com

Abstract

The main objective of this research is to analyze the determinants of youth employment in Rwanda from the point of view of the demand, supply and the general labor market. An analysis of the data shows that a skill gap is most critical for employment creation and a transition from school-to-work seems problematic. Further, questions remain about what factors influence youth employment in Rwanda and how youth employment is related to poverty reduction and distribution of income. The study uses a multinomial logit model to shed light on the determinants of youth employment status in the country using data from the National Institute of Statistics of Rwanda (NISR). It verifies how the current status of youth employment in Rwanda has evolved over time and based on its findings it provides policy recommendations to promote youth employment. The research finds that youth employment in Rwanda is influenced by gender, age, education and geographical location.

Keywords: Entrepreneurship, human capital, labor supply, Rwanda, youth employment.

JEL Classification Codes: J20; J21; J22; J23.

1. Introduction

The school-to-work transition represents a long dark tunnel for many young people all over the world. A large and growing population of young people and increasing educational attainments make creating youth employment opportunities a challenge in most countries in sub-Saharan Africa (Pastore, 2015).

In 2011, an estimated 200 million Africans were aged 15 to 24 years of which around 40 per cent had studied up to the secondary level. Recent job creation efforts have not benefited young people without job market experience; youth unemployment is also seen as a source of social unrest and conflicts in society. Only 20 per cent of the 73 million jobs created by African countries between 2000 and 2008 went to 15-24-year olds.

The main determinants of youth unemployment can be summarized as: low labor demand because of low growth of productive yet labor-intensive activities especially in the formal private sector; under-developed entrepreneurship; non-organized labor supply; unequal access to education; low quality of education; low relevance of skills acquired in general education and technical vocational education and training (TVET); lack of skill development for self-employment and employment in the informal economy; non-optimal labor market functioning; non-availability and low quality of information; non-transparency in hiring practices; and insufficient labor market regulations.

In Rwanda, where a third of the 3.7 million population is aged 15 to 34 years, youth unemployment and job creation is a critical policy issue particularly since over 14 per cent of this age bracket is unemployed. Though youth employment rates are relatively high (71 per cent for women and 91 per cent for men were aged 20 to 24 years in 2010), labor segmentation is pronounced. Due to the agricultural nature of society and low levels of services sector development, young women are more likely than their male counterparts to work on family farms (Mcarthur et al., 2014).

Between 2010 and 2011, 74 per cent of the employed women aged 20 to 24 years were in agriculture compared to 55 per cent employed men. At the same time, increasing school enrolments have meant that youth entering the labor market have higher educational attainments and are thus likely to seek different kinds of jobs. Fortunately, the percentage of women aged 15 to 34 years with no education fell from 16 per cent in 2006 to 4 per cent in 2011. The corresponding drop among their male counterparts was from 14 per cent to about 5 per cent.

Rwanda has a number of affirmative action programs to address inequalities in access to economic opportunities. For example, the Vision 2020 Umurenge Program (VUP) is both a cash transfer scheme and a public works program (Etfo and Lufumpa, 2014). The program is means-tested, targeting households in the lowest two poverty/consumption quintiles.

Under VUP, eligible households earn wages by working on community infrastructure projects in the expectation of reducing unemployment in Rwanda. Rwanda's large and growing youth population presents both a challenge and an opportunity to development. Rwanda is currently at a turning point in its demographic transition as fertility rates are decreasing and the labor force is growing as the youth population ages. If Rwanda's

economy is able to productively absorb this segment of the population, the country could reap the benefits of a demographic dividend. However, the scale of the challenge should not be underestimated. An estimated 125,000 jobs need to be created every year just to absorb new entrants into the labor market (Filmer et al., 2014)

Further, most youth (70 per cent) still live in rural areas (Escudero, 2013). Their skills gaps are critical and their transition from school-to-work is highly problematic. It is crucial to analyze the determinants of youth employment to understand the barriers that go beyond the usual lack of skills and financial and collateral issues. The following question can help in this analysis: What are the determinants of youth employment in Rwanda?

Our research assesses the determinants of youth employment in Rwanda from the demand (formal and private sector, entrepreneurship), supply (equal access to education, quality of education, relevance of skills acquired in general education and TVET), labor functioning (availability and quality of information, transparency in hiring practices) and labor market regulations. These aspects are among the most critical for the youth to transition from school-to-work. Questions also remain about the factors that influence youth employment in Rwanda and how youth employment is related to poverty, its reduction and the distribution of income.

Our research uses a multinomial logit model for testing all the youth employment determinants. The data is obtained from the National Institute of Statistics of Rwanda. The study also discusses the status of youth unemployment in Rwanda over time and provides policy recommendations.

The specific objectives of our study are:

- identifying the determinants of youth employment from both demand and supply sides;
- analyzing the determinant factors of youth employment from the point of view of labor market functioning; and
- formulating recommendations directed at policymakers for improving youth employment.

2. Literature review

This section has two components: A review of theoretical literature dealing with the determinants of youth employment in general and a review of empirical literature with evidence from other countries.

2.1 Theoretical literature review

To understand the main challenges to youth employment in developing countries, it is useful to first discuss the determinants of labor market outcomes. While these determinants are inter-related, they can be grouped into three types: labor demand, labor supply and the functioning of labor markets. The main determinants of labor market outcomes can be

summarized as: Labor demands growth in productive and labor-intensive activities, especially those in the formal private sector, entrepreneurship, labor supply, equal access to education, quality of education, relevance of skills acquired in general education and TVET, skill development for self-employment and employment in the informal economy, market functioning, availability and quality of information, transparency in hiring practices and labor market regulations (Zimmermann et al., 2013).

Referring to the labor market policy for Rwandan youth, market-led capacity building is placed at the heart of youth employment in collaboration with non-governmental organizations (NGOs) involved in youth empowerment and poverty reduction programs. Capacity building in small businesses is being offered and skill training is designed in conjunction with the private sector to meet varied and evolving market requirements.

When analyzing the determinants of youth employment it is important to note that when labor demand slows down, self-employment may be the only alternative employment opportunity available. The self-employed thus consist of those who are driven by necessity on the one hand and voluntary entrepreneurs on the other hand. The main supply side determinants of youth employment outcomes are education and skills in terms of quantity and quality and their relevance. Skills are built through formal general education, formal technical vocational education, training and apprenticeships and through informal education and training (Lee, 2013).

In the same vein, lack of non-cognitive skills is often mentioned by employers in the private formal sector as an obstacle to hiring young workers. Thus, access to primary education is the first requirement for obtaining basic literacy and numeracy skills which are a precondition for ensuring access to decent work. Besides general education, youth can acquire work-specific relevant skills through TVET programs. TVET can be integrated into compulsory schooling as an alternative to an academically oriented track, or it can be part of several post-compulsory schooling options.

Studies conducted in the Middle East and North Africa (MENA) countries show that TVET has a limited role quantitatively because of the weak links between the skills provided by the TVET system and those demanded by the private sector, insufficient funding, poor monitoring and evaluation, stigmatization and lower returns compared to secondary education. The benefits of TVET in terms of earning and social promotion vary across countries and influence its attractiveness.

2.2 Empirical literature review

Brixiová et al., (2014) researched youth employment in Africa and came up with new evidence on the effects of policies in Swaziland during 2007-10. They carried out a multinomial logit regression analysis to analyze the socioeconomic drivers of the unfavorable youth labor market outcomes on the supply side. Since many of the factors that can unlock potential employment of Swazi youth are on the demand side of the labor market, the authors examined the barriers to job creation and youth entrepreneurship. Their study

concluded that learning from the experiences of other countries could inform the design of more effective interventions for youth employment in Swaziland.

Etfo and Lufumpa (2014) used a multinomial logit model to examine factors associated with employment outcomes in Rwanda including: (i) employment in formal and informal sectors and agriculture, and (ii) wages in non-agriculture and self-employment in non-agriculture and agriculture. The authors estimated separate regressions for both categories of employment for women and men and for urban and rural areas. Their research found that the percentage of Rwandans aged 15 to 64 years who were unemployed fell from 9.3 per cent in 2005-06 to 6.9 per cent in 2010-11. However, in urban areas one in four women and one in five men were classified as unemployed (Etfo and Lufumpa, 2014). On the other hand, a relatively low percentage of youth was unemployed which may be attributable to delayed labor force entry as a result of continuing education.

According to Bicaba et al., (2015), the need to invest in education persists because of the association between high educational attainments and better jobs. This is especially necessary to ensure that young people receive post-secondary education as this appears to be a pre-requisite for high-paying, non-farm wage employment. The authors add that investments are also needed in skill development especially for women to allow them to compete in the labor market and to reduce the male-female wage gap.

This review of the literature shows that different researchers have been interested in finding the determinants of youth employment in developed and developing countries but no one has used a model using natural characteristics like age, gender and geographical location to capture the determinants leading to youth employment. Therefore, our research seeks to fill this gap in literature by considering a number of key variables.

3. Methodology

We used a multinomial logit model to assess the determinants of youth employment by considering the demand and labor market functioning in Rwanda. This approach helped us shed light on youth employment, identify its determinants and estimate their effects.

In fact, this estimation procedure helped us to examine some of the key socioeconomic determinants such as age, gender, education and location that are qualified as factors from labor market and demand functioning which contribute to youth employment. Our research studied young adults (aged 20-34 years). Following Etfo and Lufumpa (2014), a multinomial logit model is specified as:

$$(1) \quad EMP_{ji} = \beta_0 + \beta_1 GE_{ki} + \beta_2 AG_{li} + \beta_3 EL_{mi} + \beta_4 LO_{ni} + \varepsilon_i$$

where, i stands for individuals and EMP for employment status which is the outcome categorical variable indicating whether the individual has a wage employment in the public sector, the formal private sector, the informal private sector or is self-employed, inactive or unemployed. Natural characteristics (NC) including gender (GE), age (AG), education level (EL) and geographical location (LO) constituted independent variables. The error term (ε)

is appended to capture any measurement error in the employment status and left out variables.

The gender variable captured any gender gap in the labor market. Age tested the sensitivity of the likelihood of the employment status depending on age. For education, the two main qualifications in our research are undergraduates (BSc and TVET qualification) and post-graduate levels. As people living in urban areas may have higher job opportunities in the formal private and public sectors, we controlled for location to capture locational heterogeneity in employment status among the youth.

The main source of data on the determinants of youth employment in Rwanda is the National Institute of Statistics in Rwanda (NISR). We used the STATA/SE 13.0 software for data analysis.

4. Integrated and participatory approach

Experience shows that youth employment programs and policies aimed at refining labor market dynamics often result in interventions that are fragmented, too narrow or isolated and do not fully take into account the general economic, institutional and social framework. Inconsistencies may arise in terms of the content of the interventions, their level, geographical location and target beneficiaries. Moreover, supply-side measures tend to outweigh demand-side measures. Anecdotal examples of not provable interventions include skill training programs not backed by an appropriate demand for the skills in the labor market or entrepreneurship training without any possibility of gaining appropriate access to credit. It is, therefore, indispensable in the domain of youth employment to dispose of an over-arching, integrated strategy for growth and job creation.

This strategy covers labor demand (job opportunities) and supply (employability) as well as the mediation or matching process combined with well-targeted and structured interventions. A lifecycle approach to youth employment is also highly useful as it recognizes that what happens at one stage is affected by, and in turn affects, opportunities at other stages. For example, premature entry into the labor market as a child lessens the chances for better employment in adulthood because of lack of education.

Youth employment policies must be embraced in the broader context of a country's employment and growth policy considering possible crowding-out effects on other age groups. Productive employment and decent work for young people requires sustained, determined and concerted action by a wide number of actors. As they cannot stand on their own, youth employment interventions must be linked to broader development frameworks. Coherence and coordination between relevant government agencies and other national and international (for example, donor community) stakeholders is crucial.

While not necessarily the only mechanism, the use of national action plans (NAPs) for youth employment can be useful in facilitating this. To be successful, however, these plans should have strong and sustained political commitment and be based on broad participation. In this context, it is important that youth also participate actively in the decision-making process as they know best what they want and what they can offer. The participation of young people

in membership-based organizations and their engagement in decision-making processes affecting their employment and working conditions is crucial for fostering social inclusion and advancing democratization. Young people are often under-represented in these processes. A good example is the consultation of youth in PRSPs in Ghana, Honduras, Indonesia and Uganda (Kingombe, 2011).

4.1 Special attention to youth

In view of the challenges to youth employment, many governments are investing considerably in youth employment programs which complement general poverty reduction and employment policies.

Questions arise as to what justifies these youth-specific interventions and why it is not sufficient to focus only on promoting a favorable investment and business climate.

The main arguments that have been put forward to justify youth-specific interventions include young people facing specific challenges in accessing the labor market which lowers their chances of finding decent employment.

The main difficulties are:

- a higher chance of losing their jobs during economic downturns ('last-in, first-out'): Specific barriers to entry often stemming from lack of experience;
- path dependence: Early unemployment increases the likelihood of subsequent unemployment (Pastore, 2007);
- under-utilized young people incur significant economic costs ^{as} the national workforce is not used to its full potential. Moreover, in general young people are more dynamic and often have higher educational levels than their parents. It is also mainly young people who opt for migration if they cannot find adequate employment in their own country;
- under-utilization of young people in the labor market can trigger a vicious circle of intergenerational poverty and social exclusion; and
- often, lack of employment opportunities may result in social conflicts such as violence and juvenile delinquency which in turn leads to high social costs. Moreover, post-conflict countries have predominantly young populations without decent jobs; many of them are deprived of education as they have grown up in violent societies and often been combatants themselves.

4.2 Strategy to promote youth employment

4.2.1 Labor demand

Resolving the problem of youth unemployment and under-employment requires growth in salaried employment in the formal economy. This leads to more jobs for young people and encourages a transition from the informal to the formal economy. Further, the quality of

employment (for example, productivity and working conditions) in the informal economy, where a majority of young people work, should be improved.

Job creation depends primarily on economic growth which itself depends on investments and on the international context. A stable macroeconomic environment which boosts investments – both private and public – and thus growth, is fundamental in the creation of new formal jobs for all groups of workers but is of particular benefit to young people who suffer most from economic downturns because of their short job tenures and lack of experience (‘last-in, first-out’) (Braziene and Dorelaitiene, 2012).

Sectoral policies in particular can promote job creation in the medium to long term provided they are well-designed and targeted at sectors with high potential for employment growth. Well-targeted policies can promote private initiatives in traditionally ‘youth-friendly’ sectors such as tourism, catering, information and communication technology (for example, commercialization of mobile telephones has increased job creation in Rwanda) and basic and social services including health, as well as in the sports sector.

In developing countries, 75 per cent of the youth living in poverty are in rural areas (Burrus and Roberts, 2012). Rural youth are more likely to have started work in childhood. They are the victims of human trafficking and sexual exploitation and are more vulnerable to being recruited by militant extremist groups. Most urban poverty, on the other hand is a result of rural deprivation and the resulting distress urban migration (Coenjaerts et al., 2009).

Therefore, special attention should be paid to the agricultural sector by moving away from subsistence agriculture and introducing commercialization and productivity improvements (for example, maize and vegetables) through technological changes, infrastructure support and rural sector support projects. The international trade and aid policy (the Vision Umurenge in Rwanda) should also be taken into consideration in this context.

In general, youth show a strong interest in the conservation of our planet. Environmental management also has an interesting employment potential. A successful example is a youth employment project in the Indian state of Goa (Markos, 2010). As part of the project a mix of interventions based on individual motivation, use of best practices, public-private partnerships (PPPs) and legislative measures were used. The measures resulted in creation of more than 2,000 jobs for young people in waste management and recycling, with opportunities for further expansion in the last three years (Hewett and Foley, 2000).

However, it is the private sector that is the main driver of growth and job creation. Entrepreneurship is a driving force for initiating business ideas and mobilizing human, financial and physical resources for establishing and expanding enterprises and creating jobs. Entrepreneurship is another way of unleashing the economic potential of young people. The promise of youth entrepreneurship can be maximized through programs and strategies that address the barriers in doing business.

Societies that appreciate entrepreneurship and thus promote its values and norms can create a dynamic and vibrant class of young entrepreneurs. Empirical evidence shows that educating young minds in enterprising behavior and boosting their confidence for calculated risk-taking, increases the incidence of entrepreneurship being adopted as a career option

(Rolfe, 2010).

The successful development of youth businesses hinges on good access to well-integrated services such as management training, business mentoring programs, financial services, support in gaining access to markets and networking opportunities. Enhancing the youth's capacity in association building and policy advocacy can address their disadvantaged position. Young women entrepreneurs face additional hurdles as in many cultures they are more risk averse, while their roles in the family and society keep them from tapping opportunities in business development (Kabeer, 2012). This also means that they are more likely to be in the informal economy and less likely to be entrepreneurs employing others.

4.2.2 Labor Supply

Education and vocational training should be designed around the informal economy where most young working people are found in developing countries. Often, vocational training has to be complemented by remedial education as many young workers in the informal economy may have dropped out of the educational system at an early stage (Council, 2014). Young people may have begun working prematurely (while still children) because of economic necessity (for example, AIDS orphans in some African countries may have become heads of households and breadwinners) or cultural constraints. As a result, they lack basic skills including literacy and numeracy.

In fact, young people face particular challenges because they lack appropriate skills and experience, are less creditworthy and have more difficulties in accessing business networks and sources of information. A burdensome business environment is difficult for all, but as youth have generally less knowledge and experience of business regulations and related legal and institutional frameworks, this constraint can discourage them from venturing into a business career and so increase the risk of business failure (Coenjaerts et al., 2009).

Young informal workers acquire technical skills in informal activities but as these skills are often not recognized officially they face difficulties in accessing better jobs. Recognition and certification of skills acquired through informal channels are key elements in this regard. In addition, young people often do not know which profession to join and where to look for a job. Special youth labor market information and employment services and early career guidance may facilitate their entry into the labor market and help avoid a mismatch between youth labor supply and demand.

With regard to labor market institutions, it has been argued that employment protection legislations (EPLs) and minimum wages in particular increase youth unemployment by making labor too expensive. Moreover, many young people in developing countries work in the informal economy, where EPL and minimum wages have a rather limited impact. The question is not whether to regulate, but what kind and what level of regulations are appropriate to get the best forms of protection for young people without inhibiting firms from hiring.

Higher volatility and lack of work experience are strong reasons why entrepreneurs often shy away from hiring young people. Wage subsidies or reduction in payroll taxes for firms

that hire inexperienced workers seem to be the best options to counterbalance employers' concerns and thus increase the demand for young workers.

5. Results and Discussion

5.1 Multinomial logistic regression

In this section we test if youth employment in Rwanda is influenced by gender, age, education and geographical location. The employment status should be the outcome variable which is related to the different categories analyzed.

5.2 Results and interpretations

Our analysis focused on Rwanda's youth employment data using published raw data from the annual household budget survey's (EICV4) results. We used un-weighted data only on respondents who had no missing variables in all variables of interest.

The dataset contains variables for 284 respondents. The outcome variable is employment status. The predictor variables are gender, age, education and geographical location. The descriptive statistics of the variables of interest are given in Tables 1-4. Table 1 presents the distribution of employment status by gender.

Table 1: Distribution of employment status by gender

Employment status (last job)	Male	Female	Total
Paid employee	89	120	209
Employer	1	0	1
Own account worker	9	44	53
Unpaid family worker	11	7	18
Intern/volunteer	1	0	1
VUP	0	2	2
Total	111	173	284

Note: Pearson chi 2(5) = 20.0191, Pr = 0.001.

Source: Authors' calculations based on EICV4 data.

The distribution of employment status by gender in Table 1 shows that there were more women respondents more men.

Table 2 gives employability and degree obtained.

Table 2: Distribution of employment status by the highest diploma obtained

Employment status (last job)	Primary completed	Secondary common	Post primary certificate	Diploma A3, D5, D4	Humanities Diploma	Bachelors	Professional license	Total
Paid employee	33	31	2	6	88	21	28	209
Employer	0	0	0	0	0	1	0	1
Own account worker	26	7	1	1	12	3	3	53
Unpaid family worker	3	12	0	0	3	0	0	18
Intern/volunteer	0	0	0	0	0	0	1	1
VUP	0	0	0	0	2	0	0	2
Total	62	50	3	7	105	25	32	284

Note: Pearson chi2 (30) = 84.0054, Pr = 0.000.

Source: Authors' calculations based on EICV4 data.

The distribution of the highest diploma obtained by employment status (Table 2) shows that more respondents had completed humanities; a few of them had completed post-primary education. Table 3 gives the employment status by geographical location.

Table 3: Distribution of employment status by location

Employment status (last job)	Urban	Rural	Total
Paid employee	169	40	209
Employer	1	0	1
Own account worker	40	13	53
Unpaid family worker	2	16	18
Intern/volunteer	1	0	1
VUP	2	0	2
Total	215	69	284

Note: Pearson chi 2(5) = 45.1386, Pr = 0.000.

Source: Authors' calculations based on EICV4 data.

Table 3 shows more respondents were living in urban areas at the time of data collection. Our research used the 'mlogit' command to estimate a multinomial logistic regression model. The **i.** before a variable indicates that the variable is an indicator variable (that is, a categorical variable) and that it should be included in the model. We also used the option 'base' to indicate the category to use for the baseline comparison group.

We chose to use the type of employer as the baseline category in our model. The results of the regression are:

Multinomial logistic regression Number of obs = 284
 LR chi2(19) = 107.98

Log likelihood = -169.93121 Prob > chi2 = 0.0000
Pseudo R2 = 0.2411

Table 4 explains the regression results.

Table 4. Multinomial logistic regression estimates of youth employment in Rwanda

Variables	Coefficients	Std. error	z	P> z	[95% Conf. Interval]	
Paid employee						
Gender	18.03556	7297.1150	0.00	0.998	-14284.050	14320.120
Education	-0.45923	0.9043	-0.51	0.612	-2.231	1.313
Location	17.28352	12387.1100	0.00	0.999	-24261.010	24295.580
Age	-0.02278	0.2946	-0.08	0.938	-0.600	0.554
Constant	-9.98668	12387.1200	-0.00	0.999	-24288.290	24268.320
Employer (Base outcome)						
Own account worker						
Gender	19.3161	7297.1150	0.00	0.998	-14282.7700	14321.400
Education	-0.8021	0.9077	-0.88	0.377	-2.5812	0.9770
Location	17.9640	12387.11	0.00	0.999	-24260.3300	24296.260
Age	0.1020782	0.2971	0.34	0.731	-0.4804	0.6845
Constant	-15.2563	12387.1200	-0.00	0.999	-24293.5600	24263.050
Unpaid family worker						
Gender	18.2097	7297.1150	0.00	0.998	-14283.8700	14320.290
Education	-0.7518	0.9244	-0.81	0.416	2.5638	1.0600
Location	20.2085	12387.1100	0.00	0.999	-24258.0900	24298.500
Age	-0.3147	0.3246	0.97	0.332	-0.9510	0.3215
Constant	-9.3134	12387.1200	-0.00	0.999	-24287.6200	24268.990
Intern/volunteer						
Gender	2.0553	8431.4430	0.00	1.000	-16523.2700	16527.380
Education	13.5504	1291.0090	0.01	0.992	-2516.7800	2543.881
Location	4.0696	13930.4400	0.00	1.000	-27299.0900	27307.230
Age	-0.3590	0.4831	-0.74	0.457	-1.3059	0.5878
Constant	-88.2856	16605.0100	-0.01	0.996	-32633.5000	32456.930
VUP						
Gender	36.2363	10604.1300	0.00	0.997	-20747.4800	20819.950
Education	-0.1520	1.0251	-0.15	0.882	-2.1611	1.8571
Location	0.2094	16035.2600	0.00	1.000	-31428.3300	31428.750
Age	-0.12577	0.3635	-0.35	0.729	-0.8383	0.5867
Constant	-13.8366	17785.6500	-0.00	0.999	-34873.0700	34845.400

Source: STATA results based on EICV4 data.

Based on the regression results, the outcomes of the model and the conclusions thereof as far as youth employment is concerned in Rwanda are:

- the outputs show the iteration log indicating how quickly the model converged. The log likelihood found in the results (-169.93121) can be used in comparison to nested models;

- the likelihood ratio Chi-square of 107.98 with a p-value < 0.0001 tells us that our model as a whole fits significantly better than an empty model (that is, a model with no predictors);
- this leads us to conclude that the model is in line with what was expected: that youth employment in Rwanda is influenced by gender, age, education and geographical location;
- a one-unit increase in the variable s1q3y (age) is associated with a .023 decrease in the relative log odds of being a paid employee versus other employment status;
- a one-unit increase in the variable s4aq3 (education level) is associated with a .46 decrease in the relative log odds of being a paid employee versus other employment status;
- a one-unit increase in the variable s1q3y (age) is associated with a .10 increase in the relative log odds of being an own-account worker versus other employment status;
- a one-unit increase in the variable s4aq3 (education level) is associated with a .80 decrease in the relative log odds of being an own-account worker versus other employment status;
- a one-unit increase in the variable s1q3y (age) is associated with a .31 decrease in the relative log odds of being an unpaid family worker versus other employment status;
- a one-unit increase in the variable s4aq3 (education level) is associated with a .75 decrease in the relative log odds of being an unpaid family worker versus other employment status;
- a one-unit increase in the variable s1q3y (age) is associated with a .36 decrease in the relative log odds of being an intern/volunteer versus other employment status;
- a one-unit increase in the variable s4aq3 (education level) is associated with a 13.5 increase in the relative log odds of being an intern/volunteer versus other employment status;
- a one-unit increase in the variable s1q3y (age) is associated with a .13 decrease in the relative log odds of being a VUP worker versus other employment status; and
- a one-unit increase in the variable s4aq3 (education level) is associated with a .15 decrease in the relative log odds of being a VUP worker versus other employment status.

