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DETERMINANTS OF RWANDA'S TRADE PATTERN

By

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DECLARATION

I declare that this dissertation entitled **"Determinants of Rwanda's trade patterns"** is the product of my own work and has not been submitted for any academic degree at the University of Rwanda or any other educational institution.

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APPROVAL SHEET

This dissertation titled "**Determinants of Rwanda's trade patterns"** written and submitted by **MWIZERWA Jean Claude** in partial fulfilment of the requirements for the Master of Science degree in Data Science with a specialization in Econometrics, has been reviewed and accepted. The rate of plagiarism tested using Turnitin is 15 percent which is less than 20 percent accepted by the African Centre of Excellence in Data Science (ACE-DS).

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DEDICATION

This work is dedicated to my family members for their unwavering support, especially my wife, MUREKATETE Pacifique, and my children, throughout the research process. It is also dedicated to my sisters, my mother, my relatives, my friends, and my colleagues.

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Abstract

Trade plays 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 conduct a study for better understanding the determinants of Rwanda's trade pattern with the rest of the world. This study was conducted using the gravity model which is designated to study the force of attraction between two objects with the assumption that this force is positively related to their mass and inversely related to the distance between them.

This study focused on five specific objectives, which are to assess the impact of the economic size or mass (GDP) on Rwanda's trade pattern; to assess how geographical distance between Rwanda and its trading partners affects Rwanda's trade pattern; to measure the effect of exchange rate on Rwanda's trade pattern; to examine how partner trade population size affect Rwanda's trade pattern, and to assess if trade agreements or common border are significantly influencing Rwanda's trade pattern. The analysis was done using STATA, while data were collected from World Bank Development Indicators dataset, National Institute of Statistics of Rwanda (NISR), National Bank of Rwanda (NBR) and data of distance collected from distancefromto.net.

Findings of this study show that Rwanda's trade pattern is positively correlated with the size of the economy of Rwanda as well as that of its trading partners, Rwanda's exchange rate and integration in trade agreements while trade is negatively correlated with the distance between Rwanda and its trading partners and the population size in trading partners.

Based on these results the study gives several recommendations for improving Rwanda's trade.

Keywords: Trade pattern, Economic mass, Economic size, Distance, Gravity model, Rwanda.

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CHAPTER ONE
GENERAL INTRODUCTION

1.1. Overview

This is a study on the determinants of Rwanda's trade pattern. This chapter presents the background of the study, statement of problem, research objectives, research questions and scope of the study.

1.2. Background

After the 1994 Genocide against the Tutsi, Rwanda, despite being a resource-poor landlocked country, achieved remarkable economic growth. Unlike many other post-conflict nations, Rwanda restored macroeconomic stability and sustained growth rates of 5 to 6 percent, though the inflation remained relatively high. This growth was driven by public investment that resulted in higher quality infrastructure compared to much of sub-Saharan Africa, alongside targeted financial and law reforms that enhanced trade, diversified the economy, and boosted agricultural productivity. (Enrique, G.; Deléchat, C.; Jacoby, U.; Pani, M.; Hussain, M.; Ramirez, G.; Xu, R.; Fuli, E.; Mulaj, 2015; IMF, 2019; Lledo, 2021)

This places Rwanda among emerging countries that have achieved significant and sustained economic growth over the last two decades. Throughout the process, Rwanda has used international trade agreements to expose its goods and services globally, with exports and imports playing a critical role in economic growth and development. These trade activities help in the achievement of the country's socioeconomic goals, such as increasing capital availability, constructing physical capital, creating jobs, improving production

capacity, and integrating the domestic economy with the global economy. This study provides an assessment of the determinants of Rwanda's trade pattern.

After the 1994 genocide against the Tutsi, Rwanda's economy was in a catastrophic state, but the country has re-established itself and is now considered as one of the top leading economies in East Africa. Strategies to achieve this included promoting exports of traditional products like coffee, tea, and minerals, supported by various policies to boost exports. One such policy is the Made in Rwanda (MIR) initiative, launched in 2017 to reduce import reliance, promote local manufacturing, and create job opportunities (MINICOM, 2017).The MIR initiative together with the ambition of the country to improve its infrastructure in the process of attracting investors let to increase in imports of capital goods, and raw materials for processing, thus a general increase in total imports of the country. There has also been a downturn in global economic growth in recent years due to a variety of issues, including a rise in geopolitical wars in several emerging nations, which has resulted in higher energy prices and higher long-term interest rates. The Rwandan government has worked hard to put in place policies that encourage exports (BNR, 2018).