6. Conclusion and Policy Recommendations

The results of our research conclude that for youth (aged 20-34 years) there was a negative relationship between age on the one hand and education level on the other with being either a paid employee or an unpaid family worker or a VUP worker. In addition, there was a positive relationship between age and being an own-account worker which was directly

linked to job creation. The youth faced specific barriers in the labor market. Their unemployment rate was significantly higher and their employment and working conditions were worse than those of the elders which led to high economic and social costs for society.

Therefore, special attention must be paid to integrating the youth better into the labor market. This is also important given that their number is so high. Further, support for youth should mainly be based on existing employment policies which are complemented where necessary by targeted interventions; when implemented their impact on other age groups must be taken into consideration.

Supply-demand mismatch often lies at the root of the weak labor market integration of the youth. This can be resolved by adopting integrated approaches that consider both sides of the labor market effectively and involve all sectors of society.

The skills and aspirations of young Rwandans are an invaluable force. Helping young people have access to productive employment and realizing their potential is a precondition for poverty reduction and sustainable development.

Youth employment programs can serve as useful support to young people who often face specific barriers in the labor market. In fact, their under-utilization certainly leads to economic and psychological costs to the country. Nevertheless, youth programs have to be designed with caution to avoid crowding-out effects on other groups of workers.

Even though youth program initiatives exist, the following policy recommendations are put forward:

- Investors in the country should support country-led efforts in various policies that are contributing to improving the labor market. The national commitment for the promotion of youth employment involves all economic sectors. There should be greater participation of the youth within their own organizations such as in trade unions;
- Existing policies on youth programs should be improved according to the current situation and adjusted easily to youth specific needs such as youth entrepreneurship, remedial education and oriented vocational training or internships;
- Donors should support country-led efforts in various policies that are contributing to an improved labor market situation for the youth. Genuine national commitment for the promotion of youth employment requires the strong involvement of large sectors of society: Firstly, a greater participation of the youth in their own organizations or as representatives in other organizations and also in trade unions and the private sector, as well as closer cooperation with, and among, ministries and other public institutions;
- Youth employment issues can often best be resolved with already existing employment policies which could be adjusted to youth-specific needs such as youth entrepreneurship, remedial education and vocational training. Targeted interventions could, however, be useful under specific circumstances. Nevertheless, it is important to take into consideration the possible crowding-out effects on other age groups.

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Part Nine. Small and Medium Enterprises

Chapter 22. Josephine Mutesi, Christine Namaganda and Theogene Risinde, “The contribution of institutional environment and institutional support to the growth of SMEs in Rwanda”.

Chapter 23. Dative Mukarutesi, “The relationship between entrepreneurial orientation, government policy and SME performance: The case of SMEs in Rwanda”.

Chapter 24. Florence Mukamanzi and Philippe Ndikubwimana, “The effect of ICT adoption on SMEs in Rwanda: Case study of Kigali City”.

Chapter Twenty Two

The Contribution of Institutional Environment and Support to the Growth of Small and Medium Enterprises in Rwanda: A Survey of SMEs in Kigali

Josephine Mutesi¹, Christine Namaganda², Theogene Rizinde³

¹Corresponding author:

Department of management,
University of Rwanda, Kigali, Rwanda,
E-mail: mutejose5@gmail.com

²Department of Entrepreneurship,
Makerere University, Kampala, Uganda,
E-mail: namagandac60@gmail.com

³Department of Statistics,
University of Rwanda, Kigali, Rwanda,
E-mail: rizindeth@gmail.com

Abstract

Although market reforms in developing economies date back to the 1980s and early 1990s no empirical studies have assessed whether the institutional environments in these economies are favorable for small and medium enterprises (SMEs). This followed a recent effort to do so in the context of the developed and emerging economies in Eastern Europe and Latin America, our research developed a valid scale to comprehensively measure institutional environments in developing economies. SMEs are found in every sector of the economy and are crucial for sustained long term growth and employment. Despite the different initiatives to enable SMEs to survive in their operations, most of them have failed. Therefore, the purpose of this study is to ascertain the contribution of an institutional environment and support to the growth of SMEs in Rwanda. Our results show that the factors that make up an institutional environment for SMEs' growth in Rwanda include accessibility to finance, market and training in entrepreneurship skills and knowledge and SMEs' abilities to interpret the environment. The findings indicate that there is a need for improving the factors that affect the institutional environment for SMEs in Rwanda.

Keywords: Institutional environment, institutional support, SME growth.

JEL Classification Codes: G28; L26; O43; O44.

1. Introduction

Institutional theory contends that a firm's external environment is governed by institutions that have a wide range of social structures including rules and norms (Scott, 2004). In addition, institutional theory also focuses on the deeper and more resilient aspects of the social structure. It considers the processes by which structures including rules, norms and routines become established as authoritative guidelines for social behavior (Scott, 2004). Different components of institutional theory explain how these elements are created, diffused, adopted and adapted over space and time and how they fall into decline and disuse. Institutions lay down the rules of the game to which economic players such as business firms must conform to earn legitimacy that boosts their chances of economic survival and relative performance (Chen and Roberts, 2010; North, 1990; Scott, 2004). These rules may take the form of laws, regulations, norms, social conventions and other written or unwritten rules of conduct (Chen and Roberts, 2010).

SMEs' growth is essential for the economic development of nations. This is especially relevant in less developed countries such as Rwanda with serious problems of unemployment and poverty. How to promote the growth of small and medium enterprises has therefore been a central issue with policy planners in developing economies around the world. This topic has evoked considerable interest among scholars of entrepreneurship in recent years. The rate and trajectory of entrepreneurship in developing economies is significantly influenced by their institutional environments (Bruton and Ahlstrom, 2002; Peng and Heath, 1996; Smallbone and Welter, 2001).

Although market reforms in the developing economies date back to the 1980s and early 1990s no empirical studies exist which assess whether the institutional environments in these economies are favorable for small and medium enterprises. In fact, there are no valid scales to comprehensively measure the institutional environments in developing economies underscoring a need to develop good constructs and metrics for this purpose. Following a recent effort to do so in the context of the developed and emerging economies in Eastern Europe and Latin America (Manolova et al., 2008), our study first validates an instrument proposed by Busenitz et al., (2000) in the context of western industrialized countries to two emerging economies in Latin America: Brazil and Mexico. It then applies this instrument to assess the relationship between institutional environment and support to SMEs' growth in Rwanda.

SMEs are found in every sector of the economy and are crucial for sustained long term growth and employment (Macdonald et al., 2007). Specifically, Rwanda has institutions that have helped develop and support SMEs in the country. These include the Ministry of Trade and Industry (MINICOM), which is helping sensitize people to develop an entrepreneurial culture through the 'HANGA UMURIMO' campaign. This is done by encouraging nationals to develop innovative business plans of which the best are awarded resources to start businesses. The Rwanda Development Board (RDB) has several specific initiatives to support SMEs such as training programs, networking and moveable asset registration; it also works at improving the overall business environment in the country.

Despite the different initiatives to enable SMEs' to survive in their operations, most of them have failed. A report by PSFR (2008) citing a study by the Center for the Support of Small and Medium Enterprises in Rwanda CAPMER (2007) shows that a majority of the established SMEs had filed for bankruptcy and a majority of the start-ups failed in their first two years of operations and only less than 25 per cent expanded their businesses. This may be a result of unfavorable rules and regulations, lack of entrepreneurial skills and knowledge, lack of an entrepreneurial culture, lack of access to finance and lack of access to markets (MINICOM, 2010). These factors relate to the institutional environment. Therefore, our study ascertains the contribution of institutional environment and institutional support to SME growth in Rwanda. It also answers the following questions: What is the relationship between institutional environment and SMEs' growth in Rwanda? And how does institutional support affect SMEs' growth?

Our study focuses on the institutional environment in terms of its regulatory, cognitive and normative dimensions. Support focuses on access to finance, access to local and foreign markets and training in entrepreneurship knowledge and skills while SMEs' growth is studied based on enterprises' long-term survival which is explained by an increase in sales and an increase in employment over a period. Our study was confined to SMEs in Kigali city because Kigali is the capital where the researchers were able to find ventures in all categories such as small and medium enterprises and in different sectors of business activity.

2. Theoretical framework

2.1. Institutional Environment

According to institutional theory, a firm's external environment is governed by institutions which have a wide range of social structures including schemas, rules, norms and routines (Scott, 1995). Scott (1995) adds that these social structures are well established and have attained a high degree of reliance in providing authoritative guidelines for social behavior. Institutions lay down the rules to which economic players such as business firms must conform to earn legitimacy that boosts their chances of economic survival and relative performance. These rules may take the form of laws, regulations, norms, social conventions and other written or unwritten rules of conduct (Chen and Roberts, 2010; North, 1990; Scott, 1995). Legitimacy endows a firm with the right to exist and perform an activity in a certain way (Bruton et al., 2010; Chen and Roberts, 2010). Acs et al., (2008) point out that the relevance of an institutional environment for a business may be the most pronounced in times of economic distress. Support structures for new businesses are often available when the times are good, but at the time of an economic downturn it is hard to find private capital, grant funds, governmental support programs or inexpensive education that would assist start-ups. Hence, it is evident that the tax burden and regulatory requirements imposed on entrepreneurial businesses may feel particularly heavy when a business is already slowing down. Businesses around the world face increasing pressures to reconfigure their strategic orientations and capabilities in response to calls for sustainable development. For instance, in Philippines the 1996 Marcopper mining disaster was a wakeup call for the country's business leaders to be more environmentally sustainable in their business conduct. This

disaster led to the closure of the firm, hundreds of jobs were lost and there was irreversible damage to the natural environment (Bravante and Holden, 2009). Since the accident, regulatory and legislative reforms have been implemented to strengthen the Philippine government's capability to create an institutional environment that effectively mandates the business sector to adopt sustainable environmental practices. However, questions arise about the effectiveness of the various institutional environmental factors such as government policies, regulations and industry practices on the productivity of firms to adopt environmentally sustainability measures.

The concept of a country's institutional profile builds from Scott's (1995) notion that institutional environments consist of three inter-related pillars reflecting normative, cognitive and regulatory dimensions. The regulatory dimension refers to the formally codified, enacted and enforced structure of laws in a community, society or nation which promote certain types of behavior and restrict others (Kostova, 1997; North, 1990; Williamson, 1991). The normative dimension refers to social norms, values, beliefs and assumptions that are socially shared and direct behavior through a web of social obligations and expectations (Beliveau et al., 1994; Kostova, 1997; Scott, 1995).

The cognitive dimension refers to the socially mediated construction of a common framework of meaning or axiomatic beliefs that provide the templates and scripts for action (Scott, 1995). Firms achieve legitimacy from their institutional environment if their behavior and practices conform to specific regulatory, normative and cognitive standards.

2.2. Institutional Support

Support policies for SMEs vary from country to country and from developed countries to less developed countries due to differences in business contexts, cultures and the levels of industrialization. Since East European countries are now members of the European Union (EU), there are various EU programs for SMEs that cover a range of their needs including vocational training and education, infrastructure projects and individual and information technology development (Konopielko and Bell, 1997). In addition, SMEs in these countries also receive direct support from local authorities and governments. Poland and Bulgaria are a case in point where SMEs are provided training and advisory services, management, market information, access to credit, export promotion and the introduction of high-tech production. In the initial stages of transition, these countries suffered some setbacks when SMEs operated in imperfect markets that lacked institutional support. The Central and Eastern Europe (CEE) experience suggests that business support infrastructure, financial support, a legal and institutional framework and cluster and network relationships play a vital role in business development.

SME development is also becoming increasingly important in many Asian industrialized countries such as Korea, Taiwan, Singapore and Australia. The Singaporean government has identified four key problem areas of SMEs: access to technology, manpower, finance and market (Lee and Tan, 2002). In 1998, the Korean government used a number of policies to foster the growth of SMEs and their involvement in the global economy. This was done by ensuring access to finance, supporting human resource development programs and

developing technology and scientific achievements so that businesses could develop extensive relationships with the global market (Gregory et al., 2002). Countries are now focusing increasingly on emphasizing public governance which outlines the broad institutional context within which individual policies are pursued. The need for broad public sector and regulatory reforms is an issue that has moved to the centre stage in both developed and developing countries (Organization for Economic Cooperation and Development (OECD), 1997; the World Bank, 2000).

2.2.1. Access to finance

A number of studies highlight access to finance as one of the driving factors of an enabling economic environment. The World Bank and the International Finance Cooperation (IFC) rank economies according to their ease of doing business. In this framework businesses' ability to get credit is an important criterion (IFC, 2011). The Global Entrepreneurship Monitor (GEM) Entrepreneurship Framework Condition also highlights entrepreneurial finance which is defined as the availability of financial resources for SMEs in the form of debt and equity as one of the key factors for stimulating and supporting entrepreneurial activity (GEM, 2010).

Many entrepreneurs tend to depend on their own or their family's savings to start and operate a business; this means that the avenues of capitalization are limited. Thus, access to capital remains a challenge. For example, Kallon (1990) found that 65.6 per cent of the studied firms depended on personal savings as their sole source of capital, 10.9 per cent had access to family savings, 9.4 per cent used commercial banks and 7.8 per cent drew resources from partners, shareholders and other sources.

Access to finance is necessary for creating an economic environment that enables firms to grow and prosper. However, SMEs in developing countries face significant barriers to finance. Financial constraints are higher in developing countries in general, but SMEs are particularly constrained by gaps in financial systems such as high administrative costs, high collateral requirements and lack of experience within financial intermediaries. Increased access to finance for SMEs can improve economic conditions in developing countries by fostering innovation, macroeconomic resilience and growth in the gross domestic product (GDP) (Dalberg Global Development Advisor, 2010).

2.2.2 Training in entrepreneurial skills and knowledge

Identifying the importance of institutional change for the growth of entrepreneurship, Smallbone (2004) suggests that businesses need to adhere to the following conditions: first, a legal infrastructure that is appropriate to market conditions; second, the creation of a legal framework that facilitates the development of entrepreneurship training and knowledge; and finally, the creation of commodity, capital and labor markets. Institutions that include regulatory and tax authorities, licensing and registration offices and private sector institutions such as banks, accounting firms, other professional bodies and chambers of commerce must provide business support to SMEs. Such support includes creation of formal

and informal support mechanisms and training programs; educational services are particularly important in emerging market economies because entrepreneurs lack basic business skills in terms of business plan preparation, planning, decision making, negotiations, pricing, market penetration, organization and management, management of the workforce and handling of cash flows (Swanson and Webster, 1992). Government sponsored incubators, most especially science, technology and research centers which will facilitate innovation in the long run should be put in place. In particular, entrepreneurs need assistance in conducting market research.

Gatewood et al., (1991) point out that business incubators can play a major role in providing a variety of services to start-up entrepreneurs. Most incubator facilities provide office space, common office facilities, faster and efficient means of communication and counseling and advisory services to their tenants at low costs. Incubators can be very helpful in places where infrastructure is not well developed or where modern physical facilities are costly. Some research evidence also shows that successful entrepreneurs can be developed through educational and short-term training programs and the government should play a big role in fostering entrepreneurship by instructing educational institutions, technical and vocational education (tailor-made) and business education to include entrepreneurship development studies in their curricula to impart knowledge and skills to will-be entrepreneurs. There should also be direct government subsidies for research and development, support for linkages between universities and the private sector and reflect and respond to the needs of specific localities or regions to be effective in encouraging innovations rather than simply importing successful policies from other areas.

2.2.3 Access to local and foreign markets

According to OECD (2004) the rate at which countries grow is substantially determined by their ability to integrate with the global economy through trade and investments; their capacity to maintain sustainable government finances and sound money; and their ability to put in place institutional environments in which contracts can be enforced and property rights can be established.

Globalization and trade liberalization have ushered in new opportunities as well as challenges for SMEs. Presently, only a small part of the SME sector is able to identify and exploit these opportunities and deal with the challenges. A majority of the SMEs in developing and transition countries, however, has been less able or unable to exploit the benefits of globalization and, to add to the situation, SMEs are frequently under pressure in the local or domestic markets from cheaper imports and foreign competition due to lack of an enabling environment (OECD, 2004).

Therefore, governments should facilitate entrepreneurs to participate in local and international trade fairs and exhibition centers as a way of helping them to develop networks which they will use in marketing their products and services in both local and international markets and providing them necessary infrastructure such as roads, energy and modern transport and communication facilities. In addition, OECD (2004) stresses that with easy

access to suppliers and customers, development of industrial parks and trade centers, certain infrastructural elements have a substantial impact on the entrepreneurial environment.

2.3 Growth of small and medium enterprises

The term ‘SME’ includes a wide range of definitions. Organizations and various countries have established definitive guidelines for categorizing SMEs which are often based on sales, the number of employees or the value of assets. In Rwanda, there is a recently agreed upon definition by all the intervening institutions which is based on criteria such as net investments, turnover and employment.

Insert Table 1 about here

SMEs’ growth depends on many factors that vary from country to country. McIntyre (2002) argues that a synergistic relationship between SMEs and the larger enterprise sector is a critical factor. Havie (2002) observes that in China the development of township and village enterprises (TVEs) is an important aspect for the growth of SMEs. Several researchers (e.g. McIntyre, 2002; Julien, 1993; and You, 1995) recommends synergistic relationships and the process of urbanization based on both horizontal and vertical linkages such as industrial districts and clusters.

Various theories explain SMEs’ growth from different perspectives. However, for a SME to develop its core competencies, adequate resources (both internal and external) are an important pre-requisite. Rindova and Fombrun (1999) argue that resources, capabilities and core competencies are essential for a firm’s competitive advantage. Therefore, adequate resource support and policies to create capability are critical for SMEs’ growth as they are small in size and need assistance. The resource based theory provides a framework to explain how a business can identify suitable measures to overcome growth obstacles, have better access to technology, manpower, financial and natural resources, infrastructure and access to the market. Lack of capital or denial of financial resources is a major barrier for SMEs and entrepreneurs, which usually have to mobilize their own capital or their own resources to establish or expand their businesses. Also, SMEs in developing countries have difficulties in accessing bank loans because of the high risks of failing loans, low profitability and lack of collateral required by banks Harvie and Lee (2005) For many SMEs in countries in the region access to finance and capital appear to be difficult. This is a consequence of weak banking institutions, lack of capital markets and inefficient legal frameworks regarding credit and collateral assessment. Financing of SMEs and access to finance play a crucial role in the growth and development of enterprises (the World Bank, 2011).

Porter (1998) proposes that industrial cluster policies can be a growth strategy for a firm; according to the author a cluster is a geographic concentration of interconnected companies and institutions in a particular field. This argument is strongly supported by Enright and Robert (2001), Dijk and Sverrisson (2003) and Nadvi (1995) since SMEs can receive external economic advantages (economies of scale and scope) if clustering and networking offer a potential growth path for them. The networking approach should not be seen in isolation but as being connected in business systems (Ritter et al., 2003). Lechner and

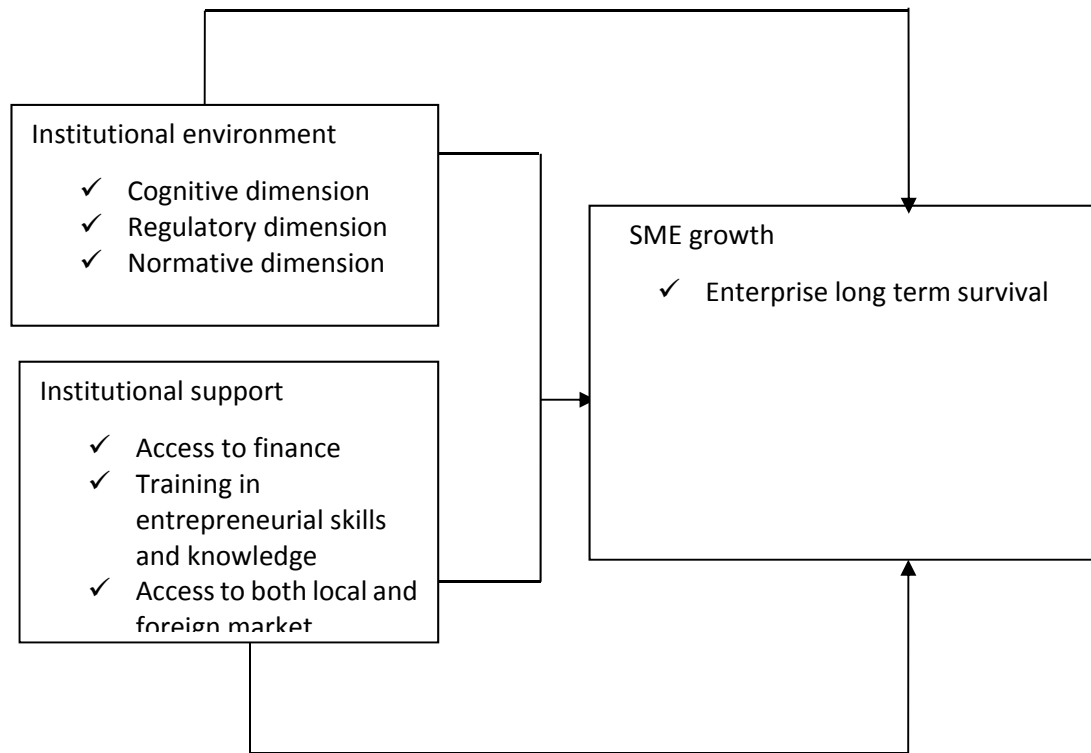
Dowling (2000) define networks as the relationships that an individual has with other individuals or relations between organizations that can have various functions. Therefore, network relationships can be considered an important intangible resource for supporting SMEs which do not have sufficient resources. These relationships help SMEs develop links with suppliers, distributors and customers, or use social contacts including acquaintances, friends, family and kin.

North (1990) emphasizes that market economies convert resources - land, labor, energy and capital -- to the manufacture of services and goods. To make this conversion a success, institutions must also help and guide these transformations in predictable ways. Observing the economic histories of both newer and mature markets in Asia, North America and Western Europe Kartz (1995) maintains that private enterprises cannot emerge and prosper in an imperfect market without a conducive policy environment and institutional support system.

3. Conceptual frame work

This research was guided by the conceptualization that SME growth if is to be improved; there is need for an effective enabling institutional environment and effective institutional support. Given that SMEs do not operate in a vacuum, investigating these relationships would be beneficial. Growth is conceptualized in terms of SME long term survival. SME survival is major concern in Rwanda as indicated by their high rates of failure. Institutional environment is conceptualized to comprise of cognitive, regulatory and normative factors. Previous studies have established that an enabling institutional environment boosts SME growth (Busenitz et al., (2000). Therefore, it was expected that if the institutional environment favoured SME operations, this would improve SME growth. Support is conceptualized to comprise the kinds of support that can be accessed from various institutional bodies in Rwanda. The support considered under this study is access to finance, entrepreneurial training and access to markets. Previous studies indicate that with such support, there is little doubt that SMEs will fail to live longer (Segnestam et al., 2002). It is therefore expected that when SMEs can readily access such support, they can improve their growth. See also Figure 1.

Figure 1: Conceptual framework



3. Research Methodology

Our study used cross-sectional designs together with the quantitative research design to establish the factors of an institutional environment that affect SMEs' growth. The population consisted of 3,352 registered SMEs' in Kigali (National Bureau of Statistics for Rwanda, 2011). A sample of 341 SMEs was chosen according to Research Advisors (2006). We used the convenience sampling method (Cosby, 2004) where we selected respondents with ease.

Primary data was collected from the respondents using self-administered questionnaires. The variables for primary data included the institutional environment and the variables were measured by a combination of different items measured on the Likert scale. Institutional environment was measured by the normative, cognitive and regulatory dimensions (Kostova, 1997; North, 1990; Williamson, 1991). Institutional support was measured by access to finance, training in entrepreneurial skills and knowledge and access to both local and foreign markets. This was according to Segnestam et al., (2002). Growth of SMEs was measured by enterprises' long term survival. This was according to North (1990); and Scott, (1995). The data collected was edited for completeness and consistency to ensure correctness of the information given by the respondents. Statistical package for social scientists (SPSS 17) was used for data entry and an analysis of the study variables. A descriptive analysis was

conducted to establish the institutional environment factors that affect the growth of the SMEs in Kigali.

4. An Analysis of the Results

Findings from our study indicate the following on the factors affecting the institutional environment of SMEs in Kigali: Sixteen of the 23 items that were found to be significant with high inter-correlation coefficients were retained. A KMO statistic of .85 which is above the acceptable .70 threshold was obtained after deleting seven items that had weak inter-item correlations (coefficients less than .3). Three factors constituting the institutional environment with Eigen values greater than 1 were extracted from the retained items. These factors in total explain 50.07 per cent of the total variance in the institutional environment. The factors were labeled regulatory, cognitive and normative dimensions. The regulatory dimension explained more of the institutional environment (29.21 per cent) followed by the cognitive dimension (12.16 per cent) and the normative dimension (8.7 per cent). This implies that the regulatory dimension explained institutional environment more than cognitive and normative dimensions in the institutional environment. The regulatory factors related to the government's efforts at enhancing SMEs' growth. The results indicate that the regulatory dimension is very critical.

Insert Table 2 about here

4.1 Correlation Analysis

Table 2 shows the correlation analysis of the respondents' understanding of the relationship between the institutional environment, institutional support and SMEs' growth. The correlation analysis was done to establish the relationships between the independent variables and the dependent variable.

Insert Table 3 about here

4.2 The relationship between the institutional environment and growth of SMEs

The first question was on the relationship between the institutional environment and SMEs' growth in Rwanda. Our results show that the institutional environment had a significant and positive relationship with SME growth ($r = .159$, $p < 0.05$). This implies that any positive change in the institutional environment was associated with positive changes in SMEs' sustainability.

4.3 The relationship between institutional support and growth of SMEs in Rwanda

The second question was whether institutional support had a significant relationship with SMEs' growth in Rwanda. Our results show that institutional support was significant and inversely related to SME growth ($r = -0.205$, $p < 0.05$). This result is surprising and contrary

to what was expected. However, a further analysis of the descriptive statistics of institutional support indicated that most of the respondents were unaware of the support provided to SMEs. The results in Table 4 indicate that individual items and the composite item had a mean of 3 on a five-point Likert scale. This explains the inverse relationship between institutional support and SMEs' growth.

Insert Table 4 about here

4.4 The relationship between institutional environment, institutional support and SMEs' growth: Regression Analysis

This analysis was done to explain the predictive powers of the institutional environment and institutional support on the dependent variable of SME growth. According to Table 4, the results from the findings indicate that the institutional environment and institutional support accounted for a 5.8 per cent (R-squared .058) variance in SME growth in Kigali. The unstandardized coefficients B shows that the values of the numbers for institutional environment were in the linear regression equation while the value for institutional support showed an inverse equation. The relationship between the institutional environment, institutional support and SME growth was 0.196 and -0.231 respectively. This means that for every change increase in the institutional environment, SME growth improved by 0.196 and for every increase in institutional support, SME growth improved by -0.231. The SMEs' growth t-value of 16.648 indicates that the model was significant at the 1 per cent level. The p-value of $P \leq .000$ indicates that the variables of institutional environment and institutional support were significant in SMEs' growth in Kigali.

Insert Table 5 about here

5. Discussions of the findings

5.1 The relationship between institutional environment and growth of SMEs

Our findings show that institutional environment was positively associated with SME growth. This concurs with numerous studies that highlight, for instance, access to finance as one of the driving factors of an enabling economic environment. The World Bank and the International Finance Cooperation (IFC) rank economies according to their ease-of-doing business. In this framework, a business' ability to get credit is an important criterion.

In line with these findings, authors such as and Lundvall (1992), Nelson (1993) and Sorge (1991) discuss that a country's institutional environment comprises of relatively stable rules, social norms and cognitive structures that guide and constrain domestic economic activity. It is well understood that a country's institutional environment guides firms' strategies and helps determine the nature and amount of business activity that takes place within the country's borders (Lundvall, 1992; Nelson, 1993; Sorge, 1991). The institutional environment sets the framework for market transactions by defining the alternative courses of action open to firms (North, 1990) dictating potential risks and payoffs for different

activities and specifying the conditions under which firms hold legitimacy (Meyer and Rowan, 1977).

5.2 The relationship between institutional support and growth of SMEs in Rwanda

Our findings show that institutional support had an inverse relationship with SME growth with ($r = -.205$). This is explained by the fact that the respondents were unaware of the existing institutional support for SME growth in Kigali. This means that there is a need for generating awareness about different avenues of support provided by both central and local governments to SMEs. In disagreement with these findings, authors such as Nguyen et al., (2009) state that support policies for SMEs vary from country to country and from developed countries to less developed countries due to differences in business contexts, cultures and the levels of industrialization. In addition, according to Batra and Mahmood (2003), SMEs in developing countries in East Asia, for instance, receive support from local governments in the form of microfinance, interventions to increase private sector training, technology development and market information. China, Malaysia, Indonesia and Thailand have benefited from these policy reforms, network relationships, cluster linkages to markets and the new support infrastructure (Harvie, (2002); Tambunan, 2005).

Based on the experiences of CEE countries, Dallago and McIntyre (2003) state that SMEs are not themselves sufficient for growth without the proper development of institutions and support structures. Further, North (1990) found that institutions were critical determinants of economic behavior and they can impose direct and indirect effects on the prevalence and types of entrepreneurship in a society. Therefore, promoting sustainable enterprises calls for the strengthening of institutions and governance systems which nurture enterprises by building formal structures, coordination amongst them, availing necessary resources and equipping people working in these institutions with skills and knowledge which will enable them to offer good services to SMEs when called upon. Promoting sustainable enterprises is also about ensuring that human, financial and natural resources are combined equitably and efficiently to achieve innovation, enhanced productivity and resource conservation (CAPMER, 2004).

5.3 The relationship between institutional environment, support and SMEs' growth

Our findings indicate that the institutional environment and institutional support accounted for 5.8 per cent (R-squared .058) variance in SME growth in Kigali. The p-value of $P \leq .000$ indicates that the variables of institutional environment and institutional support were significant for SME growth in Kigali. In support of our findings, previous studies indicate that there are reasons to believe that an institutional environment which favors new business activities and entrepreneurship can have a direct and positive impact on the performance of new firms. However, we also believe that these effects of the institutional environment are channeled to a firm through key individuals' interpretations of the state of these institutions (Busenitz, et al., 2000). Also, since institutional profiles are domain specific (Kostova, 1997), we expect that younger firms experience the effects of institutional environment for

entrepreneurship more strongly than the more established firms. Bowen and DeClercq (2008) stressed that under institutional arrangements entrepreneurial individuals are more likely to engage in the creation of new wealth through productive entrepreneurships.

6. Summary and Conclusions

Our study looked at the contribution of institutional environment and support to SMEs' growth in Rwanda. The factors that constitute the institutional environment can be summarized as: The regulatory dimension can be interpreted as accessibility to finance, access to market and training in entrepreneurship skills and knowledge as well as an interpretation of the environment. Our findings also show that there is a need to improve the institutional environment for SMEs in Rwanda especially in access to finance and fiscal regulations because our study found that the institution environment was positively associated with SMEs' growth in Rwanda. This is in line with Bartholomew (1997); Lundvall (1992); Nelson (1993); and Sorge (1991). Our study also concludes that a country's institutional environment guides firms' strategies and helps determine the nature and amount of business activity that takes place within the country's borders. This also concurs with North (1990) who stresses that the institutional environment sets the framework for market transactions by defining the alternative courses of action open to firms. These findings lead us to the conclusion that institutional support has an inverse relationship with SME growth. This is explained by the fact that the respondents were unaware of the existing institutional support for their growth. More specifically, a majority of the respondents were not sure about the kind of support being provided to them like financial and marketing institutional support being provided to facilitate their operations and protection from outside competition.

Contrary to this finding, using the experiences of CEE countries Dallago and McIntyre (2003) state that SMEs were not themselves sufficient for growth without a proper development of institutions and support structures. Kartz (1995) observes from economic histories of both newer and mature markets in Asia, North America and Western Europe that private enterprises cannot emerge and prosper in an imperfect market without a conducive policy environment and institutional support systems. Institutions must be designed so that they are able to work in the environment in which they function. In addition, our results also indicate that institutional environment and support accounted for a 5.8 per cent (R-squared .058) variance in SMEs' growth in Kigali. However, the institutional environment had a linear relationship with SMEs' growth while institutional support showed an inverse relationship. Therefore, the relationship between institutional environment, institutional support and SME growth was 0.196 and -.231 respectively which means that for every increase in the institutional environment, SME growth improved by 0.196 and for every increase in institutional support, SME growth improved by -.231. The p-value of $P \leq .000$ indicates that the variables of institutional environment and institutional support are significant for SMEs' growth in Kigali.

7. Recommendations

Based on our findings we make the following recommendations for SMEs in Kigali to improve their growth:

- There is need to establish whether the following aspects of institutional support are provided to SMEs in Kigali easily: Access to loans at low interest rates, mentorship to entrepreneurs, access to markets for their products within and outside the country, prevention of outside competition for SMEs' products and ensuring that SMEs' products easily reach the final consumer at less costs.
- SMEs in Kigali should concentrate more on improving the institutional environment than institutional support because it positively improves their growth.
- There is also need for SMEs in Kigali to understand why institutional support inversely influences SMEs' growth as this will help them structure appropriate strategies to support and to improve SMEs' growth positively.

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Table 1. Definitions of MSMEs used in Rwanda

Size of the Enterprises	Net capital investments in Million FRW	Annual Turnover in Million FRW	Employment Number
Micro-Enterprises	Less than 0.5	Less than 0.3	Less than 3
Small Enterprises	0.5 to 15	0.3 to 12	3 to 30
Medium Enterprises	15 to 75	12 to 50	30 to 100
Large Enterprises	More than 75	More than 50	More than 100

Source: MINICOM (2010).

Table 2: Factor analysis of the institutional environment in Rwanda

Items	1	2	3
Regulatory			
The government has made it easy for SMEs to access financial services for their business operations	0.751		
Local and central governments have special support available for individuals who want to start a new business	0.715		
The government provides free entrepreneurial training and sensitization to SME owners or managers	0.692		
SMEs are not over taxed in the initial stages of their operations	0.677		
The government has made it possible for SMEs to trade across borders	0.665		
The government controls prices of products/ services	0.557		
Cognitive:			
I /we understand the rules and regulations imposed on us and how they affect our business		0.766	
I / we understand the procedures for securing a loan		0.744	
I / we know where to find the information about the market for our products or services		0.656	
I / we know different taxes and payment procedures		0.641	
I / we know and understand different financial products such as short-term loan, medium-term loan, long-term loan, over draft and salary advances offered to us by financial institutions		0.633	
I / we know and understand SMEs' development policy and other government policies		0.515	
I / we know how to legally protect a new business		0.495	
Normative:			
Financial institutions in Rwanda provide loans to SMEs easily			0.735
There is protection of new businesses by the government from outside competition			0.638
The institutions of higher learning in the country produce the best workforce which is able to start a new business or work for other organizations			0.633
Eigen values	4.67	1.94	1.39
Percentage of variance	29.21	12.16	8.70
Cumulative percentage of variance	29.21	41.37	50.07

Table 3: Correlation analysis

Variables	1	2	3
Institutional Environment (1)	1	0.268**	0.159**
Institutional Support (2)	0.268**	1	-0.205**
SMEs' Growth (3)	0.159**	-0.205**	1

Note: ** Correlation is significant at the 0.01 level (2-tailed)

Table 4: Descriptive statistics of institutional support

Items	Minimum	Maximum	Mean	Std. Dev
It is easy to access loans from financial institutions	1.00	5.00	3.0382	1.48640
The interest rates on loans in the country are favorable for SMEs	1.00	5.00	3.3248	1.29987
The procedures to access loans from banks are simple for SMEs	1.00	5.00	3.1911	1.43277
There are entrepreneurship training centers in the country to help train SME owners already in business and also those who wish to start a new business	1.00	5.00	2.8185	1.01844
The government has put up incubation centers for SMEs' upcoming ideas to be tested	1.00	5.00	2.8949	1.10116
It is easy for SMEs to access markets for their products outside the country	1.00	5.00	3.4586	1.27893
There is less outside competition for SME products	1.00	5.00	3.1592	1.32081
SMEs' products easily reach the final consumer at less costs	1.00	5.00	3.0605	1.18813
Composite Variable Mean			3.11	

Table 5: Regression analysis of Institutional environment, institutional support and SMEs' growth

Coefficients ^a							R sq	adjusted R sq	F	sig
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.				
		B	Std. Error	Beta						
	(Constant)	2.316	0.139		16.648	.000	0.058	0.048	2.834	0.60
	Inst. Eenvt	0.196	0.085	0.194	2.309	0.022				
	Inst. support	-0.231	0.055	-0.351	-4.179	0.000				
a. Dependent Variable: SME growth										

Chapter Twenty Three

The Relationship between Entrepreneurial Orientation, Government Policy and SME Performance: The Case of Small and Medium Enterprises in Rwanda

Dative Mukarutesi

College of Business and Economics,
University of Rwanda, Rwanda
Email: datismuk@gmail.com

ABSTRACT

Given the ever-growing importance of small and medium enterprises (SMEs) in developing nations like Rwanda this study examines the relationship between entrepreneurial orientation, government policy and the SMEs' performance. The research study was conducted in Rwanda using a cross-sectional research design. The targeted sample was 226 firms and the collected data was entered and analyzed using the SPSS software package. The study used the Pearson correlation coefficient and the regression model analysis to test the research hypothesis. The results show that entrepreneurial orientation is significantly and positively related to both SME performance and government policy. At the same time, government policy is also significantly and positively related to SME performance. These results were confirmed by the hierarchical regression model which showed that entrepreneurial orientation and government policy were both significant predictors of SMEs' performance. Based on its findings the study gives recommendations for SME staff members to improve their performance.

Keywords: Small and medium enterprises, entrepreneurial orientation, government policy.

JEL Classification Codes: K20; L25; L26.

1. Introduction

There is no single definition for small and medium enterprises (SMEs) that is accepted universally. Different sectors of the economy have different interpretations of what defines SMEs. Further, different countries define SMEs differently. However, it is acceptable to use quantitative and qualitative criteria when defining SMEs (Gibson and Holmes, 2001). This notion is supported by scholars who agree that definitions of SMEs that are based on quantitative and qualitative factors consider the measure of the size such as gross assets, sales turnover, type of ownership and different sectors of the economy like manufacturing, wholesalers, retail, mining and textile industries. SMEs are important vehicles in poverty reduction and skill development (MINICOM, 2014-15). SMEs represent 99 per cent of all businesses in the European Commission (EC). The main factors that EC considers when defining SMEs are staff head count and either turnover or balance sheet details (Table 1).

Insert Table 1 about here

In Rwanda, SMEs include micro, small and medium enterprises. SMEs fall under various categories and they are defined with respect to the context in which they operate (MINICOM, 2010). The definitions used for SMEs in Rwanda are given in Table 2.

Insert Table 2 about here

The SME business sector is recognized as an integral component of economic development and a crucial element in efforts to lift countries out of poverty. SMEs have been a driver of development and many young people today, especially those who have just finished school and started working, resort to starting SMEs. The reason that they find this sector attractive is that it is not capital intensive (Acemoglu, 2001). The dynamic role of SMEs in developing countries as engines through which their growth objectives can be achieved despite their size, capital investments and their capacity to generate greater employment, have demonstrated their powerful propellant effect on rapid economic growth.

2. Theoretical Background

Entrepreneurial orientation refers to strategy making processes that provide organizations with a basis for entrepreneurial decisions and actions (Wiklund and Shepherd, 2003). Many reviews and assessments of entrepreneurship research conclude that the development of a cumulative body of knowledge has been limited and slow because there is lack of agreement on many key issues regarding what constitutes entrepreneurial orientation (Shane and Venkataraman, 2000). This has been partly due to the fact that researchers have failed to build upon each other's results and the fact that measurement of key variables is typically weak. Notwithstanding this, entrepreneurial orientation has become a central concept in the domain of entrepreneurship that has received a substantial amount of theoretical and empirical attention (Covin et al., 2006). Therefore, it is essential that organizations understand the systems and processes that facilitate entrepreneurial behavior. The

justification for this is that previous studies have indicated a probable non-significant link between social wellbeing and participation in the SME sector.

Even if these were not turbulent, fast-changing times, entrepreneurship would still be important for organizations seeking to survive and thrive and gain competitive advantages. The attributes of entrepreneurial orientation are product innovation, proactiveness and risk-taking behavior (Covin and Slevin, 1991; Miller, 1983; Wiklund and Shepherd, 2005).

Product innovation reflects a firm's propensity to engage in and support creativity and experimentation thereby leading to the creation of new products or the modification of existing ones to meet the demands of current or future markets (Lumpkin and Dess, 1996, 2005). Proactiveness is a forward-looking perspective characterized by the pursuit and anticipation of future wants and needs in the marketplace. By being proactive, firms capitalize on emerging opportunities and shape the evolving competitive environment. Risk taking characterizes entrepreneurial behavior in which both the cost of failure and the potential returns are high (Lumpkin and Dess, 1996, 2004).

Although Lumpkin and Dess (1996) have identified competitive aggressiveness and autonomy as additional components of the entrepreneurial orientation construct, we focus our attention on Miller's original conceptualization of entrepreneurial orientation. Lumpkin and Dess (1996: 146) argue that entrepreneurial orientation includes taking initiative(s) by anticipating and pursuing new (future) opportunities. Entrepreneurial orientation provides a system of practices and managerial styles that offer direction for the use of resources.

3. Entrepreneurial Orientation and SMEs' Performance

Various studies examine the relationship between entrepreneurial orientation and SMEs' performance though the magnitude of the relationship varies across studies. While some studies have found that businesses that adopt strong entrepreneurial orientation perform much better than businesses that do not (Wiklund and Shepherd, 2003), others report lower correlations between entrepreneurial orientation and performance (Zahra and Garvis, 2000) or they have been unable to find a significant relationship between entrepreneurial orientation and performance. The conceptual arguments of previous research converge on the idea that businesses benefit by highlighting newness, responsiveness and a degree of boldness. An extensive discussion of the arguments can be found in Lumpkin and Dess (2005).

In an environment of rapid change and shortened product and business model lifecycles, future profit streams from existing operations are uncertain and businesses need to constantly seek out new opportunities. Therefore, businesses may benefit from adopting entrepreneurial orientation as a strategy for growth. Such businesses innovate frequently while taking risks in their product-market strategies (Miller and Friesen, 2002). Efforts to anticipate demand and aggressively position new products/services often result in strong

performance (Ireland et al., 2003). Thus, conceptual arguments suggest that entrepreneurial orientation is bound to lead to better business performance.

Business performance is traditionally measured using objective measures like profitability, market share, returns on investment and sales and little attention is paid to subjective performance like psychological satisfaction and individual wellbeing. Although some businesses may continue to exist, they may make losses or perform poorly which is reflected in continuous losses, drop in sales and short-term survival (Muzenda, 2014).

Thus, there are considerable variations in the relationship between entrepreneurial orientation and business performance. Using a correlation analysis we provide a point estimate of the relationship between entrepreneurial orientation and performance across previous studies and we ask the question whether the variation is high enough to warrant an empirical examination of moderators of the entrepreneurial orientation-performance relationship. It is against this background that the following research hypothesis is studied:

H₁ *There is a significant and positive relationship between entrepreneurial orientation and SME performance.*

It is envisioned that the findings of our study will be beneficial for the SME sector in understanding the nature of the relationship between these variables which will help SMEs' managements to steer their businesses to greater heights.

4. Entrepreneurial Orientation and Government Policy

On a related note, a few writers in the more developed nations have linked entrepreneurial orientation to government policy though this link has been given far less priority by researchers in developing nations like Rwanda.

Regardless of entrepreneurial orientation, SME managers are less sensitive to issues of government interest such as gender balance and evasion of taxes in developing nations with the result that the government is more likely to resist any policies that may benefit SMEs. Boeri and Garibaldi's (2005) study is indicative that in such cases government policies are bound to be more stringent and this does not encourage SMEs to develop an increasing range of opportunities that may be available. As a result, negative consequences that are undesirable like increased rates of unemployment are noted. In developing economies, SMEs' operations which are suspected to be linked to political activities which are against the ruling regimes will definitely be resisted. On many occasions this has caused the government to institute policies that make it hard for SMEs to survive. In such a case the government considers these SMEs to be a threat to its regime and starts coming out with policies that will fail these SMEs.

We now examine our next hypothesis:

H₂ *There is a significant and positive relationship between entrepreneurial orientation and government policy.*

5. Government Policy and SMEs' performance

Government policy is aimed at improving a variety of entrepreneurs taking into account the fact that entrepreneurs are often very diverse and thus worth considering differently using different strategies (Albrecht et al., 2009). Scholars have also found different links between government policies and SMEs' performance and sustainability. For example, Schneider and Enste (2000) show that government policies may ultimately impact the performance of SMEs because they encompass issues such as taxes which affect the sustainability of the SMEs. However, these findings are contested by Friedman et al., (2000) whose work shows that government policies will not necessarily impact on the performance of SMEs.

Johnson et al., (1997) found that there was a statistically significant but negative relationship between government policies and SMEs' performance. Government policies in this case may fail to positively influence SMEs' performance for a variety of reasons especially in developing nations. In most of the developing nations, the failure to realize this link may be attributed to rampant corruption (Aruoba, 2010).

Elgin (2010) includes other factors such as political influences which combine with the factors mentioned earlier to make it impossible to realize the link between government policy and SMEs' performance. However, SMEs have to show that they need the government to be flexible in its trade related policies.

Business owners may decide to remain in business despite their losses because of the prestige that running a business attracts. Entrepreneurial orientation as a factor contributing to business performance along with government policy has been given little attention by researchers in Rwanda. It is not clear how successful SME owners have taken special care to make sure that entrepreneurial orientation is steered for the good of their businesses (Byukusenge and Munene, 2016). On a related note, little attention has been paid to identifying the degree to which entrepreneurial orientation relates to SMEs' performance.

H₃ *There is a significant and positive relationship between government policy and SME performance.*

6. Methodology

Our study adopted a cross-sectional research design to examine the research variables over the duration of the study (Du Plessis, 2004). Our study employed the quantitative approach. The unit of analysis was the SMEs while the unit of inquiry was SME owners or managers. These persons were chosen as the unit of inquiry owing to the knowledge that they have about the day to day running of the business and the performance of the SMEs. Data was

collected in Nyagatare district with SMEs as a unit of observation. According to the District Business Development and Employment Promotion Unit there were 4,623 registered SMEs in the district in 2015-16. Our research targeted 357 SMEs following Krejcie and Morgan (1970) but was only able to acquire usable responses from 226 SMEs. This represented a sample of 63.3 per cent which is considered representative enough. We used the simple random sampling approach to get the responses so as to avoid bias in estimation and to achieve consistency in the responses. Our study used both primary and secondary sources of data. The key source of primary data was the research questionnaire. This research questionnaire had structured items which were anchored using a Likert scale such that 1- represents strongly Disagree, 2 – Disagree, 3 – Uncertain, 4 – Agree and 5 – Strongly Agree.

Entrepreneurial orientation was measured using items that were developed with reference to the work of Lumpkin and Dess (2005); government policy (Boeri and Garibaldi, 2005) and SMEs' performance (Wiklund and Shepherd 2003).

We tested the research tool for reliability and validity. Reliability was tested using the Cronbach alpha coefficient (Cronbach, 1957). This measure assesses the internal consistency of the items. Higher values of the Cronbach alpha mean higher inter-correlations among the item scales. The scales are considered to be reliable if the findings that they can generate from the setting can also be acquired from another sample. Mirroring Cortina (1993) we learnt that the minimal acceptable value of the Cronbach alpha was 0.700. Any value less than that will either be questionable (if less than 0.7 but higher than 0.6) or considered poor (especially if it is below 0.600 but higher than 0.500). Unacceptable values are those for which the Cronbach alpha is less than 0.500. Content validity is the degree to which a tool or any other researcher's assessment reflects all the dimensions of a specific variable (Lawshe, 1975). The content validity index was established by considering the ratio of the number of relevant items to the total number of items that were used to measure that particular variable.

Insert Table 3 about here

The results in Table 3 show that the research study tool was both valid and reliable as indicated by the Cronbach alpha coefficient and the content validity index which were above 0.700 in both cases for all the study variables (Field, 2009). The research tool was then taken to the field and used for collecting data. Secondary sources of data included but were not limited to research journals, information from government policy papers, Nyagatare district records and statistics, reports of the Rwanda Development Board and the Ministry of Industry and Trade's annual reports (2012-13).

After gathering data from the field using the research questionnaire it was entered into the SPSS software package and analyzed. The statistical tools that were used include frequency distributions, the Pearson correlation coefficient and the hierarchical regression analysis.

7. Study Results

We use frequency distributions to present the attributes of the businesses which participated in the study. Firm attributes such as the period for which the business had been running, the size of the workforce and ownership issues are presented to give a deeper insight into the profiles of the SMEs in the sample.

Insert Table 4a about here

The results in Table 4a show that a majority of the businesses in the study had been operating for 1-5 years (50.9) and only 8.8 per cent had been operating for over 10 years. This distribution is an indicator that there are very few SMEs that have survived for over 10 years. This can be attributed to their weak management styles and lack of structures among others. Table 4a also shows the SMEs that had over 20 employees (when it comes to workforce) comprised only 16.4 per cent of the sampled SMEs. Very few SMEs could support a stronger workforce because of their limited business operations and working capital.

Insert Table 4b about here

Further, as can be seen in Table 4b, 35.4 per cent of the business owners believed that the environment was not conducive for them. In addition, most of them were not family owned businesses (98.2 per cent). The table further shows that managing of family businesses is still a challenge in SMEs in Rwanda.

8. Relationships between the Study variables

We tested the relationships using the Zero-Order Pearson Pearson (r) correlations coefficient (Table 5).

Insert Table 5 about here

The results in Table 5 show that there is a significant and positive relationship between entrepreneurial orientation and SMEs' performance ($r = .400^{**}$, $p < .01$). The results are an indication that if well-cultivated, the entrepreneurial orientation of a firm will help enhance its performance in terms of profitability and sustainability. In other words, if SMEs neglect entrepreneurial orientation it is bound to bring about a steady decline in their performance. Entrepreneurial orientation has been examined earlier by various scholars and this can be verified by considering research in various other works. Hence, we accept our first alternative hypothesis:

H₁ *There is a significant and positive relationship between entrepreneurial orientation and SME performance.*

It was further noted that entrepreneurial orientation is still low as it was less than 3.00 (mean = 1.866, SD = .970). These results show that SMEs in Rwanda are still faring very poorly

on this very important concept. Failure to take into account necessary measures for promoting entrepreneurial orientation will result in negative consequences such as loss of business or customer defection.

The hierarchical regression results in Table 5 show a positive and significant relationship between entrepreneurial orientation and government policy ($r = .425^{**}$, $p < .01$). Firms' whose managements promote creativity and innovativeness with a view to enhancing customer satisfaction and meeting customer needs are more likely to succeed. The growth of such firms will have an influence on the way that the government implements its policies. The government is bound to adjust the taxes levied, for instance, when it realizes that the SMEs are part of the solution to unemployment especially among the youth. In such cases, the government is bound to relax issues that pertain to registration of businesses. The findings lead us to accept the second research hypothesis:

H₂ *There is a significant and positive relationship between entrepreneurial orientation and government policy.*

Government policy with a mean of 1.828 and a SD of .957 rated quite poorly. SME owners did not believe in general that the government was doing enough to support them in spite of the efforts by SME managers to improve the rate at which they were employing youth. This low mean indicates that SME managers and owners believe that the government has not gone to great lengths to facilitate access to local, regional and international markets and market information, neither has it facilitated the promotion of innovation and technological capacities of SMEs for competitiveness in Rwanda. Further, the results also show that even when the government advertises how it has created a conducive legal and institution framework for SMEs in Rwanda, many of the nationals are yet to realize this.