In 2019, Rwanda saw a significant increase in its exports, with goods valued at US dollar 1,231.8 million — more than five times their value in 2010 and almost eighteen times their value in 2000. In the same year, imports amounted to US dollar 2,704.6 million, over three times their value in 2010 and nearly twenty-eight times compared to 2000. The turnover from services was comparatively smaller, with exports totaling US dollar 1,015 million and imports were worth US dollar 1,032.4 million in 2019. Despite these trade activities, Rwanda has experienced persistent trade deficit exceeding US dollar 1.5 billion in 2019, representing over 17 percent of its GDP (BOP, 2018). Due to its small share of global

exports and imports of goods, Rwanda's impact on the global market is limited, resulting in minimal bargaining power, necessitating careful selection of trade partners. The country also exhibits a high level of export concentration, with a narrow range of export products compared to other regional countries. In 2015, the concentration stood at 0.30 percent, down from 0.49 percent in 2001, with only a few regional countries, such as Zambia, Somalia, or Malawi, showing higher export concentration ratios (Cieślik & Goczek, 2018). Despite these challenges, trade openness remains key for Rwanda's economic development, providing access to foreign exchange necessary for improving productivity and expanding the export basket (UNCTAD, 2019).

In addressing the challenges to achieving its development targets, Rwanda has identified export growth and foreign direct investment as key drivers of income growth through enhanced productivity. The Made in Rwanda (MIR) initiative, aligned with the National Strategy for Transformation (NST1), aims to overcome quality and competitiveness constraints while promoting sustainable consumption of Rwandan products, focusing on high-value goods and services with a target of 17 percent annual export growth. With one of the world's highest population densities and rapid urbanization, there is a pressing need for increased investments in infrastructure, housing, and public services. Despite around 80 percent of Rwanda's population being engaged in agriculture, the average farm size is shrinking, necessitating the creation of approximately 200,000 jobs annually to support the growing population and reduce pressure on rural lands (Behuria, 2017).

The COVID-19 pandemic has significantly impacted the global development landscape, plunging the world into recession and exacerbating inequalities, particularly in low-income and developing countries, including sub-Saharan Africa (Lledo, 2021). Rwanda, which had strong macroeconomic fundamentals before the pandemic, experienced a 3.4 percent

contraction in GDP due to the pandemic's effects, especially in the tourism sector and trade in services. However, trade in goods like coffee, tea, and minerals saw growth due to global price recovery (IMF, 2019).

In 2021, Rwanda demonstrated remarkable resilience, rebounding strongly with a GDP growth rate of 10.9% driven by improvements across agriculture, industry, and services, supported by eased mobility restrictions that supported widespread economic activity throughout the year. Domestic demand was a key driver of growth, boosted by eased mobility restrictions, which stimulated private consumption and government expenditure. Additionally, investment showed robust recovery, especially in urban infrastructure projects such as road developments in Kigali and secondary cities. Despite these positive developments, challenges persisted in the labour market, with depressed employment levels, declining labour force participation rates, and notably higher unemployment rates, underscoring ongoing economic recovery efforts.(Worldbank, 2022)

1.3. Problem Statement

Due to decreasing global commodity prices, the world economy has been substantially less advantageous for Rwandan trade in the recent decade, negatively impacting the country's terms of trade. Export prices have declined by 17.4 percent for the country’s main exports products between 2011 and 2019, while the decline was 8.8 percent for coffee and tea. On the other hand, the country’s imports have continued to rise, such that imports of goods are now roughly twice the size of exports, the current account deficit remains large (World Trade Organization, 2019)

To overcome this continuous decline of Rwanda's trade balance, Rwanda has promoted the manufacturing sector through the Made in Rwanda (MIR) initiative launched in 2017, aiming to diversify the economy. Despite these efforts, this sector remains underdeveloped, contributing an average of only 17 percent of GDP between 2000 and 2022 and relying heavily on food processing. Despite the agricultural intensification program's ongoing execution, weather circumstances continue to play a big role to the country's harvest, indirectly influencing the industrial production and the export of Rwanda. Poor agricultural yields in fiscal years 2013-14, 2016-17, and 2019-20 led to underperformance in the economy and the manufacturing sector (NISR, 2023).