The correlation results further show the relationship that exists between government policy and SME performance ($r = .425^{**}$, $p < .01$). The results show that government policy can easily influence SMEs' performance in a positive manner. Government policies such as favorable tax rates will ensure that SMEs have more incomes for further investments in their business operations. This investment can ensure outreach and a greater customer base for their businesses. These findings lead us to accept the research hypothesis H₃:

H₃ *There is a significant and positive relationship between government policy and SME performance.*

SME performance was noted to be faring negatively and as such this led to their failing miserably (mean = 2.252, SD = .940). This unsatisfactory performance of the SMEs in Rwanda can be attributed to a lack of essential human and the financial resources. Most SMEs in general cannot meet their financial obligations and thus end up failing usually after less than two years of operations.

9. Regression Analysis Results

We used the hierarchical regression model to examine the prediction level of entrepreneurial orientation and government policy on the dependent variable, SME performance. In the first Block or Model 1, entrepreneurial orientation was entered by itself. Government policy was also entered as a predictor variable in Block (Model) 2 with SME performance as the dependent variable for both the models.

Insert Table 6 about here

The hierarchical regression model's results in Table 6 show that entrepreneurial orientation in Model 1 is a significant predictor of entrepreneurial performance in the regression model (sig. <.05). At this level in Model 1, it is noted that the R-square is only 15.7 per cent and Model 1 is statistically significant at the 99.0 per cent confidence interval level. Model 1 is statistically significant and could at the same time predict 15.3 per cent of the variance in SME performance if it is derived from the population of the SMEs. The reduction in the model's prediction for R-square and adjusted R-square is 0.004 which is quite minimal.

On a related note, it was also observed that in Model 2, when government policy was introduced in the model, the model improved slightly as the R-square improved from 15.3 per cent to 20 per cent and the model remained statistically significant (sig. <.01). At the same time, entrepreneurial orientation remained a statistically significant predictor of SME performance (Beta = .279**, $p < .01$). These findings confirm hypotheses H₁ and H₃ which were supported by the findings of the correlations coefficient results in Table 5. Regarding collinearity, collinearity in the regression model is often taken care of but a multi-collinearity is a situation in the regression analysis when the predictor variables are so highly correlated with each other that they render the regression model almost useless in an interpretation of the effect of the predictors. A well-known and suggested measure of the collinearity is the Variance Inflation Factor (VIF) which should not exceed 10 in the worst case. Bowerman and O'Connell (1990) argue that when VIF values are greater than 10, the collinearity is a problem in the model and thus should be well addressed before interpreting the rest of the model. This idea is supported by Myers (1990). On the other hand, tolerance is simply the inverse of VIF and its values are less than 0.1 indicating a very grave problem in the regression. Our research results show that VIF was within the acceptable model limits, that is, less than 1.500 for both Models 1 and 2 showing that collinearity was not a problem in the data.

10. Analysis of Variance (ANOVA) Results

ANOVA results give us further insights into the nature of the sampled SMEs.

Insert Table 7 about here

The ANOVA results show that the SMEs differed in the concept of entrepreneurial orientation ($F = 8.720$, sig. <.05) when examined for the period for which they had been

operating. On government policy and SME performance, it is noted that there was no significant difference among the SMEs relative to the period for which they had been operating. It follows that the longer the period for which a SME has been managed successfully, the more it is likely to have a notable change in the level of its entrepreneurial orientation. It can be seen from Table 7 that the level of entrepreneurial orientation of the firms tends to decline as they operate for longer periods of time. This result on entrepreneurial orientation poses another challenge for SMEs. SMEs are very likely to deteriorate on this variable as they spend longer periods of time operating. This can be attributed to the fact that SMEs tend to have higher staff turnover rates and this compromises the quality of services that their members can provide to customers over prolonged periods of time.

11. Discussion of the Results

Our findings show a positive and significant relationship between entrepreneurial orientation and the other study variables -- government policy and SME performance. Government policy was noted to be significant and positively related to SME performance, indicating that all our research alternative hypotheses were highly supported. Considering the link between entrepreneurial orientation and SME performance, our finding is supported by earlier scholars such as Lumpkin and Dess (1996) whose work is indicative that firms which have a strong bias towards entrepreneurial orientation are more likely to achieve their business targets. Wiklund and Shepherd (2005) concur with Lumpkin and Dess (1996) in stating that much as there has been overwhelming evidence of the great potential of entrepreneurial orientation in helping businesses achieve their goals, many businesses have not leveraged the significant role of entrepreneurial orientation to achieve their financial and non-financial performance targets.

There are very few studies, especially in the developing world which link entrepreneurial orientation and SME performance and many researchers have not taken a keen interest in the subject especially in African countries (Kreiser, 2011). Some scholars like Anderson et al., (2009) and Mueller et al., (2012) have attempted to explain the mechanism by which entrepreneurial orientation predicts SME performance. They believe that entrepreneurial orientation does improve the learning capabilities of the management and the management is better placed to handle the problems of running a business in a dynamic business environment.

On the basis of our findings it can be concluded that there has been no coordinated policy to address the SME landscape and unlock SMEs' underlying potential in national development. To achieve increased off-farm employment and tax revenues, the Government of Rwanda needs to implement a coherent and coordinated policy to create an enabling environment for the growth of the SME sector in Rwanda. Such a collaboration can optimize SME structures and facilitate utilization of knowledge and expertise and provide access to latest technologies,

equipment and financial products and services. Several recent policies of the Government of Rwanda focus on cluster development for value-addition sectors to increase the country's international competitiveness, create more opportunities, expand the supply of skilled people and technology, expand the local supplier base, increase efficiency and productivity and foster innovations. The government needs to put in more effort in building an entrepreneurial spirit among Rwandans; more effort can also be put in for building an inclusive financial sector in Rwanda. To improve the performance of SMEs in Rwanda, it is recommended that more effort be put in to attract further investments mostly in the services, industry and agriculture sectors so that they can satisfy the domestic market and have surplus for exports as well.

12. Policy Implications and Recommendations

Our statistical findings show that government policy and entrepreneurial orientation are significant predictors of SMEs' performance. This has policy implications for the government. SMEs have to pay the same registration fees as the more advanced and developed businesses which do not have any difficulty in paying taxes thanks to their enormous turnovers and profits. To help SMEs, there is a need to ensure that helpful policies are developed. Failure to do so will lead to the failure of more SMEs, aggravating the already serious problem of unemployment.

Further, the existing trade policy gives free entry and marketing of goods in the country and these directly compete with the local SMEs who have to endure high energy bills. To help local Rwandese SMEs to have a competitive edge, there is a need to reduce their energy bills. The rates should be revised downwards for registered SMEs so that they can save more resources for other investments and innovations. Energy bills such as electricity bills have cut deep into the resources of the SMEs and more so for those who have to rely heavily on electricity usage like businesses in the welding and metal fabrication sector which have seen heavy failure rates due to high power rates.

Our findings can be used by SME managements to promote entrepreneurial orientation through several well thought out employee performance measures. Among these, the management should consider using periodic performance appraisals for their employees which should be conducted with the major aim of assisting employees to perform better. These performance appraisals should then be examined for weaknesses and strengths. Where the employees have shown extraordinary performance, due credit should be given. However, when weaknesses are identified, the management should assess these weaknesses and determine which ones are likely to have led to poor performance on the entrepreneurial orientation construct. Employees should then be assisted from that perspective. Sometimes, the employees may need to be trained after a careful needs assessment while at other times, they may need simple counseling and sharing their personal problems with the management.

Further, managements should also prioritize and evaluate the effectiveness of training so that value for money can be realized.

SME managements are in a position to lobby for better policies from the government to enhance their business performance. SME managers should team up with other recognized and non-political institutions such as NGOs and humanitarian organizations such as the International Labor Organization when they notice some critical points where they are being oppressed by the government. This oppression may be in the form of very high and unexplained taxes, stringent and bureaucratic registration processes or restrictions on the geographical areas within which the SMEs are allowed to conduct their businesses. In some cases, Members of Parliament may be very effective and useful in fighting for the welfare of the SMEs.

More efforts should also be made to attract further investments mostly in the services, industry and agriculture sectors for more productivity to satisfy the domestic market and to have surplus for exports.

RDB, RRA and the districts should work more closely to have full information about SMEs to be able to respond to their specific needs.

We recommend pursuing urbanization programs as it has been proven that urban areas attract more investments than rural areas as more business people in Nyagatare district have shifted to Kigali for investment purposes and for better business opportunities.

13. Limitations of the study

Our study has some limitations owing to the limited nature of its geographical and conceptual scope. It does not cover firms in sectors other than SMEs. It would have been better if the findings of our research could be validated by the findings in another sector such as banking. Perhaps researchers can take our research forward and try and verify our findings by say the telecom sector or the agricultural sector.

We were also limited by the very scanty research on SMEs in Rwanda especially in entrepreneurial orientation and SME performance. Secondary data was very hard to access, a challenge not made any easier given the secretive nature of the government institutions in Rwanda.

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Table 1: Definition of SMEs in the European Commission (EC)

Company Category	Staff Head Count	Turnover	Balance Sheet
Medium sized	Less than 250	Less than or equal 50M	Less than or equal 43M
Small	Less than 50	Less than or equal 10M	Less than or equal 10M
Micro	Less than 10	Less than or equal 2M	Less than or equal 2M

Source: European Union.

Table 2: Definition of SMEs in the Rwandan context

Size of the enterprise	Net capital investment (million Rwf)	Annual turnover (million Rwf)	Number of employees
Micro	Less than 0.5	Less than 0.3	1 to 3
Small	0.5 to 15	0.3 to 12	4 to 30
Medium	15 to 75	12 to 50	31 to 100

Source: Ministry of Trade and Industry (2010).

Table 3: Reliability and validity of the research study

Variable	Cronbach Alpha Coefficient	Content Validity Index
Entrepreneurial Orientation	.817	.833
Government Policy	.904	.833
SME Performance	.780	.750

Source: Primary data.

Table 4a: Firm Characteristics-Firm age and Workforce Size

N = 226		Count	Per cent	Cumulative Per cent
Period the firm has been operating	1 - 5 yrs	115	50.9	50.9
	5 - 10 yrs	91	40.3	91.2
	Above 10 yrs	20	8.8	100.0
N = 226		Count	Per cent	Cumulative Per cent
Workforce Size: Number of employees in the Business	1- 5	61	27.0	27.0
	5-10	24	10.6	37.6
	10-15	59	26.1	63.7
	15-20	45	19.9	83.6
	Over 20	37	16.4	100.0

Source: Primary data.

Table 4b: Firm Characteristics-Business Environment and Ownership

		Count	Per cent	Cumulative Per cent
Is Business environment conducive?	Yes	146	64.6	64.6
	No	80	35.4	100.0
		Count	Per cent	Cumulative Per cent
Is your company owned by a family?	Yes	4	1.8	1.8
	No	222	98.2	100.0

Source: Primary data.

Table 5: Pearson Correlation Results

	Mean	SD	1	2	3
Entrepreneurial Orientation-1	1.866	.970	1.000		
Government Policy-2	1.828	.957	.425**	1.000	
SME Performance-3	2.252	.940	.400**	.371**	1.000

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data.

Table 6: Regression Model

	Model 1	Model 2
(Constant)	1.530**	1.279**
Entrepreneurial Orientation	.380**	.279**
Government Policy		.240**
Dependent Variable: SME Performance.		
R	.396	.455
R-Square	.157	.207
Adjusted R-Square	.153	.200
Std. Error of the Estimate	.852	.828
Change Statistics	.157	.050
F-Change	4.805	13.827
Sig. F-Change	.000	.000
Average Tolerance	1.000	.819
Average VIF	1.000	1.221

Note: sig; **< .01, *<.05

Source: Primary data.

Table 7: ANOVA results for Business Age by Variable

N = 226		N	Mean	SD	Std. Error	F	sig.
Entrepreneurial Orientation	1 - 5 years	115	2.122	1.109	.103	8.720	.000
	5 - 10 years	91	1.615	.742	.078		
	10 and Above	20	1.550	.510	.114		
Government Policy	1 - 5 years	115	1.948	1.083	.101	1.943	.146
	5 - 10 years	91	1.736	.786	.082		
	10 and Above	20	1.600	.681	.152		
SME Performance	1 - 5 years	115	2.530	.985	.092	.223	.801
	5 - 10 years	91	2.462	1.014	.106		
	10 and Above	20	2.600	.681	.152		

Source: Primary data.

Appendix 1: Table for Determining Sample Size from a Given Population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	168	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	198	3000	341
80	66	420	201	2500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note: N = population size, S = sample size

Source: Krejcie and Morgan (1970).

Chapter Twenty Four

The effects of ICT adoption on Small and Medium sized enterprises in Rwanda: A Case study of Kigali City

¹Florence Mukamanzi, ²Philippe Ndikubwimana

¹Corresponding Author:
Department of BIT,
University of Rwanda / College of Business and Economics
Email: fkamanzi15@yahoo.fr

²Department of Insurance and Banking
University of Rwanda / College of Business and Economics
Email: ndiphil2000@gmail.com

Abstract

ICT adoption is an important field of study in various areas including small and medium enterprises (SMEs). This study examines the factors that influence the adoption and use of ICT by SMEs in Rwanda. It also examines perceptions of SMEs' employees and managements on adoption and use of ICT, assesses the level of awareness and skills of SMEs' employees and other variables which can be helpful in gaining valid outputs. It uses a specially designed structured questionnaire to collect data and uses t-test statistics to compare the mean difference between the level of awareness and adoption patterns of ICT facilities among SMEs. A regression analysis helps evaluate factors influencing ICT adoption choices in the SME sector and assess the perceptions of SMEs' employees towards ICT adoption. It uses the SPSS software to perform data entry and analysis. This study examines the relationship between ICT adoption and its five factors -- perceived benefits, perceived costs, ICT knowledge, external pressures and government support. The results show that perceived costs and external factors were insignificant in ICT adoption whereas perceived benefits, perceived costs and ICT knowledge were significant in ICT adoption. According to the results, perceived benefits had a strong and significant relation to ICT adoption and the relation between ICT knowledge and employees' skills about ICT adoption were also significant.

Keywords: Information communication technology (ICT), technology adoption, Small and Medium Enterprises (SMEs).

1. Introduction

The European Commission defines small and medium enterprises (SMEs) as organizations with less than 250 workers. The finances of a SME cannot exceed € 50 million as turnover, and/or €43 million on the balance sheet. In addition, the Commission of European Community stipulates terms of ownership, indicating that SMEs ought to be independent with less than 25 per cent of a SME being owned by outside interests (Diabate, 2014; Ngugi et al., 2013). SMEs are pillars of modern market economies and play an important role particularly in developing countries like Rwanda. As stated by Ghobakhloo et al., (2011) in today's technological progressions the implementation and application of IT is a significant driving force behind many socioeconomic changes (Dierckx and Stroeken, 1999). As the utilization and commercialization of IT becomes more widespread throughout the world, the adoption of novel IT can generate new business opportunities and various benefits. Nowadays, both large organizations and SMEs are seeking ways to reinforce their competitiveness and improving their productivity (Premkur, 2003). Accordingly, within SMEs there is an increasing consciousness of the necessity to derive profits through investments in IT.

In most countries, SMEs are the dominant form of business organizations, accounting for over 90 per cent of the business population and they play a key role in driving sustainable economic growth and job creation. SMEs in Rwanda refer to micro as well as small and medium enterprises. Rwandan SMEs make up 98 per cent of the total businesses and account for 41 per cent of all private sector employment (MINICOM, 2015). SMEs in Rwanda face many macro-level challenges including limited transport and energy, lack of entrepreneurship skills, low levels of societal trust, limited access to financial institutions, challenges with contract enforcement and a weak education system. Bringing SMEs up to speed with the digital revolution is not just a matter of improving their quarterly profits, but also about creating growth and jobs. In the digital age, no business can thrive without better use of technology. Jeronimo and De Medeiros (2012) emphasize that SMEs grow two to three times faster when they embrace technology.

A study by BMG et al., (2015) found that almost all SMEs used the internet for business purposes but the intensity of the use varied with increasing size. The most common use of internet was being in touch with customers. While the use of e-commerce was increasing it was still much less prevalent: only 20 per cent of the turnover was delivered from this source in 2013 and only 22 per cent of the businesses had e-commerce sales. A quarter of the SMEs reported that they did not possess basic digital skills; there was a positive link between digital skill level and turnover growth. SMEs have an attitudinal barrier towards developing an online presence, there is lack of awareness about the benefits and opportunities available and a lack of understanding about online security threats.

Embedding digital learning throughout the education system is a long-term solution but there is also clear need to enhance digital capabilities in the shorter term. A key to increasing capacities to take advantage of digital opportunities is through providing digital courses, awareness-raising initiatives through existing local private and third sector networks and improving cyber security.

In a competitive and changing environment, SMEs have changed their way of working by improving the quality of doing business so that they can compete in regional and global markets. Therefore, digital technologies play a significant role in SMEs' growth. The Government of Rwanda has come up with different policies and initiatives to facilitate technology in all sectors like Policy Vision 2020, NICI plans, EDPRS 1&2, a business sector strategic plan and ICT in the business master plan (Government of Rwanda, 2006).

The Government of Rwanda wants to increase internet accessibility through an optic fiber covering all 30 districts as well as 4G penetration as these will help SMEs use technology easily. While the importance of digital technology for SMEs is acknowledged there is little system-wide data about how widely technology is being used by Rwandan SMEs. Overall, the reviewed studies show that technology is associated with moderate business gains. However, there are considerable variations in impact (Blok et al., 2002). Our study analyzes the use of technology in SMEs and explores the factors affecting technology adoption in SMEs in Rwanda.

According to a report by the Ministry of Trade and Industry (2010) the SME sector had the potential to lower Rwanda's trade imbalance. Rwanda's trade deficit grew from \$229million in 2005 to an estimated \$770million in 2009. In 2010, the Government of Rwanda's (GoR's) vision was to increase the role of value-added exports to increase export revenue and reduce the import-export imbalance. GoR was dependent on external grants and borrowings for 48 per cent of the government expenditure GoR sought to reduce its dependency on foreign aid and debt by increasing the internal tax revenue. Tax revenues increased by 10 per cent in 2009 compared to the previous year largely from the collection of value added tax (VAT).

According to a study by the Institute for Policy Analysis and Research (2015), SMEs currently generate Rwf 4.9 billion in annual tax revenue. Of the estimated 72,000 SMEs in the country 25,000 are registered and of those registered only 24 per cent pay taxes on a regular basis. In addition to expanding the export sector, SMEs also represent a potential source of tax revenue and can thus help in reducing Rwanda's dependence on foreign assistance. SMEs in Rwanda have remained less competitive compared to its neighbors and if no effort is made to make them more competitive, this situation is likely to worsen with the full-fledged East African Community (EAC) common market, which Rwanda entered in July 2010. Making existing and new Rwandan SMEs more competitive in value added exports is therefore one among many actions necessary to reverse the country's trade imbalance and build competitiveness. By adopting ICT and implementing its use by encouraging SMEs to use ICT in their businesses their revenues can be increased and the economy can improve.

2. Problem statement

The Government of Rwanda has evolved an empowering environment to support SMEs and has attracted players with good local, regional and international experience in using innovations and technology to expand business activities and increase economic growth. However, a majority of the SMEs are struggling to increase productivity, organizational effectiveness, sustained competitive advantages and satisfactory rates of return on

investments. To increase SMEs' competitiveness in global markets, they should be financially sound and should be well connected to markets. This, however, is not going to be easy in an economy where traditional and informal practices of business management are still applied. It is evident from research that innovative technological strategies are a key resource for gaining competitive advantages, but this is challenging because some enterprises lack entrepreneurship and innovative skills. Consequently, many small businesses fail and close a few days after they start (Ndikubwimana, 2016). Many SMEs are realizing the benefits of using new digital technologies but some are late adopters or need specific support and guidance before they adopt digital technologies.

Although the government and other development partners have rolled out a number of initiatives as far as digital technology is concerned, there seems to be a huge gap in awareness among SMEs about the changes that are inevitably brought about by technology in terms of business growth and how they should adapt to this shift. The focus has shifted from whether or not to use technology to understanding which technologies can be used for what specific business purposes and also on investigating how they can best be applied in a range of contexts.

While SMEs in Rwanda are excited about the changes brought about by the use of technology in business there are also many challenges including lack of network infrastructure and slow or unstable wireless access. Some SMEs do not have the bandwidth to support internet activity in their businesses. This provides a great challenge in the communication process between staff members and the management. The other challenges are poverty, not enough knowledge and lack of training on how to use digital technology. In addition, ensuring that technology is used to enable and to advance effective business practices is also a big challenge. Hence, there is a need to investigate the effects of digital technology adoption in SMEs in Rwanda. The purpose of our study is to investigate SMEs' employees and management attitudes and perceptions about adopting and using technology in their businesses to come up with the factors that are hindering its adoption and use by small and medium enterprises.

3. Objectives of the study

General Objective

Our study examines factors affecting technology adoption for sustainable development and management of SMEs in Rwanda. The study is anchored on management theory and the technological determination theory.

Specific Objectives

The specific objectives of our study are:

1. To determine the factors affecting technology adoption in SMEs in Rwanda.
2. To determine the perceptions of SMEs' employees and managements about adopting and using technology.

Significance of the Study

The purpose of our study is to gain an understanding of the factors which influence the adoption and use of ICT by SMEs in Rwanda. It examines the relationship between ICT adoption and its five aspects -- perceived benefits, perceived costs, knowledge about ICT, external pressures and government support. The results of our study show that three factors are significantly important in the adoption of ICT -- perceived benefits, government support and knowledge about ICT-- whereas perceived costs and external pressures are insignificant in determining its adoption.

ICT involves the use of internet and internet access devices that have given SMEs the ability to do business anytime, anywhere. ICT includes a wide range of tools and practices including e-business activities; new strategies for doing business such as online selling and buying activities; different ways of advertising products by using websites; easy communication between SMEs and their customers; and exploring different markets all over the world which give them competitive advantages.

4. Literature Review

As technology has spread throughout the world, the practices and ways of working have changed. Digital technology is changing people's lives and is hence bound to lead to dramatic changes in businesses as well. To sustain and achieve sustainable development, reliable, potential, innovative and efficient tools such as the mobile phones, microcomputers, e-mail and the internet must be used (Ciriaci et al., 2013).

Theoretical and empirical studies have been carried out on ICT adoption which demonstrate its importance in generating positive outcomes in various organizations; transactions over the internet have helped in linking SMEs to global markets. Literature on ICT shows that its adoption, as proxied by transactions over the internet and use of different digital technologies has significantly improved the performance and productivity of SMEs.

Berger (2012) and Mingaine (2013) show that SMEs which employ a large number of people contribute to the national income. However, researches done in China, USA, Kenya and other African countries show that contributions of SMEs are not the same across all the enterprises (Mingaine, 2013; Mutwiri and Mingaine, 2014). Research on SMEs talks of a variety of descriptive variables that influence the adoption and use of digital technology such as e-commerce, computerization and inter-organizational systems (Ajonbad, 2015). The factors affecting the adoption of new technology include lack of knowledge, confidence, management, dependability and budget (Vilaseca, 2013). Lack of awareness and cost are critical elements in the general adoption and use of technology for SMEs. Lack of awareness includes many factors like uncertainties about the benefits of technology, lack of guidance and unfamiliarity with technologies (Premkumar and Roberts, 2010). Giovanni and Mario (2013) show that cost is mostly related to technological factors such as training, maintenance, information systems and software. According to Barua (2011) lack of a technological environment including lack of critical mass use, unavailability of ideal technology and e-

business infrastructure are major external hindrances obstructing technology adoption and use by SMEs. Kirby and Turner (2012) observe that a majority of external hindrances come from business related barriers.

Ritchie and Brindley (2010) show that there are three barriers in the adoption and use of technology by SMEs: external pressures (requirements of trading partners and competition from other players), organizational readiness and perceived benefits of the technology. The authors argue that perceived benefits form a key reason why many SMEs adopt and continue to use technology. Most adoption and use frameworks look like a general framework using the technology, the capabilities of the organization and the external environment as its key explanatory variables (Giovanni and Mario, 2013).

According to Muraya (2009), the external environment (suppliers, buyers, government interventions and competitive pressures) is a very crucial factor influencing adoption and use of technology by many SMEs. The author suggests that environmental and organizational characteristics are required for proper implementation of technologies in SMEs. Alila and Ove (2011) observe that as a primary external factor of technology adoption and use, the government's role is a very important factor in the integration of technology by SMEs. Ajonbadi (2015) notes that most of the government's roles are related to financial support including direct support for developing an application and tax breaks on technology infrastructure.

According to Iacovou et al., (2009), SMEs need more financial support than big companies because of their structural characteristics such as weaknesses in market power and lack of experience. Vilaseca (2013) argues that due to the proliferation of ASPs and rapid development of a variety of technologies, outsourcing of technology is becoming suitable and is emerging as an influencing factor for many SMEs. Dixon et al., (2012) observe that the cost of technology is an important influencing factor in the adoption and use of technology by many SMEs. The authors argue that SMEs are less likely to adopt and use technology when their initial setting-up costs are high. Matlay and Weathead (2013) note that many SMEs in Africa often have a lot of difficulty when outsourcing for financial support. Therefore, these enterprises may consider adoption and use of new technologies to be expensive because of lack of financial support.

According to Paul and Pascale (2013), many SMEs in Africa face specific problems in formulating innovative strategies because of limited technological competencies and limited financial resources. A study conducted by Ghimire and Abo (2013) on unlocking the potential of small and medium enterprises in West Africa reveals that adoption and use of technology by SMEs depended on the owner being the decision-maker. The findings from this study indicate that technology adoption and use are positively related. The linkages between adopting digital technology and increased productivity are clear. However, despite the benefits of productivity, SMEs are slow to take the leap and invest in adopting new technologies (the Conference Board of Canada, 2014). While many SMEs are aware of the benefits of digital communication devices, applications and systems that transmit digital data to enable interaction and communication, some are choosing to be late adopters (ACMA, 2015). The reasons for this vary as some do not want to be guinea pigs and others find that information overload makes it hard to judge which technologies are the most suitable. SMEs

are also looking for guidance from trusted information sources like industry organizations to help them make choices. ACMA (2015) highlights that if you are a SME, digital technologies can benefit your business in a number of ways -- you may save costs, reach more customers and improve experience. But you need to feel confident in this brave new world.

Some empirical studies by Bartelsman and Doms (2000), Brynjolfsson and Yang (1996), Dedrick et al., (2003), Kohli and Devaraj (2003) and Melville et al., (2004) confirm the positive effects of ICT on firm performance in terms of productivity, profitability, market value and market share. These studies also show that ICT has some effect in terms of intermediate performance measures such as process efficiency, service quality, cost savings, organization, process flexibility and customer satisfaction. The introduction of ICT offers various new investment opportunities within local industries, particularly for SMEs.

According to holakia and Kshetri (2004), the specific factors that contribute to SMEs' involvement with the internet are prior technology use and the customer service sub-scale of perceived competitive pressures. Moreover, the relative importance of some of these predictor variables decreases as the level of internet involvement increases. Tarute and Gatautis (2013) confirm that ICT has an impact on improvements in external and internal communication and for best performances it is important to align ICT investments with internal capabilities and organizational processes.

Olise et al., (2014) examined the determinants of ICT adoption for improved SME performance in Anambra state, Nigeria. They found that there was a significant difference in the levels of awareness and adoption patterns of ICT facilities among SMEs. Capital base, turnovers and the asset values of the businesses investigated had a significant influence on ICT adoption. With respect to SMEs' output performance, SME owners' capital inputs, marital status and business experience had a positive and significant relationship with their output performance. Kabanda and Brown (2017) did a structural analysis of SMEs in Tanzania and found that the SMEs used websites in a limited way as they drew upon their understanding of websites as being incompatible with the Tanzanian cultural bargaining system, which is characterized by cash transactions and face to face bargaining. Websites were viewed primarily as a platform from which SMEs could portray a sophisticated image and advertise/market their products. SMEs used mobile technology extensively, as they drew on the technology's ability to offer transactive capabilities, mobility and communication. Their findings also point to technological challenges which SMEs face from the environment, mainly from lack of supporting industry institutional support. SMEs hence established partnerships with international organizations that could support them in overcoming technological challenges. Partnerships with large ICT organizations required stringent conditions such as SMEs needing certifications to be affiliated. The study gives practitioners a better understanding of how SMEs perceive e-commerce in Tanzania amidst organizational and environmental opportunities and constraints, and thus helps practitioners to better design appropriate e-commerce context-specific policies and interventions that address SMEs' problems. This will ensure that available resources are used in a more effective manner without negative consequences.

5. Research Methodology

We adopted a cross-sectional approach to measure firms' responses regarding adoption of ICT. Data was collected from 250 respondents with the help of a questionnaire. The respondents included 50 senior executives, 50 middle-level managers and 150 workers; they were purposively selected from SMEs in service and manufacturing industries in Kigali city. A survey instrument was formulated to obtain feedback from SMEs in Rwanda, assessing their awareness, receptivity and adoption of ICT in their businesses.

In our research ICT adoption is the dependent variable. We analyzed the dependent variable to find out the answer or solution to the question: What makes a company adopt ICT in its business? For this we tested five independent variables -- perceived benefits of ICT, perceived costs of adoption, ICT knowledge and skills of the employees, external pressures and government support -- that are believed to have some influence on the dependent variable (ICT adoption) either in a positive or a negative way.

A packet of 250 survey instruments including a return envelope were sent to selected respondents from insurance, banking and finance, health and medical, education, tourism, logistics, professional management, IT related services and the advertising sectors. The response rate for the survey was 72 per cent (193 responses). Due to missing values for at least two sections of the responses 13 samples were discarded from this research and 180 samples were processed and analyzed. Bivariate frequency distribution of the respondents according to type of business, ownership of the company, respondent's position, computer ownership, internet access, length of internet access and the operating system was presented. Cronbach Alpha was the basic formula used for determining the reliability based on internal consistency (Kim and Cha, 2002).

The values of alpha for perceived benefits yielded a reliability coefficient of 0.826.

The total sample size was determined using Krejcie and Morgan's formula and the sample size of each SME was calculated using the proportion of its respective population:

$$(1) \quad n = \frac{x^2 \times N \times P(1-P)}{(ME^2 \times (N-1)) + (X^2 \times P \times (1-P))}$$

where, n = *samplesize*

x^2 = *Chi –*

square for the specified confidence level at 1 degree of freedom

N = *Populationsize*

P = *Populationproportion (.50 in the table)*

ME = *Desired margin of Error (expressed as a proportion)*

To test reliability, we used Cronbach's Alpha for comparing internal reliability between the variables and the formula used to test it was:

$$(2) \quad \alpha = \frac{N \cdot \bar{C}}{v + (N-1) \cdot \bar{C}}$$

Here, N is equal to the number of items, $\bar{c}$ is the average inter-item covariance among the items and $\bar{v}$ equals average variance.

6. Results and analysis

General information about the respondents

The profile of the responding companies includes type of business, ownership of the company, respondent's position, computer ownership, internet access, length of internet access and operating system. Our study provides the frequency distribution of each variable for the sample respondents. A majority of the surveyed companies were in wholesale and retail businesses (47.7 per cent). Most of the respondents' companies had local ownership (98.3 percent) or 159 out of 180 respondents.

More than 50 per cent (53.9 per cent) of the surveyed middle-managers (and below in rank) represented a higher percentage amongst all the 97 respondents. However, executives formed the second highest group in our study at 27.8 percent, followed by managers at 12.8 percent. Top level management such as CEOs and owners of companies were the least (5.6 percent or 10 out of 180 respondents).

Regression analysis

We analyzed the data using a multiple linear regression. The purpose of a regression analysis is to relate a dependent variable to a set of independent variables. We estimated the regression coefficient of independent variables on ICT adoption. The overall model is significant at the 1 per cent level. The independent variables explain 53 per cent of the variance in ICT adoption. Of the independent variables, perceived benefits (+), ICT knowledge and skills (+) and government support (+) were the only predictors statistically different from zero and had a significant and direct effect on ICT adoption intention. The remaining -- perceived costs (-) and external pressures (+) -- had no significant direct effect on ICT adoption intentions.

Discussion

According to our results, a perceived benefit has a strong, significant relation to ICT adoption. This was expected since literature has consistently shown that perceived benefits have a significant and positive influence on the ICT adoption (Bingi et al., 2000; Grover and Goslar, 1993; Wang and Tasai, 2002). Internet allows a company to cross international boundaries. However, the respondents did not find computers simplifying their daily business operations.

Use of ICT applications for business purposes brings numerous advantages for users. In our study most of the businessmen were curious to find out the benefits that they could gain through appropriate ICT implementation.

Perceived costs were found to have a direct impact on ICT adoption. One possible reason for this is that SMEs did not have all types of financial support. They did not have options to get financial support for ICT costs including investments in its implementation (networks, PCs, data storage, demonstration, servers, software/hardware and other peripheral devices). These conditions can lead to perceived costs of ICT adoption. The relation between employees' ICT knowledge and skills was significant. It is important for SMEs to determine their employees' knowledge and skills of ICT because this knowledge or previous experiences may influence an organization's decision to adopt ICT. Moreover, managers or owners knowledge or skills about ICT is increasing the opportunity of ICT use among businesses.

Reynolds et al., (1994) found that small business owners/managers were unlikely to adopt more sophisticated technologies if they were not familiar with the basic ones. This is supported by Mehrstens et al. (2001) who demonstrate that employees with technological skills in particular encouraged firms to recognize and implement ICT in their businesses. This is a principal internal motivating factor for businesses to adopt ICT. Past studies have also found that external pressures play a critical role in IT adoption by small firms (Beatty, 1998; Swatman and Swatman, 1991; Webster, 1994). However, our study found that external pressures had a positive relationship with ICT adoption intentions and this relationship was not significant. One possible reason is that Rwandan SMEs are not involved in global businesses so there is not much pressure from customers or suppliers to adopt ICT in their operations.

7. Recommendations

Our study shows that government support had a significant and strong positive relation to ICT adoption. This is also supported by Stoneman and David (1986). The impact of government policies and initiatives has direct and indirect stimulation to the supply of information which produces faster technology diffusion. For example, the Government of Rwanda wants to increase internet accessibility by implementing optic fiber covering all 30 districts which will help SMEs use technology easily.

Our study shows five significant indicators of SMEs' intention to adopt ICT in their businesses. Government agencies like RDB, RURA, the Ministry of ICT and other government agencies should create better awareness about the benefits of ICT to encourage a higher rate of adoption. This can be done by having seminars or induction sessions to allow SMEs to evaluate their new inventions.

To get a greater response to ICT adoption, it is recommended that the authorities should give certificates as a token and financial support for attending seminars. They could establish a close link with all SMEs and get continuous feedback from them to identify the problem areas and take necessary actions to rectify them.

Another way of enhancing the use of ICT in the SME sector is for the government to enforce standardized, consistent and uniform policies in all SME sectors, agencies or subsidiaries in implementing ICT systems. As the respondents in our study found ICT a complex system,

the system should be made user-friendly as not all users are familiar with computers and the internet, especially old SMEs.

Global ICT policies have become more mainstream in the last decade underpinning growth, jobs, increasing productivity, enhancing the delivery of public and private services and achieving broad socioeconomic objectives in the areas of healthcare, education, climate change, energy, employment and social development especially among SMEs. As such, the global ICT industry is fast changing as a result of emerging technologies and economic, social and business trends. As ICT applications and services are becoming ubiquitous, they are increasingly essential for ensuring sustainable economic development by enforcing use of ICT in business sectors. Hence, it is recommended that policymakers should emphasize policies and strategies for ICT implementation in all sectors and among SMEs as we have seen that in Rwanda SMEs form 98 per cent of the total businesses and account for 41 per cent of all private sector employment (MINICOM, 2015).

The Government of Rwanda, as well as other East African countries can also use this research to take into consideration the impact of ICT on SMEs' performance in designing, implementing and evaluating ICT policies and initiatives in the region.

8. Conclusion

The purpose of this study was to investigate the effects of technology adoption by SMEs in Kigali city. This study contributes to and extends our understanding of the internet as a medium for commercial use in the service arena, identifying the rationale for SMEs adopting or rejecting ICT. From a managerial viewpoint, our findings provide support for investment decisions and for decisions relating to the development of internet services that address and take the concerns and needs of companies into consideration.

A multiple regression analysis showed that perceived benefits, ICT knowledge and skills and government support were significant elements of ICT adoption. Our model explained 52 per cent of the variance in SMEs' intentions to adopt ICT. As the Rwandan government grows in importance in doing business worldwide, an understanding of the factors that influence SMEs' adoption of ICT is valuable.

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Part Ten. Entrepreneurship and manufacturing

Chapter 25. Charles M. Ruhara and Charles R. Kayitana, “Mind-set and entrepreneurial activities in Rwanda: A firm level investigation”.

Chapter 26. Alexis Uwamahoro, “Effects of supply chain integration on the supply chain performance: an analysis of manufacturing”.

Chapter Twenty Five

Mind-set and Entrepreneurial Activities in Rwanda: A Firm Level Investigation

Charles M. Ruhara and Charles R. Kayitana

University of Rwanda,
College of Business and Economics,
E-mail: ruharamch@yahoo.fr

Abstract

This study examines the effect of mind-set on an entrepreneur's activities in Rwanda. By doing so it seeks to establish whether the lack of an entrepreneurial mind-set contributes to the high rates of small and medium enterprises' failure in the country. This is necessary because evidence from various studies highlights that lack of entrepreneurial mind-set leads to business failure. We estimated an entrepreneurship activities equation and used the OLS regression analysis. The factors affecting a firm's sustainability include an entrepreneurial mind-set, the manager's years of experience, gender and competition that has entered the market. Our study also shows that an entrepreneurial mind-set is an important factor of performance and sustainability in Rwanda without which a business will fail. This study recommends entrepreneurial education to nurture and support a firm's success. There is a need to analyze the entrepreneurial mind-set at the household level. In addition a dataset collected for different time periods will help capture mind-set dynamics and inform the policymaking process.

Keywords: Mind-set, entrepreneurship, Rwanda.

1. Introduction

Entrepreneurship is having the desire and wish to start and run a new business, to accept any associated risks with it and to take further action so that more profits can be earned in the future. Hebert and Link (1989) state that while an entrepreneur covers the existing needs of consumers he/she also goes beyond this to manufacture an innovative product or service that stimulates a new demand. An entrepreneur initiates the process of creative destruction or market instability that enables economic progress. Schumpeter (1942) provided an example of creative destruction with the change in power production from the water wheel to the modern power plant. Entrepreneurial innovations develop new products, interrupt the circular flow of economic life and transform an industry's operations. Disturbances provoke transformations and enable economic development. An entrepreneur enables economic development by developing innovative products or processes that make the existing ones obsolete.

Entrepreneurship is individuals' ability and willingness on their own or in a group within and outside existing organizations to perceive and create new economic opportunities and introduce new ideas in the market while facing uncertainties and other obstacles by taking decisions on the use of resources and institutions (Wennekers and Thurik, 1999). Entrepreneurs' motivation is the desire to generate a value added to what exists through the creation and/or expansion of economic activities by discovering new products, new processes, new practices or new markets. Since entrepreneurs might not clearly assess market returns for their services they run a greater risk because they depend on residual wages as they receive the remaining revenue, if any, after all other deductions.

It is generally agreed that entrepreneurship and entrepreneurs are created by a combination of three factors: opportunities, skilled people and resources (Ahmad and Hoffman, 2007). Skilled people are those with education, experience and also those having an entrepreneurial mind-set. An entrepreneurial mind-set is needed since most of the companies which are started die at an early age. For instance, in South Africa the number of firms that fail in year five of their existence varies between 50 and 95 per cent while about 75 per cent of new small and medium enterprises (SMEs) have no chances of becoming established firms. GEM (2011) reported that only 2.3 per cent of South African owned SMEs remained in existence for over 3.5 years. While there are no available records for other countries, it is safe to assume that this situation is not specific to South Africa.

In Rwanda, different development programs give full support to entrepreneurial activities. The Rwanda Development Board (RDB) has a Human Capital and Institutional Development Department (HCID) that aims at encouraging business starts-ups. It does this through training and creating awareness aimed at empowering youth and women with entrepreneurial skills to achieve their dreams. It is believed that building a young generation of Rwandan entrepreneurs will ultimately lead to vibrant SMEs, contribute to creating decent jobs and help in reducing poverty. The program also aims at preparing students to start thinking with an open mind about business innovations while at school. Its objectives include developing positive attitudes/mind-sets towards innovations, enterprise and self-employment.

However, formulating evidenced-based entrepreneurship policies requires a clear understanding of both the factors that affect entrepreneurship and their benefits. Unfortunately, very limited empirical information relating to these factors and benefits exists. And where there are policy references to entrepreneurship most of them simply equate it with SMEs in general or with the number of self-employed while neither of these fully capture what entrepreneurship is. An empirical investigation of the effect of mind-set on entrepreneurship has been ignored in most of the studies.

Our study attempts to examine and understand the effect of a mind-set on an entrepreneur's activities in Rwanda. By doing so, we seek to establish whether the lack of an entrepreneurial mind-set contributes to the high rate of SME failure in Rwanda. This is necessary because evidence from various studies highlights the fact that the lack of an entrepreneurial mind-set leads to business failure.

2. Literature review

Mind-set is defined as a mental attitude which determines how an individual interprets and responds to situations. It is a predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object (Schwarz et al., 2009). An entrepreneurial mind-set indicates a way of thinking about business and its opportunities that aim at maximizing the benefits associated with uncertainty (Dhliwayo and Vuuren, 2007). It portrays an innovative and energetic search for opportunities and facilitates actions aimed at exploiting market opportunities within a country or getting access to foreign markets (Senges, 2007).

Attempts have been made to examine the relationship between mind-set and entrepreneurship. For instance, Fishbein and Ajzen (1975) suggest that a mind-set or attitude can only be seen through implied actions and by those actions that are not made explicitly by an individual. Establishing an entrepreneurial mind-set is a very efficient way of sustaining the competitiveness of economic organizations. Ireland et al., (2003) argue that the future generation needs to be more entrepreneurial for which it needs to be creative or innovative with the ability to use and expand existing opportunities. This shows that successful future strategists should exploit an entrepreneurial mind-set and have the ability to rapidly think, act and mobilize even under uncertain conditions. McGrath and MacMillan (2000) assert that individuals/SME owners capture these benefits in their search and attempt to exploit high potential opportunities commonly associated with uncertain business environments.

Dhliwayo and Vuuren (2007) suggest that an entrepreneurial mind-set is about creativity, innovation and taking opportunities that lead to organizational wealth creation and success. This type of a mind-set enables entrepreneurs to take optimal decisions when faced with uncertainties. Creativity is a means of unlocking the entrepreneurial potential of individuals, entrepreneurs and organizations since new ideas and approaches are key ways of promoting an entrepreneurial culture. Devanna and Tichy (1990) highlight that creativity is very important for the success of any organization and Trevisan et al., (2002) found creativity to be one of the strongest distinguishing characteristics for success. Encouraging creativity is

therefore a strategic choice that firms should take into consideration since creativity makes a significant contribution to organizational innovations.

Mind-set or attitude has been found to be influential in entrepreneurial conduct (Krueger, 1993). Luthje and Franke (2003) document that if public policies seek to raise the number of new entrepreneurs an improvement in an individual's attitude towards entrepreneurship is an effective tool. Moen et al., (1997) stress that programs and policies should aim at cultivating attitudes towards entrepreneurship as a person may have business knowledge but without a positive attitude about entrepreneurship, he or she may not plunge into the field without a change in attitude with more positive thinking about the entrepreneurial field. Those who wish to foster entrepreneurship must support and reinforce the perceptions that it is personally feasible and socially and personally desirable.

Different studies show that the sense of adapting to uncertainties and the ability to act and organize are fundamental to entrepreneurship (Ireland et al., 2003; Krauss et al., 2005; McGrath and MacMillan, 2000). Pihie and Sani (2009) show that an entrepreneurial mind-set in students after following an entrepreneurship education course as well as the various teaching techniques in improving entrepreneurial awareness and entrepreneurial skills are keys to a business' success.

SMEs' inability to create more job opportunities because of the owners' mind-set is well perceived as one of the major causes of SMEs' failure (Nieman, 2006). Entrepreneurs with entrepreneurial mind-sets consider constraints, problems and challenges as opportunities and thus develop innovative ways to deal with them and exploit and merge opportunities (Eno-Obong, 2006). Having an entrepreneurial mind-set is a successful tool that can help individuals to successfully move forward in an entrepreneurial process regardless of the problems that a business faces (McGrath and MacMillan, 2000). Dhliwayo and Vuuren, (2007) emphasize that an entrepreneurial mind-set is an important success factor for SMEs without which a business will fail. This means that the current business environment needs an entrepreneurial mind-set that must unlearn traditional management principles in order to minimize the high failure rates of SMEs (Morris and Kuratko, 2002). However, the effects of a mind-set may vary from country to country depending on market opportunities. This suggests that there is a need to investigate the effect of a mind-set on business sustainability using data from Rwanda.

Other empirical studies have linked entrepreneurship programs to a change in attitude towards entrepreneurship. For instance, Hatten and Ruhland (1995) found that students participating in entrepreneurship programs were more likely to become entrepreneurs because of the changes in attitudes through training and other programs. Similarly, Souitaris et al., (2007) suggest that it is possible to tune and shape individuals' entrepreneurial attitudes especially with well-planned entrepreneurship programs which could further enhance a rich entrepreneurial culture among individuals.

Other potential factors that may affect entrepreneurship too have been reported in literature. Studies show that being a woman was a constraining factor in entrepreneurship suggesting that women are less likely to start a business if there are no supportive factors. High levels of regulations were also found to discourage individuals with business skills from starting a

business. While regulations were reported to have an overall negative impact on entrepreneurial activities, their effect was stronger on certain types of people. Storey (2003) shows that public policy on entrepreneurship can be both constraining and supportive in case it provides financial assistance and services. However, since there is limited data on regulations, it is not included in our study.

Several studies have established that a risk taking attitude is an important factor in a firm's performance. A risk reflects the degree of uncertainty and prospective losses associated with the outcomes which may be gotten from a given behavior or a set of behaviors (Forlani and Mullin, 2000). Dhliwayo and Vuuren (2007) show that risk-taking is essential for the success and growth of a business which is based on how entrepreneurs perceive and manage the risks in their environment. Dunlap (2008) highlights that business ventures should adopt an entrepreneurial mind-set wherein at the heart lies the ability of an entrepreneur to accept and manage risks.

A study by Nieuwenhuizen and Kroon (2002) shows a strong relationship between the willingness to take risks (risk taking) and entrepreneurial business success which further stresses the need for including risk in entrepreneurship education and training programs. Ward (1997) concludes that 'without risk-taking, the prospects for business growth wane' and thus it becomes imperative for entrepreneurial firms to be willing to take risks.

Other studies have investigated the role of access to capital, research and development (R&D) and technology. These factors are known to be very important for entrepreneurs and entrepreneurship outcomes. The EU points out that access to capital is one of the most important factors that supports successful entrepreneurship activities. Capital covers different phases of a business' life from access to early seed funds to access to stock markets. R&D creates new inventions that entrepreneurs and entrepreneurial businesses can turn into new products or processes. It should be understood as a resource that can be created or purchased whether directly or in an embodied or diffused form. Blanchflower and Oswald (1988) suggest that the probability of being self-employed is a joint probability of having an entrepreneurial vision and then having access to the necessary capital to implement it. While individuals who receive an inheritance are more likely to be self-employed, those who receive an inheritance may also be from a background that encourages self-employment.

The drivers of entrepreneurship include available opportunities created by market conditions in a country. Market conditions include public involvement in markets, competition in the markets, access to foreign markets, procurement regulations and so on. Entrepreneurship happens within a regulatory framework which affects performance. A combination of opportunities, capabilities and resources does not necessarily lead to entrepreneurship if opportunity costs (for example, forgone salaries and losses in health insurance) and start-up costs outweigh the potential benefits. In this event, a rational, potential entrepreneur will not pursue the opportunity and will not create value through a new product, process or market.

Experience is another important factor of entrepreneurial success, especially if the experience is in the same industry sector of the proposed business venture. Most studies have tested and confirmed a positive relationship between an entrepreneur's prior experience and a firm's growth and survival of the business. Pihie and Sani (2009) document that students

who preferred running a real business technique acknowledged that it enabled them to obtain real business experience; allowed them to recognize and experience a sense of responsibility in understanding the risks and rewards of setting up a business; gain real experience in raising money; and planning all the business management functions (such as production, marketing, finance and the real business operations).

Davies (2001) brings to light the fact that it is difficult to introduce entrepreneurship as a discipline particularly in tertiary institutions because of different mind-sets, funding methods and confusion between entrepreneurship training and creation of small business managers. Considering this and reflecting on the state of entrepreneurship education and training in different countries, it is noticed that the existing strategies that are in place are not working. Therefore, there is a need to adapt new strategies.

At an individual level, the results suggest that the level of entrepreneurial activity is contingent upon the individual level of the need to achieve in society. Kahneman and Tversky (1979) reveal that the utility that an individual derives from an entrepreneurial activity depends on expectations, standard for success or the competition's performance.

A mind-set which influences business creation and sustainability has its own drivers. Mind-set literature suggests that some people have a fixed mind-set while others have a growth mind-set. Individuals with a growth mind-set believe that one's abilities and success are due to learning and that intelligence can grow and change with effort; they also believe in trying other approaches or seeking help when faced with difficulties and tend to adopt learning goals. The reasoning behind this is that most great business leaders who have been successful had a growth mind-set since building and maintaining excellent organizations in the face of constant change requires such a mind-set (Dweck, 2006). Mind-set drivers include training and education, work experience, risks, creativity and motivation.

Different studies have shown that education is an important factor affecting an entrepreneurship mind-set. Entrepreneurship education is considered a lifetime learning process to develop personal qualities and skills that enable one to survive in the world of business (Rugtvedt, 2006). Several studies have established a correlation between education and business creation. They recommend that for entrepreneurship education to maximize returns it needs more technical training in the dominant informal sector perspective. Timmons and Spinelli (2004) and Lüthje and Frank (2002) state that entrepreneurship education has a high contribution in job creation and that it also has an effect on poverty alleviation. This suggests that policies and training can influence and direct individuals' attitudes.

Ingrid and Yoshie (2008) recommend that entrepreneurship education should begin in the early childhood since individual values, behaviors, attitudes and skills acquired during this period might have a lasting effect on the rest of their lives. However, if entrepreneurship education is a strategy for reinforcing an individual's ability to see and exploit opportunities in an economic, social and cultural perspective then it should be used as a proactive strategy to build entrepreneurial personalities in organizations and societies. However, Isaacs et al., (2007) posit that education alone cannot completely prepare entrepreneurs to be successful business owners; it can increase the chances of business success though.