The balance of payments deficit increased by 5.2 percent to US$62.6 million at the end of FY 2017-18, primarily due to a decline in mineral exports and an increase in energy imports. The decrease in mineral exports negatively impacted the volume of exported goods in 2018. During the same period, imports from EAC countries increased by approximately 10 percent due to reduced import tariffs, non-tariff barriers, and more efficient border controls, while exports to EAC declined significantly to 44 percent. Intra-EAC trade is also impacted by the low level of competition, as most member states predominantly trade in primary and low-tech manufacturing products (Winfred Atieno, 2017). Despite its trade deficit, Rwanda maintains a stable macroeconomic framework, though infrastructure inadequacies and limited labor force expertise remain significant challenges (WorldBank, 2011).

Since 2000, Rwanda has prioritized increasing exports and attracting foreign direct investment, driving significant growth in goods and services exports, largely influenced by rising commodity prices until 2014. In the current context of flat commodity prices and slow global growth, Rwanda faces challenges in achieving its growth goals, necessitating

a thorough analysis of the relationship between international trade and the Rwandan economy, as well as the factors influencing the selection of trade partners to understand the determinants of Rwanda's trade pattern.

1.4. Research objectives

This study focuses on the following main objective and specific objectives.

1.4.1. General Objective

The general objective of this thesis is to assess the determinants of Rwanda's trade pattern.

1.4.2. Specific objectives

The specific objectives of the study are:

1) To evaluate the influence of economic size (GDP) on Rwanda's trade pattern.
2) To analyze the impact of distance on Rwanda's trade pattern.
3) To examine the effects of exchange rate fluctuations on Rwanda's trade pattern.
4) To assess the role of trading partners' population size in shaping Rwanda's trade pattern.
5) To investigate the significance of trade agreements in influencing Rwanda's trade pattern.

1.5. Research questions

From the specific objectives, this study aims at finding answers to the following questions:

1) To what extent the economics size or mass of Rwanda as well as that of its trade partners influence Rwanda's trade pattern?

2) To what extent is Rwanda’s trade pattern affected by the distance to its trading partners?
3) How is Rwanda’s trade pattern influenced by the exchange rate fluctuation?
4) How does the population size of trading partners affect Rwanda’s trade pattern?
5) Do trade agreements and common borders significantly shape Rwanda’s trade pattern?

1.6. Scope of the research

This research covers Rwanda and its trading partners, examining the fluctuations in Rwanda's trade with other countries over time as a crucial aspect. The analysis focuses on Rwanda's trading patterns with its trading partners using panel data for sixty-three countries for the period 2000 to 2022 allowing for the analysis of both individual countries and time effects. Independent variables include economic indicators such as GDP, population, exchange rate, distance between economies, and a dummy variable for trade agreements and common border, while Rwanda's trade serves as the dependent variable. 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.

1.7. Organization of the Research

This research is divided into five chapters: Chapter one is a general introduction, and it is composed of the background of the study, Statement of the problem, Objectives of the study, Research questions and the Scope of the study. Chapter two presents the literature in relation to the topic under study, this chapter deals with the definition of key concept, theoretical Reviews, conceptual framework, critical Reviews, and partial Conclusion. Chapter three briefly highlights the various research methods; simply this chapter indicates

the model specification, and data analysis methods. Chapter four presents the data analysis and interpretation of the results. It shows the index of data analysis in a scientific way and various tools such as tables, graphs, charts, maps etc. Chapter five includes summary of findings, conclusion, and recommendations. The researcher analyzes and interprets summarized findings using known practices against elaborated research questions. Conclusions will be based on the research findings and analysis done, and then possible implications are also indicated. Finally, the research provides recommendations on what should be done to boost economic growth as well as international trade.