Numerous studies have confirmed that there is a relationship between motivations and opportunities. Shane et al., (2003) have established that individuals differ extensively in their motivation to seize opportunities and that it will be interesting to know if certain motivations influence entrepreneurs to take action in an attempt to discover new opportunities. Creating the right entrepreneurial mind-set is therefore a challenge for educators and trainers, educational institutions, businesses, public authorities and individuals because the demands for entrepreneurs with an ability to see opportunities and to be creative and innovative affect all spheres of life.

3. Data and Methodology

Our study used secondary data collected by the World Bank between June 2011 and February 2012 in Rwanda. Through questionnaires and interviews in the manufacturing and services sectors, the survey assessed the constraints in private sector growth. The objective of the survey was to obtain feedback from enterprises on the state of the private sector and also to track changes in the business environment over time, thus allowing, for example, impact assessments of reforms. The primary sampling unit was the establishment. An establishment was a physical location where a business was carried out and where industrial operations took place or where services were provided.

A firm may be composed of one or more establishments. For example, a brewery may have several bottling plants and several establishments for distribution. For the purposes of the survey an establishment had to take its own financial decisions and have its own financial statements separate from those of the firm.

The standard Enterprise Survey's topics included firm characteristics, gender, age of the manager, manager's level of education, economic and individual factors like work status, individual experience and ability, mind-set, age of the firm, internationally recognized certifications, power outages, water supply, domestic sales, tax exemptions, competition, new products or services, annual services and the spending on research. The other variables included access to finance, costs of inputs and labor, workforce composition, bribery, licensing, infrastructure, trade, crime, competition, capacity utilization, land and permits, taxation, informality, business-government relations, innovations, technology and performance measures.

Over 90 per cent of the questions objectively ascertained characteristics of a country's business environment. The remaining questions assessed the survey respondents' opinions on what were the obstacles in a firm's growth and performance. The size of the sample was 241 establishments (230 in Kigali and 11 in Butare). In the sample, 65.5 per cent of the firms were from the services sector while 34.4 per cent were from the manufacturing sector.

In our paper the dependent variable is entrepreneurship activities. This is measured by a firm's sustainability proxied by the total annual sales of a firm. A firm's sustainability measure was chosen since firm owners with fixed mind-sets see their firms dying in the first five years. Among the explanatory variables, the variable of interest is the mind-set which is assumed to affect entrepreneurship behavior significantly. The other independent

variables are the age of the firm, manager's level of education, gender of the manager, internationally recognized certifications, power outages, insufficient water supply, total national sales, tax exemptions, competition in the field, new products or services and spending on research. We used the ordinary least squares (OLS) regression method to compute the estimates.

The estimated model can be written as:

(1)

$$Y_i = \lambda_0 + \lambda_1 X_{1i} + \lambda_2 X_{2i} + \lambda_3 X_{3i} + \lambda_4 X_{4i} + \lambda_5 X_{5i} + \lambda_6 X_{6i} + \lambda_7 X_{7i} + \lambda_8 X_{8i} + \lambda_9 X_{9i} + \lambda_{10} X_{10i} + \lambda_{11} X_{11i} + \lambda_{12} X_{12i} + \lambda_{13} X_{13i} + \varepsilon_i$$

where, Y_i measures the entrepreneurship activities of firm i , λ s are the model parameters to be estimated and the subscript i for each variable stands for firm i since the unit of analysis in the survey is the firm. X_{1i} is the owner's mind-set for firm i , X_{2i} measures the years of experience in activities or the age of the firm, X_{3i} is the educational level of the manager, X_{4i} is the manager's gender, X_{5i} stands for internationally recognized certifications, X_{6i} is the experience of power outages, X_{7i} is water supply, X_{8i} measures the percentage of national sales, X_{9i} is tax exemption, X_{10i} is the competition that has entered the market, X_{11i} captures the competition from unregistered or informal firms, X_{12i} is the new product or service while X_{13i} is the spending on research. ε_i is the disturbance or the error term representing all values which can influence entrepreneurship but which are not directly included in the model.

The use of descriptive statistics in the model helped in capturing qualitative information from the data. Since we used a sample of 241 firms and needed generalized conclusions for all Rwandan firms we used inferential statistics represented here by a regression analysis. The results of the study are relevant for forming policy. The STATA software package was used in all computation processes.

4. Results and discussion

We present the empirical results of the determinants of entrepreneurship in this section. We first report the descriptive statistics related to the model. For the first model, the coefficients (odds ratios) and estimates from OLS regression model are discussed.

4.1 Descriptive statistics

The sample used shows that among the 241 firms, only 19.92 per cent were owned by women while about 80.08 per cent were owned by men. Gender disparity seems to be a problem despite the government's efforts in terms of gender balance. There seems to be a big disparity in the sector for the top managers since it varied from 2 years to 42 years. The average working experience was 12.84 years. This means that a majority of the firms' managers had enough experience. However, the standard error is 9.45 showing that the different values were not close to the mean. About 3 per cent of the owners had no education or did not know their educational levels. At least 3.7 per cent of the owners had a primary certificate, 17.4

had at least a high school certificate, 5.8 per cent had vocational training and 70 per cent had done university studies.

Only 12.8 per cent of the firms had internationally recognized certificates, 68 per cent reported having experienced power outages while about 84 per cent of the firms reported that they had enough water supply for their production. A majority of the firms (79.25 per cent) stated that they communicated with clients and suppliers by emails, with 40.25 per cent of the firms having their own websites. A majority of the firms (61.41 per cent) reported that they had introduced new products or services during the last three years.

Regarding the biggest obstacles in a firm's development, 20.7 per cent of the owners believed that access to finance was the biggest obstacle affecting business development while 17 per cent of them considered the tax rate to be the biggest obstacle. For 11.6 per cent of the firms' owners, the problem was in the practices of competitors while 10.3 per cent said that there were no problems. Other factors affecting business development included access to land, crime, thefts and disorder, an inadequately educated workforce, electricity and tax administration and transport related issues (Table 1).

Table 1: Descriptive Statistics

Variable	Number of observations	Mean	Standard deviation
Annual sales	241	1.30e+09	6.03e+09
Mind-set	241	1.59751	1.076179
Years of experience	241	12.84647	9.455448
Education	241	4.81327	2.086262
Gender	241	1.80083	0.400207
Internationally recognized certifications	241	1.33610	2.097395
Power outages	241	1.182573	1.234853
Water supply	74	1.837838	0.371115
Domestic sales	241	96.23651	16.93314
Tax exemption	19	1.947368	0.229415
Competition in the market	241	1.867220	3.859917
Competition against unregistered or informal firms	241	0.547717	2.994231
New product or service	241	1.385892	0.487818
Spending on research	241	1.647303	0.829208

Source: Authors' compilation.

4.2 Determinants of Entrepreneurship activities in Rwanda

In Table 2 the Adjusted R-squared measuring the goodness of fit indicates that the estimated models give an adequate description of the data because it is highly significant implying that all the 13 model parameters are jointly different from zero. The results show that working experience was an important factor explaining entrepreneurial activities in Rwanda. The variable is significant at the 1 per cent level of significance. As experience increases by 1 year, entrepreneurship behavior increases by 0.0027 if all other factors are held constant.

The coefficient of gender is positive and significant suggesting that being a man rather than a woman improved entrepreneurship behavior by 0.00142. Its coefficient is positive and significant at the 1 per cent level. This means that while holding all other factors constant, being a man rather than a woman increased entrepreneurship by 0.00142. The coefficient of water supply is another factor influencing a firm's sustainability. Its coefficient although statistically insignificant shows that water supply shortages harmed a firm's sustainability. Tax exemption is another factor that affected a firm's sustainability. This result suggests that benefiting from tax exemptions improved a firm's sustainability by 0.0088.

The mind-set variable is positive and significant at the 1 per cent level of significance. The results suggest that having a growth mind-set increased a firm's sustainability. In the dataset, a number of variables were used to capture a growth mind-set including whether or not a firm's owners communicated with suppliers through email, used technology licensed from a foreign-owned company, had improved methods of manufacturing products or offering services, had improved organizational structures or management practices and had improved marketing and organized campaigns against HIV-AIDS. The results in Table 2 show that mind-set was significantly associated with a firm's sustainability. This finding is similar to Neneh's (2014) finding who established that entrepreneurs with entrepreneurial mind-sets performed better in creativity and had a risk taking propensity which are vital for a business' success.

Our results also find support in Dhliwayo and Vuuren's (2007) study who documented that an entrepreneurial mind-set is a firm's wealth creation and success and that this type of mind-set enables entrepreneurs to make optimal decisions in case of uncertainties. They further elaborate that an entrepreneurial mind-set unlocked the entrepreneurial potential of individuals, entrepreneurs and firms as new ideas and approaches are key ways of promoting an entrepreneurial culture. In addition, Devanna and Tichy (1990) maintain that a mind-set that opens creativity is very important for the success of an organization. Further, Trevisan et al., (2002) state that mind-set is one of the strongest distinguishing characteristics since creativity makes a significant contribution to organizational success. Spinoza et al., (1997) have established that business success needs an entrepreneurial mind-set that opens individuals/SMEs to modern styles (creativity, motivation, risk taking) to secure them a place in the modern business world and unlearn traditional management principles in order to minimize high failure rates among SMEs.

In addition, the coefficient of education was important for entrepreneurs since it was statistically and significantly different from zero. Our results are in line with Nielse's (2014) who documented that higher levels of education encouraged innovative thinking and creative problem solving which helped aspiring entrepreneurs to develop proprietary ideas for a new business or its expansion. Higher education levels enhanced an entrepreneur's credibility and helped reduce capital constraints. It is shown that entrepreneurship education could be used as a proactive strategy to build entrepreneurial personalities, organizations and societies.

Table 2: OLS Estimates: Dependent variable is Annual sales by the firm

Variable	Estimates	T-statistics
Mind-set	1.3**	3.08
Years of experience	0.11***	3.75
Education	-0.93***	-5.38
Gender	0.094***	4.12
Internationally recognized certifications	-0.00147	-0.29
Power outages	0.31	0.19
Water supply	-0.376	-1.17
Domestic sales	0.31	1.23
Tax exemption	0.0088***	16.13
Competition in the market	-0.013	-5.13
Competition from unregistered firms	0.0092***	8.43
New product or service	1.751	1.34
Spending on research	-0.0002***	-9.78
Constant	-1.22*	-2.94
Adjusted R-squared	0.9345	

Note: *** ** and * = significant at the 1%, 5% and 10% levels respectively.

Source: Authors' compilation.

5. Conclusion and recommendations

The objective of this paper was to find out the effect of a mind-set on entrepreneurial activities in Rwandan businesses. A clear understanding of this is necessary to guide the formulation of appropriate policy measures. We estimated an entrepreneurship activities equation and used the OLS regression analysis. The factors affecting a firm's sustainability include an entrepreneurial mind-set, the manager's years of experience, gender and competition that has entered the market. The mind-set variable was positive and significant suggesting that having a growth mind-set increased a firm's sustainability. This means that entrepreneurs with an entrepreneurial mind-set performed better in terms of creativity and in risk taking propensity which are vital for a business' success. Our study also shows that an entrepreneurial mind-set is an important factor of performance and sustainability in Rwanda without which a business will fail.

However, since acquiring an entrepreneurial mind-set requires re-learning how to motivate one-self, take risks and become creative and innovative our study recommends entrepreneurial education to nurture and support a firm's success.

Given that the data used in our study is cross-sectional collected only from Kigali and Butare, there is a need for further research using more representative data covering the entire country. There should be national representative data. Our study looked at the entrepreneurship mind-set at the firm's level in firms that are already established. There is a need to analyze the entrepreneurial mind-set at the household level. In addition a dataset collected for different time periods will help capture mind-set dynamics and inform the policymaking process.

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Chapter Twenty Six

Effects of supply chain integration on performance: An analysis of manufacturing firms in Rwanda

Alexis UWAMAHORO

School of Business, University of Rwanda,
P. O. Box 1514 Kigali, Rwanda
E-mail: uwamahoro231@yahoo.fr

Abstract

This study extends the developing body of literature on supply chain integration (SCI), which is the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organizational processes to achieve effective and efficient flows of products and services, information, money and decisions to provide maximum value to customers. Previous researches were inconsistent in their findings about the relationship between SCI and performance. We attribute this inconsistency to incomplete definitions of SCI, in particular the tendency to focus on customer and supplier integration only excluding the important central link of internal integration. Mainly using a cross-sectional approach, we used a structured questionnaire to collect responses from 258 employees drawn from 580 registered companies in the Rwanda Development Board (RDB) and analyzed these with the help of Pearson's correlation and structural equation modeling (SEM). We use three dimensions of SCI -- internal integration, supplier integration and customer integration -- to determine the effects of individual SCI dimensions and their interactions on a firm's performance. The findings indicate that SCI is related to both operational and firm performance. Further, the results also indicate that internal and customer integration are more strongly related to improving performance than supplier integration.

Keywords: Supply chain integration, internal integration, customer integration, supplier integration, firm's performance.

JEL Classification Codes: M11; L10; M110; M19; L60.

1. Introduction

Researchers around the world have articulated the importance of the close relationship between the performance of manufacturing firms and their supply chain integration (Elmuti et al., 2008; Gibson et al., 2005). These researchers call for a systematic approach to supply chain integration (SCI) as global competition has increasingly caused organizations to rethink the need for cooperative, mutually beneficial supply chain partnerships (Lambert et al., 2000; Wisner and Tan, 2000) and the joint improvement of inter-organizational processes has become a high priority (Zhao et al., 2008).

Our study addresses SCI's influence on a firm's performance. As discussed by Vaart and van Donk (2008), literature on SCI is characterized by evolving definitions and dimensions. While some research focuses on individual dimensions of SCI, in particular on customer and supplier integration (Cousins and Menguc, 2006; Homburg and Stock, 2004; Koufteros et al., 2007), others use various omnibus definitions (Rosenzweig et al., 2003) examining SCI as a single construct. In addition, many conceptualizations of SCI are incomplete, leaving out the important central link of internal integration. These incomplete and evolving conceptualizations have led to inconsistent findings leaving out the important role of internal integration in implementing supply chain integration and its role in performance (Das et al., 2006; Devaraj et al., 2007; Germain and Iyer, 2006; Stank et al., 2001a).

Some studies have found that integration across the supply chain has a positive impact on firms' performance (Bagchi and Chun Ha, 2005; Flynn et al., 2010; Kim, 2006; Zailani and Rajagopal, 2005) while others have proved that integration has a positive impact on supply chain performance (Lee et al., 2007; Narasimhan and Kim, 2002) and operational performance (Flynn et al., 2010; Frohlich and Westbrook, 2001). Lee (2007) views the main benefits of the integrated supply chain in terms of cost reduction, but also an increased value for the focal firm, its shareholders and members of its supply chain. Yeung et al., (2009: 66) posit that, 'the rationale behind supply chain integration is to combine partners' resources and perspectives into a firm's value propositions thus allowing all firms in a supply chain to excel in performance.' Evans (2015) in a study on the impact of supply chain integration strategies on the performance of the pork processing industry in Rwanda shows that there is a positive relationship between internal factors, supplier and customer integration and a firm's performance.

Despite these benefits some manufacturing firms in Rwanda are striving to cope with the management of individual functions instead of integrating activities into key supply chain processes; only a few firms have adopted and successfully implemented the concept of jointly planning, controlling and designing a supply chain with their partners to improve their performance.

2. Literature review

2.1 Supply chain integration

Supply chain integration is defined as 'the extent to which all activities within an organization, and the activities of its suppliers, customers, and other supply chain members,

are integrated together.’ Customer and supplier integration are commonly referred to as external integration, which is the degree to which a manufacturer partners with its external partners to structure inter-organizational strategies, practices and processes into collaborative, synchronized processes (Stank et al., 2001). Customer integration involves core competencies derived from coordination with critical customers, whereas supplier integration involves core competencies related to coordination with critical suppliers (Kim, 2006).

In contrast, internal integration focuses on activities within a manufacturing firm. It is the degree to which a manufacturer structures its own organizational strategies, practices and processes into collaborative, synchronized processes to fulfill its customers’ requirements (Cespedes, 1996; Kahn and Mentzer, 1996; Kingman-Brundage et al., 1995) and efficiently interact with its suppliers. While internal integration recognizes that the departments and functions within a manufacturing firm should function as part of an integrated process, external integration recognizes the importance of establishing close, interactive relationships with customers and suppliers. Both perspectives are important in allowing supply chain members to act in a concerted way so as to maximize the value of the supply chain.

Researchers argue that a close relationship between customers and a manufacturer offers opportunities for improving the accuracy of demand information, which reduces the manufacturer’s product design and production planning time and inventory obsolescence, allowing it to be more responsive to customer needs. Because customer integration generates opportunities for leveraging the intelligence embedded in collaborative processes, it enables manufacturers to reduce costs, create greater value and detect demand changes more quickly. Customer integration has been found to be related to customer satisfaction both directly (Homburg and Stock, 2004) and indirectly through its relationship with product development and innovation (Koufteros et al., 2007; Song and Di Benedetto, 2008).

Studies have also investigated the importance of supply chain integration on performance (Droge et al. 2004; Frohlich and Westbrook 2001; Zailani and Rajagopal 2005). Some authors have also questioned the validity of integration (Cousins and Menguc, 2006; Danese and Romano, 2011; Gominez et al., 2012) and suggest that external supplier integration does not improve a firm’s operational performance. Supply chain integration increases performance only if supply complexity is high.

Bask and Juga (2001) argue that in their study conducted in China intensive integration was not necessarily the best solution in all cases; rather limited integration might be beneficial in some areas depending on different national and industry contexts. Donaldson (2011) analyzed the impact of customer integration on efficiency and the moderating role of supplier integration. In a survey conducted in Thailand, Wong et al., (2011) argue that under environmental uncertainty the relationships between supplier/customer integration and delivery and flexibility performance and those between internal integration and product quality and production costs are high.

2.2 Internal integration

Internal integration is defined as a process of inter-functional interaction, collaboration, coordination, communication and cooperation that brings functional areas together into a cohesive organization (Flynn et al., 2010; Zhao et al., 2011). Internal integration is defined as ‘the degree to which a manufacturer structures its own organizational strategies, practices and processes into collaborative, synchronized processes, in order to fulfill its customers’ requirements and efficiently interact with its suppliers’ (Flynn et al., 2010).

Internal integration deals with integrating and linking information among different organizational departments, creating easy access to inventory information, developing an easily accessed integrated database that encompasses main operational data, integrating production processes using advanced information systems and linking production and marketing departments using computerized planning systems (Lee et al., 2007).

Further, supply chain partners who exchange information regularly are able to work as a single entity and can understand the needs of the end customer better and hence can respond to market changes quicker (Stein, 1998). Companies with low internal integration strategies will achieve low levels of external integration and companies implementing the full internal integration strategies will have the highest levels of external integration (Gimenez and Ventura, 2005).

2.3 External Supply chain integration

As the competitive environment is becoming increasingly challenging, firms are undertaking efforts to compete along multiple fronts. However, many firms find it difficult to compete in the market by relying on their internal resources and competencies alone. Hence, they are collaborating with their customers and suppliers to obtain information and complementary resources which they can deploy to build competitive advantages (Zhao et al., 2011).

2.4 Supplier Integration

Li et al., (2014) define supplier integration as ‘The long-term relationship between the organization and its suppliers. It is designed to leverage the strategic and operational capabilities of individual participating organizations to help them achieve significant ongoing benefits.’

Supplier integration is characterized by various aspects and activities such as information sharing, coordination, trust, shared technologies, integrated processes, long-term contracts, assisting suppliers in improving production processes, fostering quality improvements, investing in suppliers’ assets including suppliers in new product development, improving suppliers’ overall capabilities, risk and reward sharing and shared gains from development efforts (Echtelt et al., 2008). As such, integration results in improved decision making, enhanced knowledge sharing, aligned capabilities, built learning routines and increased performance of supply chain (SC) partners (Echtelt et al., 2008). Trust enhances the degree of commitment between the two parties, reduces transactional costs, improves cooperation,

enhances the satisfaction of the two parties, decreases formal contracts and reduces conflicts (Sahay, 2003).

Supplier integration, also called 'backward' integration (Frohlich and Westbrook, 2001) refers to the process of interaction and collaboration between an organization and its suppliers to ensure an effective flow of supplies (Zhao et al., 2011). Supplier activities include activities such as placing strategic activities with suppliers, involving suppliers' capabilities to generate new products during the design stages, production planning and inventory management, having a rapid response order processing system with suppliers, installing a supplier network that ensures reliable delivery and exchanging information with suppliers. According to Yao et al., (2007), supplier integration has to do with data flow between two or more companies and constitutes a way towards achieving process integration under which a supplier takes control of the inventory and purchasing functions of the buyer.

2.5 Customer integration

Tan et al., (1998) define customer integration as 'demand management practices through long-term customer relationship, satisfaction improvement, and complaint management.' The fundamental aspect of customer relationships is the focus on key customers to understand their needs and requirements and to satisfy them. Customer integration includes different activities and practices such as integrated problem-solving initiatives, direct customer contacts, managing customer complaints, increasing customer satisfaction and establishing long-range relations with customers (Sousa, 2003; Tan et al., 1998). Customer integration is expected to yield different benefits to organizations including the ability to differentiate their products from competitors, increased market share and retention of profitable customers, improved customer loyalty, quickly resolving potential problems, shared knowledge and expertise concerning new technologies, a deep understanding of customer needs and rapid responses to customers (Magretta, 1998; Wasti and Jeffrey, 1999).

Customer integration, also called 'forward' integration (Frohlich and Westbrook, 2001) refers to the process of interaction and collaboration between an organization and its customers to ensure an effective flow of products and/or services to customers. Customer integration involves sharing demand information, it helps the manufacturer in understanding customer needs better and forecasts better customer demand as well as the collaborative involvement of customers with respect to product design, provision of better quality products at a lower cost and more flexibility in responding to customer demands (Flynn et al., 2010). Customer activity concerns processes dealing with planning, implementing and evaluating relationships between service providers and service recipients. Customer relationship management (CRM) focuses not only on inbound customer relationships but also on outbound customer relationships in SCM. Customer activity involves the ability to communicate the delivery of products and services to end-user customers both locally and globally. Customer activity is principally about the sharing of product information with customers, accepting customer orders, interacting with customers to manage demand, having an order placing protocol in the system, sharing order status with customers during order scheduling and providing information during the product delivery stage.

2.6 Contingency Perspective of Supply Chain Integration

The contingency theory is often employed to understand organizational issues from a contextual perspective (Jayaram et al., 2004). The contingency theory suggests that organizations should align their structures and processes with the environment to enhance performance (Petersen et al., 2005). In a supply chain, customers and suppliers can be deemed as important parts of a firm's performance. According to the contingency theory, an organization's performance is influenced by how its practices are aligned (Pagell, 2004) and the individual dimensions of SCI should be aligned to enhance a firm's performance. The environment that an organization operates in shapes its structures and processes. Accordingly, we propose the following alternative hypothesis H1. *There is a significant relationship between SCI and a firm's performance.*

2.6.1 Internal integration and performance

Because internal integration breaks down hierarchical barriers and improves cooperation to meet customer requirements, rather than operating within the functional silos associated with traditional departmentalization and specialization, it is expected to be related to performance. Internal integration also increases the amount and variety of information available to a manufacturer (Montaka et al., 2015). In addition, frequent interactions and confrontations with different perspectives may reduce mistakes and waste, acquire opportunities for simplification and achieve concurrent engineering. In this sense, internal integration is the base for SCI and is positively related to operational and financial performance. Previous studies have found that components of internal integration such as cross-functional collaboration and integrative inventory management systems have positive impacts on a firm's performance (O'Leary-Kelly and Flores, 2002; Rosenzweig et al., 2003; Vickery et al., 2003).

2.6.2 Relationship of customers and supplier integration with performance

A close relationship between customers and a manufacturer offers opportunities for improving the accuracy of demand information which reduces the manufacturer's product design and production planning time and inventory obsolescence allowing it to be more responsive to customer needs. Because customer integration generates opportunities for leveraging the intelligence embedded in collaborative processes, it enables manufacturers to reduce costs, create greater value and detect demand changes more quickly. Customer integration involves sharing demand information; interacting with customers to set reliability, responsiveness and other standards to understand customer needs better and to forecast better customer demand; and the collaborative involvement of customers with respect to product design, provision of better quality products at lower costs and more flexibility in responding to customer demands (Homburg and Stock, 2004).

To implement customer and supplier integration successfully, manufacturers need to be internally integrated well because internal integration functions as coordination and learning mechanisms in customer and supplier integration (Marquez et al., 2004). Customer and

supplier integration extends internal integration by establishing a cross-functional team integrating external organizations.

3. Methodology

Our study employed a cross-sectional survey design using a questionnaire to solicit data from a sample of 258 respondents drawn from 580 registered companies in Rwanda using the Slorvin and Yamane's formula (Yamane, 1967):

$$(1) \quad n = N/[1+N(e)^2].$$

In the 580 companies contacted, 258 questionnaires were distributed of which 177 were usable. The respondents were 109 from supply chain departments (purchasing, logistics managers) and 68 top level managers who were directly involved in supply chain activities. An exploratory factor analysis (EFA) using a principal component analysis with varimax rotation was used to assess the construct validity of SCI and performance. The appropriateness of using a factor analysis was further substantiated by Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy. The value for KMO measures of sampling adequacy should be greater than 0.7 and is inadequate if it is less than 0.5.

The Bartlett's test should be significant at a significance value of less than 0.05 (Leech et al., 2005). From our results, the KMO values were well above the recommended acceptable level of 0.7 which is 0.611 closer to 0.7 thus confirming that the collected data was worthy of a factor analysis. Based on Frohlich and Westbrook (2001) and Agus' (2001) suggestions coupled with the fact that data for this study was generated using multi-scaled responses, we carried out a reliability test. The reliability analysis was conducted by calculating the Cronbach Alpha for the main constructs in the study to test the internal consistency of each factor. The results show that the Cronbach Alpha of the four main constructs exceeded the threshold point of 0.70 suggested by Nunnally (1978). Also, the alpha optimization process that was carried out showed alpha coefficients for SCI.

The key constructs are i) internal integration (II), ii) customer Integration (CI), iii) supplier integration (SI), and iv) firm performance (Perf). Internal integration was measured based on periodic interdepartmental meetings among internal functions (II1), and integrative inventory management (II2). Supplier integration was measured by the level of strategic partnerships with major suppliers (SI1) and key supplier involvement in organizational planning and goal setting (SI2). Customer integration was measured by frequent interaction with customers to set reliability, responsiveness and other standards (CI1) and the level of frequent follow up of the organization with its customers for quality/services feedback (CI2). Operational performance was measured by a quick modification of products to meet major customer requirements (P1) and the firm's outstanding on time delivery record to customers (P2) while the supply chain performance was measured by annual sales (P3). The constructs and the relationship are presented in Figure 1.

Insert Figure 1 about here.

4. Results and Discussion

The data collected was reviewed for completeness and accuracy. Thereafter, the data was sorted and coded and then entered into the Statistical Package for Social Sciences (SPSS). We used the Chi-square to test the extent to which supply chain integration affected the performance of manufacturing firms in Rwanda. The data collected was cleaned for errors; internal integration, supplier integration, customer integration and performance were subjected to a factor analysis and a reliability test. The essence of these tests was to arrive at the critical items of the constructs that were to be applied for statistical and hypotheses testing. In addition, an exploratory factor analysis (EFA) was done to establish whether the resulting factors from the factor analysis closely fit the constructs as theoretically given in literature.

The EFA results pointed to the fact that all elements had loadings on their respective factors that were significant showing Eigen values exceeding 2, with cumulative variance explained by values ranging between 35.304 and 100. Additionally, the KMO (Kaiser-Meyer-Olkin) approximation was 0.713 and showing a significant Chi-square value (Barlett's test of sphericity = 33.90). This put the KMO estimate for our study above the threshold value of 0.50 recommended by Hair et al., (1998). Factor loadings of all the constructs in our study were thus sufficiently high enough to make the findings meaningful.

Considering the descriptive statistics and factor analysis in Table 1, the results show that among the supply chain integration (SCINT) metrics, under supplier integration, the level of strategic partnerships with major suppliers showed the highest mean (2.95), followed by the level of the organization reliability on a few dependable suppliers (2.63), the level of information exchange with major suppliers through information networks (2.50) and supplier participation in design (2.40). Under internal integration the level of departments in the supply chain that established more frequent contacts with each other had the highest mean (3.33) followed by cross-functional teams in process improvement (3.19), integrative inventory management (3.10) and organization application integration (3.06). Also, under company integration with customers metrics, periodic contacts with customers had the highest mean (4.57), followed by the agility of the ordering process (4.21), level of communication with customers (4.13), follow up with customers for feedback (4.11), customers ordering computerization (2.70) and sharing of marketing information (2.10). Under customer integration (CI), the analysis shows that the highest recorded mean was in computerization for easy customer ordering (3.72) followed by frequent interactions with customers to set reliability, responsiveness and other standards (3.52), quick ordering systems with major customers (3.33) and frequency measurement and evaluation of customer feedback (3.01).

Insert Table 1 about here.

Finally, under firms' performance (FIRMPERF) sales and on time delivery recorded the highest mean (4.31) followed by operational performance (3.05) represented by the on-time delivery record (2.93) and the quick modification of products to suit major customer requirements (2.98).

As shown in the proposed structural model (Table 2), our hypotheses were supported or partially supported, broadly indicating that SCI is related to performance. Specifically, by applying the contingency approach we found that internal integration was directly related to both business and operational performance ($\alpha = 0.042 < 5$ per cent) and that customer integration was directly related to operational performance. Although supplier integration was not directly related to either type of performance, the interaction between supplier and customer integration was related to operational performance explained by p-values equal to .048 and $0.042 < 5$ per cent respectively. The most significant variables were organizational follow-up, interdepartmental meetings, interacting with customers and suppliers' involvement.

Insert Table 2 about here.

When the results of our study are compared with those from previous research on SCI (Droge et al., 2004; Germain and Iyer 2006; Stank et al., 2001a and b), it is evident that internal integration was significantly related to operational and business performance. Thus, our research reinforces the importance of internal integration in improving a firm's performance. Hence, the findings of our study are important since much of existing literature on SCI does not include internal integration as a dimension of SCI. Our findings on customer integration are significantly related to performance. This is consistent with the findings of several previous studies (Germain and Iyer, 2006; Koufteros et al., 2005). However, our findings contradict Devaraj et al.'s (2007) study which shows that customer integration had no direct significant effect on operational performance.

Our results show that supplier integration was negatively related to certain aspects of operational performance. This conforms with the findings of Stank et al., (2001a) and contradicts Devaraj et al., (2007) who found a positive relationship between supplier integration and operational performance.

4.2 Pearson's Correlation of Supply Chain Integration and a firm's Performance

We used Pearson's correlation to test the interactions between SCI and business performance (PERF). Our results show that a firm's performance dimension, 'sales performance' had high correlations with customer integration especially with frequent interactions with customers to set its reliability, responsiveness and other standards ($r = .56$) and was closely followed by 'internal integration' especially on the level of periodic interdepartmental meetings among internal functions ($r = 0.53$).

Operational performance had a high correlation with periodic interdepartmental meetings among functions ($r = 0.54$), followed by frequent follow up with customers for quality/service feedback ($r = 0.55$) and integrative inventory management ($r = 0.51$).

An analysis of these findings indicates that there is a direct relationship between internal integration and a firm's operational performance supporting H1 that states that there is a relationship between internal integration and performance of manufacturing firms in Rwanda. On the other hand, these results also indicate that customer integration affected a

firm's performance especially in frequent interactions with customers to set its reliability, responsiveness and other standards to meet customer requirements. These results support H2 that states that customer integration directly affects a firm's performance while supplier integration does not. Therefore, the results of our study fail to accept H3 which states that supplier integration affects the performance of manufacturing firms in Rwanda.

4.3 Structural Equation Modeling

Structural equation modeling (SEM) is a very general statistical modeling technique which is widely used in behavioral sciences. It can be viewed as a combination of factor analysis and regression or path analysis. Interest in SEM is often on theoretical constructs which are represented by latent factors. SEM is an appropriate tool for investigating the strength of a relationship between various phenomena and hence it was employed to simultaneously determine the relative strength of the relationship between the constructs of our study: Internal integration (II), customer Integration (CI), supplier integration and a firm's performance. To do this effectively, an alternative hypothesis (H1: The SEM model has a good fit) was enacted. The relative strength of the relationship between these constructs is given in Table 3.

Insert Table 3 about here.

Empirical data as used in our study is expected to support the underlying assumptions of SEM regarding the goodness of fit to allow for the acceptance of the alternative hypothesis (H1) that the model has a good fit. In this regard, the resulting probability value must be significant to support the overall alternative hypothesis of the SEM model. The SEM results showed a Chi-square value of 89.247 with 24 degrees of freedom and a probability value of 0.200 as indicated by the results of the default model. Based on these results, it was clear that the null hypothesis that the SEM model had a good fit was supported. The model can thus be said to fit the data ($p\text{-value} > 0.05$).

Based on these results our study shows that most of our hypotheses were supported or partially supported, broadly indicating that SCI is related to a firm's performance. By specifically applying the contingency approach our study found that internal integration was directly related to both firm and operational performance, customer integration was directly related to operational performance and sales enhanced an understanding of the effects of SCI on a firm's performance. Although supplier integration was not directly related to either type of performance, the interaction between supplier and customer integration was related to operational performance.

5. Conclusion and Recommendations

Our study built on the contingency theory by testing the applicability of the theory in Rwanda. First, it adds to literature by empirically testing the relationship between supply chain integration and a firm's performance. Our study reveals a significant correlation between internal integration and customer integration with a firm's performance. The supply

chain integration should be focused on to achieve the desired influence including but not limited to customer interactions, frequent follow-ups with customers for quality /service feedback, periodic interdepartmental meetings among functions and integrative inventory management.

The implication of the relationship between supply chain integration and supply chain patterns is that they individually and collectively influence the performance of businesses. Hence, our study concludes that supply chain integration is a critical ingredient for improving manufacturing firms' business performance in Rwanda.

While our study makes a significant contribution to SCI literature and has important implications in practice, it does have some limitations which provide some opportunities for future studies. First, our study used a cross-sectional design which means that causality cannot be established. Because integration between customers, suppliers and manufacturers is developed over time, it will be fruitful for future research to examine the evolution of SCI patterns in a longitudinal fashion. Second, because the data was only collected from manufacturing firms, future studies can broaden the scope by collecting data from all supply chain partners including suppliers, manufacturers and customers. Third, although our research provides some interesting findings about the relationships between SCI and performance in Rwanda, it is not clear whether these relationships will be the same in other countries.

Future research should examine the effects of these contextual factors on SCI patterns and their relationships with performance in Rwanda. Another interesting area of research is the factors that influence the degree of customer, supplier and internal integration in SCI patterns. These may include factors such as a competitive environment, relationship commitment, trust, organizational characteristics and national culture. Likewise, the relationship between SCI and competitive performance is another potentially interesting area for future studies, especially in Rwanda.

However, this relationship may be different across different firm sizes, countries, ownership types, industries or regions. It is recommended that efforts be made to examine the differences in the relationship between SCI and firm performance across different firm sizes, ownership types, industries or regions.

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Table 1. Factor analysis and descriptive statistics

Descriptive Statistics			Factor analysis			
Supply chain dimensions	Mean	Std. Dev	SI	CI	II	PERF
SI1: Strategic partnership with suppliers	2.95	1.052	.615	-.258	.191	.335
SI2: Supplier Involvement in planning	2.65	.851	.758	.212	-.143	-.113
CI1: Frequent Interaction with customer	3.52	.783	.125	.754	.185	.149
CI2: Customer follow up for feedback	3.10	1.077	-.390	.468	.367	-.419
II1: Interdepartmental meeting	2.91	.920	-.078	.195	.112	.875
II2: Integrative inventory management	3.10	1.143	.171	.080	.812	.138
P3 : Annual sales	2.98	.873	.666	.060	.326	-.064
P2 : On time delivery	2.93	.849	.567	-.115	-.225	.145
P1 : Quick product modification	3.05	1.428	.028	.610	-.474	.068

Note: Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

Table 2: Standardized Regression Weights: (Group number 1 - Default model)

Standardized Regression Weights			Estimates
Product modification	<---	Strategic partnership	.217
On time delivery	<---	Strategic partnership	.261
Product modification	<---	Interaction with customer	.048
Product modification	<---	Organization follow- up	-.030
Product modification	<---	Supplier involvement	-.203
On time delivery	<---	Supplier involvement	-.042
On time delivery	<---	Interaction with customer	.041
On time delivery	<---	Organization follow-up	.019
Annual sales	<---	Product modification	.034
Annual sales	<---	On time delivery	.103
Annual sales	<---	Interdepartmental meeting	.042
Annual sales	<---	Integrative inventory	.105

Source: Author's calculations.

Table 3. CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	30	89.247	24	.200	3.719
Saturated model	54	.000	0		
Independence model	9	133.927	45	.200	2.976

Source: Author's calculations.

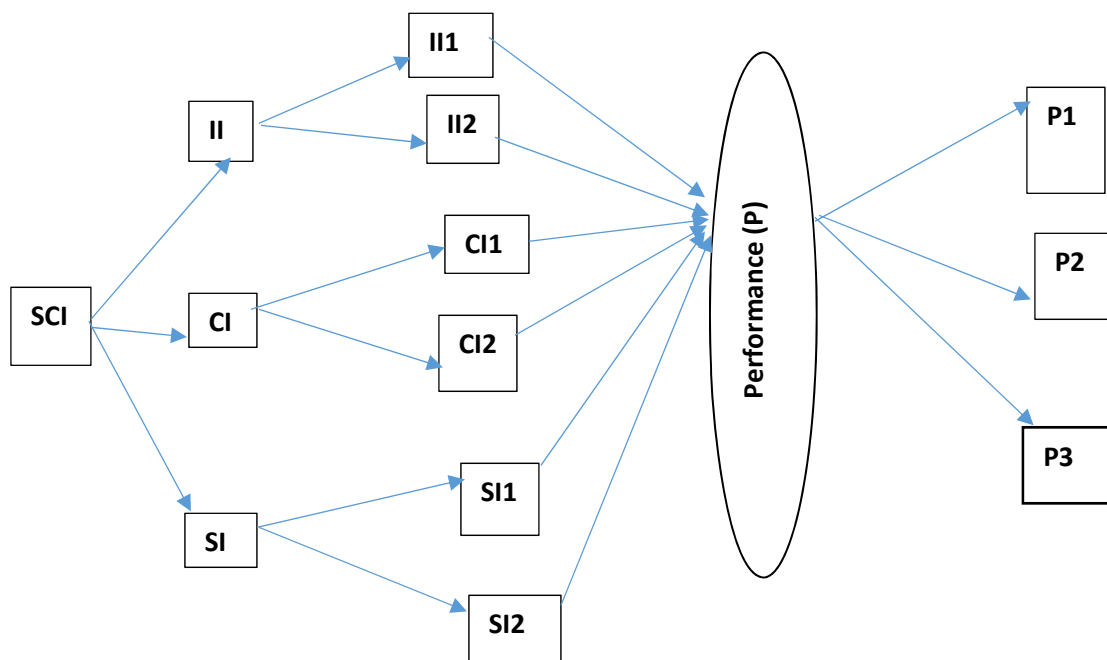


Figure 1: Constructs of SCI and a Firm's Performance

List of Ministries, Public Agencies and NGOs in Rwanda

The Government of Rwanda has 17 ministries, Minister in President's Office, Minister in Prime Minister's Office in charge of Cabinet Affairs and the Minister in Prime Minister's Office in charge of Gender and Family Promotion.

1. List of Ministries

Ministry	Phone	E-mail	Website
The Ministry of Local Government (MINALOC)	+250 788384081/5353	webmaster@minaloc.gov.rw	www.minaloc.gov.rw
The Ministry of Infrastructure (MININFRA)	+250 252585503	info@mininfra.gov.rw	www.mininfra.gov.rw
The Ministry of Trade and Industry (MINICOM)		info@minicom.gov.rw	www.minicom.gov.rw
The Ministry of Agriculture and Animal Resources (MINAGRI)	+250 788673779	info@minagri.gov.rw	www.minagri.gov.rw
The Ministry of Finance and Economic Planning (MINECOFIN)	+250 252 575 756	info@minecofin.gov.rw	www.minecofin.gov.rw
The Ministry of Education (MINEDUC)	+250 252580236	info@mineduc.gov.rw	www.mineduc.gov.rw
The Ministry of Health (MINISANTE)		info@moh.gov.rw	www.moh.gov.rw
The Ministry of Defence (MINADEF)	+250788843383	info@mod.gov.rw	www.mod.gov.rw
The Ministry of Justice (MINIJUST)	+250 252 586398	moj@minijust.gov.rw	www.minijust.gov.rw
The Ministry of Youth and ICT	+250 788 487 899		www.myict.gov.rw
The Ministry of Sport and Cultural (MINISPOC)	+25 0788 214 597	info@minispoc.gov.rw	www.minispoc.gov.rw
The Ministry of Public Service and Labour (MIFOTRA)	+250 252 585503	info@mifotra.gov.rw	www.mifotra.gov.rw
The Ministry of Internal Security (MININTER)			www.mininter.gov.rw
The Ministry of Foreign Affairs and Cooperation (MINAFFET)		info@minaffet.gov.rw	www.minaffet.gov.rw
The Ministry of East African Community (MINEAC)	2525	mineacom@mineacom.gov.rw	www.mineac.gov.rw
The Ministry of Natural Resources (land, forests, Environment and Mining)	+250 252 582 628	info@minirema.gov.rw	www.minirena.gov.rw
The Ministry of Disaster Management and Refugees (MIDIMAR)	(+250) 785080364	info@midmar.gov.rw	www.midimar.gov.rw

The Ministry of Gender and Family Promotion (MIGEPROF)	+_0252 587128	info@ <i>migeprof</i> .gov.rw.	<u>www.migeprof.gov.rw</u>
Ministry of Youth (MINIYOUTH)	+ <u>250788 487 899</u>		www.myict.gov.rw

2. List of Private Companies in Rwanda

Name	Phone	E-mail	Website
AB Bank Rwanda	+250788 319 108		www.abbank.rw
Access Bank Rwanda	+250788145300	rwandacontactcenter@accessbankplc	www.accessbankplc.com
Bank of Africa Rwanda Limited	+2507881362228		www.boarwanda.com
Bank of Kigali	+250-788143000		www.bk.rw
Banque Populaire du Rwanda SA	+250-788187200	info@bpr.rw	www.bpr.rw
Banque Populaire du Rwanda			
Bourbon Coffee	+ 250 280 305 555	info@bourboncoffee.biz	www.bourboncoffee.rw
Bralirwa Brewery	+250 252 587200	bralirwa@heineken.com	www.bralirwa.com
Compagnie Générale de Banque	+250 788 155 500	cogebank@cogebank.com	www.cogebanque.co.rw
Equity Bank Rwanda Limited	+250788190000	rwandans.abroad@equitybank.co.rw	www.rw.equitybankgroup.com
Great Lakes Energy	+25 0788 656 025		www.rwandayp.com
Guaranty Trust Bank	+250788 149 610		www.gtbank.co.rw
Housing Bank of Rwanda	(+250) 252 575079		www.brd.rw
I&M Bank Rwanda Limited	+250 788 162 000		www.imbank.com
KCB Bank Rwanda Limited	+250788190202		www.rw.kcbgroup.com
National Bank of Rwanda	+ (250) 788199000	info@bnr.rw	www.bnr.rw
National Post Office	(+250) 252 582703	info@i-posita.rw	www.i-posita.rw
Rwanda Development Bank	(+250) 252 575079	brd@brd.rw	www.brd.rw
Rwanda Stock Exchange	+250 - 788 516 021		www.rse.rw
RwandAir	+250788177800		www.rwandair.com
Rwandatel	+25.025.250.32.63	info@rwandatel.rw	www.rwandatel.rw
Silverback Cargo Freighters	+250 0850 5496		www.kigalikonnnect.com
SORAS Group Limited	+25 07 88 18 53 00.	infovie@soras.co.rw	www.sorasgroup.rw
Terracom	+250 50 32 63	info@terracom.rw	www.terracom.rw
Unguka Bank	+250726 019 165		www.ungukabank.com
Urwego Opportunity Bank	+250 788 444 666		www.urwegobank.com
Zigama Credit and Savings Bank			www.zigamacss.rw

3. Public authorities in the category ‘government agencies’/ Public Agencies

Public Agencies	Phone	E-mail	Website
<u>Government Assistance Fund for Vulnerable Survivors of the Genocide against the Tutsi (FARG).</u>	3562	info@farg.gov.rw	www.farg.gov.rw
<u>Higher Education Council (HEC).</u>		info@hec.gov.rw	www.hec.gov.rw
<u>Institute of Legal Practice and Development (ILPD).</u>	(+250) 788616394	info@ilpd.ac.rw	www.ilpd.ac.rw
<u>Media High Council (MHC).</u>	+250) 788 460 385/ +250) 788 833 780	info@mhc.gov.rw	www._mhc.gov.rw
<u>National Agricultural Export Development Board (NAEB).</u>	(+250) 252 57 56 00	info@naeb.gov.rw	www.naeb.gov.rw
<u>National Capacity Building Secretariat (NCBS).</u>	+250255120686/ +250 722 128 316	info@cesb.gov.rw	cesb.gov.rw
<u>National Children Commission (NCC).</u>	(+250) 788754590	info@ncc.gov.rw	www.ncc.gov.rw
<u>National Council of Persons with Disabilities (NCPD).</u>	+250 788 300 952	info@ncpd.gov.rw	www.ncpd.gov.rw
<u>National Electoral Commission (NEC).</u>	+250 000000000/+250 7830000000	info@nec.gov.rw	www.nec.gov.rw
<u>National ID Agency (NIDA).</u>		info@nid.gov	www.nid.gov.rw
<u>National Industrial Research and Development Agency (NIRDA).</u>	+250 255104465	info@nirda.gov.rw	www.nirda.gov.rw
<u>National Inspectorate and Competition Authority (NICA).</u>			www.sobanukirwa.rw
<u>National Institute of Statistics of Rwanda (NISR).</u>	+250 252 571035	info@statistics.gov.rw	www.statistics.gov.rw
<u>National Law Reform Commission (NLRC).</u>	+250 789 000 480	info@rlrc.gov.rw	www.rlrc.gov.rw
<u>National Post Office (NPO).</u>	(+250) 252 582703	info@i-posita.rw	www.i-posita.rw
<u>National Women's Council (NAWOCO).</u>		cnfgov@cnf.gov.rw	www.cnf.gov.rw
<u>Office of the Government Spokesperson (OGS).</u>			www.rwandapedia.rw
<u>Public Sector Capacity Building Secretariat (PSCBS).</u>			www.minaffet.gov.rw

<u>Public Service Commission (PSC).</u>		info@psc.gov.rw	www.psc.gov.rw
<u>Road Maintenance Fund (RMF).</u>	02 55 10 29 91		www.fer.gov.rw
<u>Rwanda Academy of Language and Culture (RALC).</u>		info(at)ralc.gov.rw	www.ralc.gov.rw
<u>Rwanda Civil Aviation Authority (RCAA).</u>	(+250)252585845	info@caa.gov.rw	www.caa.gov.rw
<u>Rwanda Demobilisation and Reintegration Commission (RDRC).</u>	(250) 587159	demobrwandariPvaboo.com	www.demobrwanada.gov.rw
<u>Rwanda Development Partners</u>	(+250) 252 577 581		www.devpartners.gov.rw
<u>Rwanda Directorate General of Immigration and Emigration</u>	+250 788 674 848	info@migration.gov.rw	www.migration.gov.rw
<u>Rwanda Education Board (REB).</u>	(+250) 255121482	info@reb.rw	www.wda.gov.rw
<u>Rwanda Environment Management Authority (REMA).</u>	+250252580017	info@rema.gov.rw	www.rema.gov.rw
<u>Rwanda Governance Board (RGB).</u>	(250)255 112 023	info@rgb.rw	www.rgb.rw
<u>Rwanda Law Reform Commission (RLRC).</u>	+250 789 000 480	info@rlrc.gov.rw	www.rlrc.gov.rw
<u>Rwanda Natural Resources Authority (RNRA).</u>	+250 252 560 506	info@nlc.gov.rw	www.rnra.rw
<u>Rwanda Private Sector Federation (PSF).</u>	+(250)-252-570650	info@psf.org.rw	www.psf.org.rw
<u>Rwanda Public Procurement Authority (RPPA).</u>	+250786582957	rppa@rwanda1.rw	www.rppa.gov.rw
<u>Rwanda Revenue Authority (RRA).</u>	+250 788185500	info@rra.gov.rw	www.rra.gov.rw
<u>Rwanda Transport Development Authority (RTDA).</u>		info@rtda.gov.rw	www.rtda.gov.rw
<u>Rwanda Utility Regulation Agency (RURA).</u>	+250 252 584562	info@rura.gov.rw	www.rura.rw
<u>Workforce Development Authority (WDA).</u>	+25025535113365/7 88300539	Info@agi.gov.rw	www.wda.gov.rw

4. List of non-governmental organizations (NGOs) registered in Rwanda

Name of NGO	Domain of Intervention	Area of operation	Contacts	Address in Rwanda
Association of student's fund /ASEF	Social welfare	Nyabihu, Karongi, Burera,Gakenye	asefstudents@gmail.com	Kicukiro , kagina,
HELP AGE	Infrastructure	Burera musanze Gicumbi	Inforwanda@helppage.org	Gasabo Kimihurura, Umutekano village
WOCCU	Financial sector Development	Central Level	jthiboutot@woccu.org	Kacyiru. not precise
SPARK MICRO GRANT	Community development	Burera district, kagogo	ngaboerneste@spakmicrogrants.org	Musanze district muhoza village ruhengeri city
GVEP International	Energy/inflastructure	Central level,Gakenke district	energy water and sanitation authority Ihema.	
SUSTAIN RWANDA	Environnemental conservation	Nyaruguru/ Muganza , ntyabimata/	Katharine.Troeger@sustain-rwanda.org	Huye,Ngoma sector Buye Avenue
IMC (international Medical Center)	Heath	Nyaruguru/Munini Hospital	Jrukanikigitero@internationalmedicalcorps.org	Huye Distict ,Ngoma Sector
JPIEGO	Health	Central Level	Jeremie.zougrana@jhpigo.org	Kacyiru gasabo Umucyo village Near US embassy
Deseret International	Health	Central level with MOH, Gasabo District	dicrwanda@gmail.com	Gasabo, Rwimbogo sector
BETTER WORLD	Health	Rwamaganamunyiginya	ysleerwa@gmail.com	Kanombe military hospital
AWOG	Gender promotion.	Nyamagabe	munyoma@yahoo.com	Kicukiro sector Remera village
ICAP	HEALTH	CENTRAL LEVEL	Vm2208@columbia.edu	Nyarugenge kiyovu inyarurembo
ADEF	EDUCATION	Kicukiro	adefrwa@yahoo.fr	Kicukiro Niboye , Gaseke
APIE	EDUCATION	kicukiro	emily@apartnerineducation.org	Kanombe kicukiro kabeza
WELLSPRING	Eduaction	Gasabo	Rwanda@thewellspringfoundation.org	Gasabao remera sector Kamahwa

				Ner TZ Embassy
INTERNATIONAL EDUCATION EXCHANGE (IEE)	Education	Kicukiro,Gatsibo ,Bugesera	murenziemmas@yahoo.co.uk	Kimironko Gasabo
World Vision	Health,Eduaction,s ocial welfare , Community Amenities	Rulindo,Huye, Gasabo , Gicumbi,Nyamagabe, Rutsiro	infowvrwanda@wwvi.org	Gasabo, Kamatamu Kacyiru sector near US Ambassy residence
ACCORD	Social economic	Bugesera ,kamonyi,Musanze,Ngororero	accordrwanda@rwanda1.com	Nyarugenge,Muhima, Kabeza Ingenzi
VETERINAIRE SANS FRONTIERES	Agriculture	Huye	d.ripoche@vsf-belgium.org/ dbimenyimana@yahoo.fr	Huye District (Ngoma sector, Butare cell, Buye Village, opposite Huye stadium)
ONE ANCRE FUNDS	Agriculture	Gisagara,Karongi Rusizi,Nyamasheke/ Nyanza,Nyaruguru Rutsiro	Eric.pohlman@oneacrefund.org	Karongi ,Rebengera, Village,
SNV	Agriculture-(Coffee production)	Ngororero,Karongi, Nyamasheke, Rutsiro,Gakenke, Rulindo, Nyanza, Gisagara, Nyaruguru ,Rusizi,Kirehe	rwanda@snvworld.org	Boulevard de l'umuganda , Printex House near Top Tower Hotel
Oral Health Foundation Rwanda (OHFR)	Health	Kmaonyi remera Rukoma, Kigarama, Kicukiro Kigali	pauloojudith@yahoo.fr	Gasabo, Kimironko,Intashyo
The Gorilla Organization	Environment /Gorrila conservation	Musanze District	Ruhengeri Resource Center e Emmanuel@gorrilas.org	RUHENGERRI Resource Center , Habyarimana Claude Building
The Gorilla Organization	Environment /Gorrila conservation	Musanze District	Ruhengeri Resource Center e Emmanuel@gorrilas.org	RUHENGERRI Resource Center , Habyarimana Claude Building

Hope and homes for Children	Children and family promotion	Central Level	Hhc_rwanda@yahoo.com	Nyarutarama Cell Gasabo
Water Aid	Water and sanitation	Central level	Rwanda@wateraid.org	Nyarugenege Sector Ntaruka village
MABAWA	Education	Nyaruguru	gashagazaleo@hotmail.com	Mata Nyamyumba Ntaruguru District
Water for people	Water supply and hygiene	Rulindo, Ngoma District	rwanda@water for people.org	Kicukiro African Union Road
Mountain Gorilla veterinary project UC wildlife	Environment	Musanze	Dzimmer2@gmail.com	Musanze Muhoza Ruhengeri
JAM (Joint Aid Management international)	Social welfare for Children and women	Muhanga shyogwe	Rwanda@jamint.com	Muhanga , shyogwe sector
Generation Rwanda	Education	Central level	info@generationrwanda.org	Nyarugenge sector , kiyovu
Drew Cares International	Health/MINADEF	Kanombe Military Hospital	dcirwanda@dcintl.org	Kamataba Kacyiru sector Gasabo
International alert	Unity and reconciliation	Gasabo/kinyinya kimironko, Gisagara /Muganza, Huye/save, Ngororero/Kigembe	gbazigaga@international-alert.org	Gasabo , Kacyiru Nyabisindu
VI- agro forestry	Environment Conservation	GASABO, Rulindo, kamonyi	Kajsa.halleen@viafp.org	Kabare, Gasabo, Kacyiru
William J Clinton foundation	Agriculture	Kayonza, Kirehe, Gatsibo	lufitinema@clintonfoundation.org	Gikondo RFCC Building – Kigali-Rwanda
Rwanda Girls initiative	Education	Bugesera , Gashora	Maria.bwakira@gmail.com	Gihahama, Gashora, Bugesera
Panos Paris	Media	Central level	Vicky.byicaza@panosparis.org	Remera main road International airport road Opposite come again
Land O' Lakes	Agriculture	Nyagatare; Rwamagana Gatsibo, Kayonza	info.rdc2@idd.lando	Nyarutaram Kigali

		Bugesera, Gasabo, kicukiro, Gicumbi, Kamonyi, Ruhango, Nyanza, Huye, Gisagara, Musanze, Rulindo, Rubavu, Nyabihu.		
Aegis trust	Genocide prevention	Gasabo, Huye, Bugesera, kamonyi	Fredyy.mutanguha@aegis trust.org	Kigali Genocide memorial center.
Medicus Mundi	Health	Kamonyi Gakenye	Paloma medicusmundi@yahoo.fr	Kimihurura Umudugugudu intambwe
Global Health Corps	Health sector	Central level	shema@ghcorps.org	Gasabo, Remera, Village
Vision for a Nation	Health	Central level	info@vfanf.org	Juru Village Kimihurura Cell Gasabo Kigali
Bridge 2 Rwanda	Education	Central level	mkarugarama@bridge2rwanda.org	Telecom House, 4th floor ,b wing, Kigali, Rwanda
Savings Banks Foundation	Micro finance	Central level	Office.kigali@sbfic.ce.de	Gasabo Kacyiru Kibaza
Cornerstone development	Education.	Rwamagana	Cstone@imul.com	Gasabo, Remera, Rukiri
PSI	Health.	NGOMA,HUYE KICUKIRO,Musanze Gasabo Nyarugenge	info@psirwanda.org	Gasabo kacyiru kabare
Wildlife conservation society	Environmental conservation	RDB, park level NNP (Nyungwe national park)	mmasozero@wsc.org	Nyamasheke Bushekeri Gisakura
Good neighbors	Community Development	Gasabo Gisozi	gnrwan@gmail.com	Kimihurura Rugando
Hope international	Economic development	Gasabo	EMutabazi@hopeinternational.org.	Karukamba cell. Kacyiru gasabo

Mercy Ministries	Environment	Gasabo ndera rubavu sector	gladmin@lerucher.org	Kibenga –Rugazi Gasabo ndera
Esthers’ aid	Reintegration	Kacyiru gasabo ,	Esthers.aid3636@gmail.co	Kibaza kacyiru
Oxfam GB	Social economic	Nyagatare Nyamagabe Musanze,Nyamasheke Rulindo	Kigali@oxfam.or.uk	Kacyiru ,Gasabo
American Refugee Committee	Refugee Camp support	Gicumbi,Gatsibo Karongi,All camps	Arcrwanda@arc.org.rw	District Gasabo kimihurura
Millennium Promise	Education	Bugesera Mayange	Donald.ndahiro@milleniumpromise.org	Bugesera, Nyamata
MLFM	Water and Sanitation	Gicumbi	Omar.ruanda@gmail.com	Gicumbi in front of the Distrcit
Tulane University	Education	Huye Kicukiro Nyarugenge,Huye	office@tulane rw.org	NyarugengeVillage
Welt Hungerhilfe	Agriculture	Huye,Muhanga,Ruhango	Daniel.Meijering@welthungerhilfe.de	Kimihururura Rugarama
Winrock International	Infrastructure	Kayonza,Mwiri,Rwinkwavu	cvoorhuis@field.winrock.org	Juru ,Kimihurura,Gasabo
Survivor’s fund	Education	Karongi,Rurtsiro ,Ngororero	Surf_rw@yahoo.ca	Kimihurura gasabo
Aquadev	Micro finance	Muhanga,Rubavu	jean-bosco.harelimana@aquadev.org	Gasabo Kimihurura kamukina
FHI360	Health	Kicukiro ,Nyarugenge Rusizi ,Rubavu,Gicumbi	Rwanda.info@fhi360.org	Nyarugenge District Kigali Rwanda
Send A cow	Agriculture and	Bugesera,Rwamagana	Info@sendacowrwanda.org	Gasabo
Global Civic sharing	Agribusiness. Social welfareCommunity development	Kamonyi ,Nyarubaka	gcsrwanda@gcs.or.kr	Kmonyi Nyarubaka kigusa

Living water International	Water supply and sanitation	Ruhango	druhombe@water.cc	Nyarugenge Muhima
Girlhub	Health Reproductive health	Central level	Kate.wedgwood@girlhub.org	Rukiri2,Gasabo,Remera
Global Communities	Health /Community development	GAkenke,Rutsiro Gasabo,Kamonyi, Karongi,Muhanga Ngororero,Nyagatare Nyamagabe,Nyarugenge, Nyaruguru,Rubavu Ruhango,Rulindo	mfunes@rw.chfinternational.org	Kacyiru kamatamu itetero
Femmes Development asbl	Social welfare /health	Ruhango kamonyi	Kayisoso@yahoo.fr	Nyarugenge Cellule Nyamirambo avenue de la paix
La Benevolincija	Communication and media	Gasabo HQs	Aimable.t@labenevolincija.org	Kimihurura Gasabo amajyambere
Africa Anchor of hope	Social welfare Scholrship provision	Gakenke	Rugira_moses@yahoo.fr	Gasabo Remera Rugara
Al maktoum Foundation AMF	Education	Muhanga Nyamabuye	munazzamatrw@rwanda1.com	Muhanga district southern province
Agahozo –shalom	Education	Rwamagana	jc@asyv.org	Rwamagana Rubona sector
WORLD RELIEF	Heath Economic develoment	Kicukiro,Nyamasheke Bugesera,Musanze	wrrwanda@wr.org	Kacyiru, Rubona, Karuruma
Africa Ahead	Health/ Hygene	Rusizi	Not yet esterblished	MoH building `
Food for the hungry	Social economic and welfare	Muhanga ,Ruhango,Kamonyi,Bugesera	rmushanga@fh.org	Karukamba kayiru sector Amajyambere village
THE \bishop john rucyahana and harriet	Social economic activities	Musanze	bpjohnnk@yahoo.com	Musanze District Muhoza village

RUCYAHANA FOUNDATION				
IGCP	Gorilla conservation Comminty Based program	Musanze	info@igcp.org 0788305374	Gishushu Remara
MEDICUSMUNDI	Health	kamonyi	0782379052 Paloma medicusmundi	Kamonyi kayenzi
THE DIANA FOSSEY	Gorilla conservation	Musanze (volcanic national park)	Juancrlsobonilla@yahoo.com , 0788303435	Mmusanze
AHF	Health	Gasabo,Kimironko Nyabihu	Horatius.munyampundu@aidshhealth.org 0788302798	Gasabo district , \igishyushyu village
DOT Rwanda	ECONOMIC development	Kicukiro Nyarugenege Gasabo,Huye muhanga Ngoma,Nyagatare,Musanze	0788381270 vuwamutara@dotrust.org	Yussa Plaza Economic Building
Heifer International	Agriculture and livestock	Nyagaatre Rwamagana Gatsibo	0788302803 heiferrwanda@heifer.org	Agishushu airport road
EDC	Youth livelihood development	Kicukiro,Kamonyi Bugesera,Nyanza, Rwamagana	msany@edc.org 0785084862	Gasabo, District, igali
International Rescue	Health and justice	Ngoma,	Pierre.nzeyimana@rescue .	Majyambere kimihuru
Right to play	Youth leadership	Gasabo, Nyarugenge Bugesera,Rubavu	Righttoplayrwanda@.com 0788388656	Gasabo kimihurura village Immihigo Village
MAd4 Africa commitee	Social education Sector	Huye	Keey83@hotmail.com 0783108579	Huye mbazi cyahafi village
Protos	Water supply Infastructure	Muhanga	Philippe.daout@protosh2o.org , 078450972	Kimihurura Mutara vilalge gasabo
Technoserve	Coffee farming support	Gakenke/Mugunga,Musanze,Nyanza/ruhsngo, Rusizi,Nyamasheke	info@tnsrwanda.org.rw 0788385957	Gasabo Murenzi Building

		Gatsibo		
Florida International University	Water supply and infrastructure	Kayonza gatsibo	mcdonoso@fiu.edu 0788308737	Kimihurura Gasabo Village
Save the Children	Education	Burera,Rubavu,Ruhango Gicumbi,National	cd@savethechildren.net 0786134478	Kamutwa, riganwa
Africa Humanitarian Action	Health	Rubavu ,Nygatare KarongiGicumbi(camps)	aha@rwanda1.com 0788304622	Gasabo kinyinya village
Team Heart	Health	Central level	0788304402 teaamheartinfo@gmail.com	Rugunga dalla house 2nd floor
San/Acess	Child protection	Kicukiro	Sanacessrwanda@ingo.in go@gmail.com	Kicukiro kigaram bwerakori
Bridges to prosperity	Infrastructure Pedestrian Bridges	Karongi,Ngororero,Gakenke,Rulindo,Nyamagabe	rwanda@bridgetoprosperity.org	Gasabo jkacyiru Utexrwa avennue
Trocaire	Food Security	Karongi,Muhanga Nyamagabe,Nyamasheke,N	Pwartson@toaire.org	Nyarugenege no12, KN 31st
ADRA Rwanda	Education /Health	Karongi,Nyagatare,Nyamashoke,Kamonyi,Muhanga,Karongi ,Kayonza Kirehe,Ngoma	cd@adra.org.rw	Nyarutarama remera
Gardens for Health	Health Nutrition Food Security	Musanze,Gasabo,Bdera Sector ,Nyaruguru,Gisagara, Nyagatare	julie@gardensfor health.org	Bumbogo Musaze Gasabo
ZOE Ministry	Food Security	Gisagara Huye muhanga Ruhango	epiphanie@zoeministry.org	Niboye Kicukiri District
Rwanda Avenir	Gender and promotion	Nyanza ,Gasabo	anonciam@yahoo.fr	Imena gasabo kimironko

Venture strategies innovation (VSI)	Maternal Health	Central level /Gisagara District	evangeline@vsinnovation.s.org	Kiyovu kigali grand pansion plaza
Maryland Global initiatives	Health	Central level	cbaribwira@mgcirwanda.org	Chadel building opposite mille colines Nyarugenge
CECI	Gender equality	Central level	pluvifrwanda@gmail.com	Gasbo Kimihurura
Women for women	Agriculture	Kicukiro,Muhanga Rwamagana,Kayonza	akayitesi@womenforwomen.org	Gasabo kimihurura,Village imihigo
AVSI	Education	Gatsibo, Kamonyi, Ruhango, Nyanza.	Lorette.birara@avsi.org	Kimironko Bibare
Pact Rwanda	Mining	Gasabo Kimihurura	pactrwanda@pactworld.org	Kimihururra gasabo
Search for common ground	Conflict resolution	Central level	rwanda@sfcg.org	Gasabo Remera Rukiri
Hope ethiopia/Rwanda	Community development	Kicukiro kanombe Kabaza	Ronald.asimwe@hopethiopia.com	Rue de la technique Inind House
INTERNATIONAL youth fellowship	Youth \promotion	Gasabo kigali city	iyfrwanda@gmail.com	Gsabo kmironko Near Market
World Learning	Intercutural	Gasabo kacyiru	Appolon.kabahizi@sit.edu	Kamatamu, Gasabo Kamutwa
Management science for health MSH	Health	Central MoH	uwayitu@msh.org	niboye avnue Kicukiro
LDGL	Human right	Central level	Ldglse01@gmail.com	Gasabo Kimihurura vilage imihigo
EGPAF (elisabeth Glazer \pediatric AIDS Foundation)	Health Hiv	Central level	smukherjee@pediads.org	CHADEK Building Oppositee ecole belge
Compassion International	Holistic Child development	Country wide	compassion@rw.ci.org	Kimirongo Ituze House
Earth Institute	Health	Bugesera,Musanze,Ngo ma,Nyabihu	Fk2294@columbia.edu	Mpanga,kiyovu,kigali
International justice Mission	Gender basic violence	Gasabo,Kicukiro Nyarugenge	rwanda@ijm.org	Kimihurura, Gasabo Rebero

Miracle corners	Community development Through youth empowerment	Bugesera District	solange@mcwglobal.org	Nyamata kayenzi Bugesera District
SOS village d'enfant	Education Orphans support	Gicumbi, Kageyo, Gasabo, Kinyinya	sosbcn@soskd.org.rw	Kamatamu, Kacyiru Gasabo
Fondation de don Carlo	Health	Rilima /Bugesera	Caritaskigali@yahoo.fr	Caritas de la archdiocese Kigali
White dove foundation	Education	Kinyinya, Gasabo,	info@whitedovefdtn.org	Kinyinyinya gasabo
Action aid	Food rights and livelihood & Women rights	Gisagara, Musanze, Karongi, Nyanza	Actionaid.rwanda@actionaid.org	
VSO	Education	Nyamagabe, Nyamasheke, Bugesera, Gicumbi, Burera, Gisagara, Rubavu, Kicukiro, musanze, Ngoma, Ngororero, Nyagatare, Gasabo, Nyanza, Nyarugenge	Amina.bisamaza@vsoint.org	Remera behing RSSB building pansion plaza
Wir fur Ruanda	Disability	Gisagara Kibilizi	Petermpolokoso@yhoo.com	Amizero yubuzima, Kibilizi Rwanda
Partners in health	Health domain	Burera Kayonza Kirehe	Rwanda @pih.org	One year of registration
Tearfund Rwanda	Community empower in church	Rwamagana, Muhanga, Nyarugenge, Kicukiro, Bugesera, Nyamagabe, Gasabo	exam@tearfund.org/nishi mwe@tearfund.org	Kamutwa vil Nyamata Rugarama 1 lag Gasabo Kacyiru
Rafiki Foundation	Education	Bugesera Nyamata	dmukasahaha@intrahealth.	Nyamata Rugarama 1

Plan International Rwanda.	Child protection And Education	Gatsibo Bugesera Nyaruguru	Rwanda co@plan-international.org	Kagugu gasabo Kinyinya
EDUCAT	private sector development	Gasabo District	info@educat.dk	Kiyovu, Dallass Second floor, masaka kiyovu
Human right Watch.	Human right violation/justice	Central level	mudgel@hrw.org	District Nyarugenge Sector
My Right-Empowers people with disability	Disability	nyaruguru gasabo kayonza nyagatare	Bernard.bagwagwa@shi a.se	Musanze muhoza sector
Project Akilah	Education	Kibagaga	aline@akilahinstitute.org	Gasabo kimironko Kibagabaga
JSI Research and Training R&T	Health	Central level	Skidde@rw.pfscm.org Tel0788304661	Kacyiru Kamatamu near World Vision
RCN justice et Democracy	Justice	Central level.	cdm@rcn.rw/ cdm.rcn@gmail.com 0788301983	Gasabo Remera sector Rukili cell 1
Catholic relief Service	Health	Rulindo, Gakenke, Kamonyi, Muhanga	Crs_rw@crs.org 0788307256	Near by Ubumwe House KBC
Nibakure Children's Village	Social, Education, Health	BUGESERA(Nyamata	prosper@nibakure.org/ 0784576860	BUGESERA(Nyamata)
Fred Hollows	Health	Rubavu Gisenyi	fhf@hollows.org, bumure rwa@hollows.org, 078947 8020	Kicukiro centre near market
Anew begining	Education.	Musenye Nyagatare	Ngarambe.john@yahoo.com , 0788762904	Musenye karangazi
San francisco	Health	Kigali Nyarugenge	Salen5@emory.edu +25203233	Nyarugenge Ruegenge sector village Kiyovu
Care International	Sanitation marketion and supply chain development	Kayonza, Gatsibo, Buge sera, Rwamagana, Gicumbi, Rulindo, Gakenke, Burera, Musanze, Nyabihu, Rubavu, Karongi.	Navarajg.rw@co.care.org /care.rw@co.care.org 0788306241	Gasabo-Kacyiru-Urugwiro village Plot no 146

CHABHA	Social welfare	Gasabo ,Kicukiro,Bugesera	grace@chabha.org 0784110700	Gasabo,Kacyiru Kibaza ,Kabagari
Help A Child	Basic Education	Rulindo Ngoma	Malvern.chikanya@redeekind.nl, 0784118127	Kacyiru Gasabo District
Centre Culturel Islamique	Education and Health	Nyarugenge	Cci_kigali@yahoo.com 0788301964	Nyamirambo kivugiza
Clinton Health Acces Initiative	Health	Kigali City, Gatsibo, Kayonza, Kirehe	lufitinema@clintonfoundation.or , 0788308101	Kacyiru Sud (behind President's office)
Norwegian People Aids	Good governance	Central level, Nyarugenge, Gakenke, Musanze,Rulindo, Burera Kayonza, Bugesera,Gatsibo,Nyagatare, Kamonyi, Nyaruguru,Ngororero, Karongi	nparwanda@npaid.org; 078830 08 99	Kacyiru middle village Urugwiro and South African Embassy
ITOCA information training and outreach for Africa	Education	Central level	Itoca@itoca.org 0789222845	Kimironko Jabana gasabo
Ubuntu Edmonton	Social welfare	Gasabo	Alainrush07@gmail.com 0788438471	Gasabo Distrcit , Kimironko , Bibare Cell / Centre Cesar
Global Grassroots	Women empowerment	Kicukiro/Southern province	guwitonze@globalgrassroots;0788890401	Gasabo Remera Rukiri
Ruanda Stiftung	Education, Health	RULINDO	Nata.bknda@gmail.com Tel:0788503790	Gasabo district ,Jabana Sector, Karurama cell
Reborn Kyoto	Education(TVET)	Gasabo	yamahira@reborn-kyoto.org	Gasabo, Kinyinya Gacuriro
Handicap International	Mental Health	Kayonza,Muhanga Kamonyi,Musanze Ruahango,Gicumbi Rulindo,Gasabo Nyarugenge,Ritsiro Nyamasheke,Rubavu	direction@hi-rwanda.org 0788303203	Nyarugenge Kiyovu Rugunga

Concern world wide	Health	Gisagara Huye Nyamagabe Nyaruguru Rubavu	Alice.simington @concern.	Nyarugenge, Nyarugenge Nyarurembo
KAGENO	Education	Nyamasheke Rangiro sector	levi@kageno.org 0788 50 77 06	Nyamasheke, Rangiro, Banda Village.
CURE International	Health	Central Level	Esperance.uwizeye@cure internationala.org 0788 62 38 64	Gasabo, Kimironko Sector, Bibare Village
Human in Love Rwanda Branch	Education	Bugesera	jiheedorothy@gmail.com 07828 1 4866	Gasabo, Remera Sector
Spark	Capacity building in private sector		rwanda@spark-online.org 0788 38 25 81	Kacyiru, Kimihurura, Kamukina Cell, KG 5 /13
CIAT	Agriculture	Central Level	c.muhabenimana@cgiar. org	Kacyiru, Concorde Building
CBM	HEALTH/ eye treatment& physical impairments (disability)	Kayonza Muhanga	Eugeniemcbmi-nbo.org 0784730110	Gasabo Kimuhueura Rugando Rebero village Plot 677
IPA	Health, baseline survey, health outcomes ,community functioning activities.	RUSIZI,KICUKIRO,	kcox@poverty-action.org tel0787608757	Kicukiro,Niboye,Rwezamenyo
CCA	TRADE AND INDUSTRIE (Rwanda cooperatives)	MUHANGA,	usengimanaemma@yaho o.fr , el0788749071	Muhanga district, Nyamabuye Sector
ICCO	AGRICULTURE	Bugesera,Karongi,Ruha ngo,Nyanza	Esperance.Mukarugwiza @icco-cooperation.org	KACYIRU

			Tel:0788532061	
Breast Cancer Initiative East Africa	Health	Central Level	anrvisions@yahoo.com, evagara@yahoo.com Tel:0788484332	Gasabo, Nyarugenge , Nyamirambo
The Ihangane Project	Health	Gakenke	info@theihanganeproject.com, uwadelly@yahoo.com Tel:0788600050	Gakenke, Ruli
Isaro Foundation Rwanda	Education	Central level	rwanda@isarofoundation.org, Tel:0788403777	Gasabo ,Kacyiru
Fondazione Don Carlo Gnocchi	Health	Bugesera	mwumvaneza@libelo.it Tel :0788307736	Caritas Archidiocese de KIGALI
Institute For Reproductive health	Health	Gatsibo, Rusizi, Karongi ,Kamonyi	irhinfo@georgetown .edu	Nyarugenge
Health Volunteers Overseas	Health	Central Level	hvo.rwanda@gmail.com	Nyarugenge sector , Sugira cell
African Center for Education Research and Transformation	Education	Central Level	Chikadyke @gmail .com Tel:0784729666	Kicukiro, Gikondo, Mburabuturo
Heart& Hands	Health	Gasabo	Kms8046yu@hanmail.net, Tel :0784103840	2nd floor DELTA HOUSE, MUHIMA 5
ARCOS Net work	Environment	Burera, Rutsiro	info@arcosnetwork.org Tel:0788754615	Gasabo, Kimironko, Nyagatovu
RWANDA AID	Education	Nyamasheke, Rusizi	nyambojp@yahoo.fr, office@rwanda-aid.org Tel:0788649789	Rusizi, Kamembe

Rwanda Handbook of Economic and Social Policy

Since several decades the Swedish International Development Cooperation Agency (SIDA) has financed collaborative higher educational programs and research capacity building in a number of African countries. Collaboration between Jönköping International Business School, University of Rwanda and Addis Ababa University has resulted in research and publication of a number of academic books on poverty, well-being, entrepreneurship, management challenges, economic integration, and sustainable and inclusive growth and development in Africa. These studies contribute to an improved understanding of the process of economic policy making, development and growth and the challenges facing African countries in general and East African countries in particular.

A major policy challenge facing many African countries, in particular countries like Rwanda, is how to achieve sustained and higher rates of economic growth. In addition, this economic growth should help reduce the high poverty rates and be both socially and regionally inclusive and environmentally sustainable. Among the many challenges facing Rwanda are population growth, rapid urbanization, limited urban infrastructure, provision of services, low capacity and efficiency of institutions and the urgency in responding to climate change.

This volume is a collection of selected empirical studies on social and economic policy and practice to achieve economic growth and development in Rwanda. They shed lights on effectiveness of policies and practices in growth generation and poverty reduction in Rwanda.