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

This chapter provides a description of key concepts, a review of existing issues that have been explored and studied by different authors about the topic. It is primarily centered on views points taken from books, the internet, reports, tables etc. This chapter includes the following sections: definition of key concepts, Theoretical review, empirical literature review, conceptual framework, critical review, critiques of existing literature, and the research gaps.

2.2. Definition of Key Concepts

2.2.1. Economic growth

Economic growth is the increase in the market value of the goods and services produced by an economy over time. It is conventionally measured as the percent rate of increase in real gross domestic product, or real GDP, of more importance is the growth of the ratio of GDP to population. An increase in growth caused by more efficient use of inputs is referred to as intensive growth. GDP growth caused only by increases in inputs such as capital, population or territory is called extensive growth (Mura et al., 2011).

2.2.2. Exchange rate

An exchange rate is the cost of one currency stated against a basket of currencies or in terms of another currency. According to Kabayiza et al. (2019), the foreign exchange market's dynamics of supply and demand influence rates in a floating exchange rate regime.

2.2.3. Population

A population is a discrete group of individuals, be it a nation or a group of people with a shared characteristic. The set of individuals from which a statistical sample is drawn for statistical research is known as a population. Accordingly, a population can be described as a collection of individuals who are connected by a shared attribute (Rigg & Miller, 1991).

2.2.4. Distance

The numerical representation of the separation between two items or locations is called a distance measurement. Distance can be defined as a physical length or as an approximation based on additional physics-related criteria or customary usage (Plotkin, 2007).

2.2.5. Gravity Modeling

The way that Newtonian physics defines the gravitational pull is comparable to the gravity model for trade. According to the model, the amount of trade that occurs between two countries is directly proportionate to their economic mass (national income) and inversely correlated with their distance from one another. (Chaney, 2013)

2.3. Theoretical Review

In this sub-section the researcher focuses on different theories related to trade. It includes classical theory of trade which comprises Conventional theory, Leontief Paradox Theory, and the Theory of Comparative Advantage in international trade (Klein, 1996).

2.3.1. Classical Theory of Trade (Conventional Theory)

The foundation of conventional trade theory is the factor proportions theory of the Heckscher-Ohlin model and its extensions, which is based on general equilibrium models and their associated assumptions. Classical theories of trade, most notably the Ricardian model, have stressed international differences in technology and real wage levels, focussing on differences in factor productivity. Neoclassical developments in trade theories, however, emphasise distinctions not in factor productivity but in factor endowments.

Key assumptions of this theory include perfect competition, concave (or quasi-concave) and constant-returns-to-scale production functions, as well as well-behaved and homothetic preference functions. Additional theorems associated with the conventional theory include the factor equalization theorem, the Stolper-Samuelson theorem regarding gains from protected import-

competing sectors, and the Rybczynski theorem concerning the expansion or contraction of sectors based on factor abundance or scarcity.

Critiques of the conventional trade theory have arisen on methodological and empirical grounds. Methodological criticisms have often emerged from non-neoclassical formulations, such as evolutionary theory, while challenges to the empirical validity of the model have been raised from both within and outside the neoclassical framework. The first empirical test of the Heckscher-Ohlin model was conducted by Leontief in 1953, utilizing input-output analysis. Leontief discovered that the US was a net exporter of labor-intensive goods and a net importer of capital-intensive goods, a finding that became known as the "Leontief paradox." Despite not invalidating the H-O model, this outcome sparked significant debate and led to attempts to reinterpret the results. However, there is growing recognition that the conventional trade theory is inadequate in explaining real-world phenomena. (P. R. Krugman, 1985)

The explanatory and predictive capabilities of the conventional trade theory have faced criticism from both within and outside the neoclassical analytical framework. Several factors have contributed to the reassessment of the efficacy of this theory, including changes in international trade, shifts in the roles and competitive positions of countries in the global economy (e.g., the US and Japan), and evolving perspectives in the field of economics, particularly concerning industrial structure and competition analysis (e.g., incorporation of tools from industrial organization).

2.3.2. Leontief Paradox Theory

In economics, the Leontief paradox states that a country with more capital per worker has a lower capital/labor ratio in exports than in imports. Wassily W. Leontief's attempt to empirically test the Heckscher–Ohlin theory ("H–O theory") yielded this econometric finding. In 1953, Leontief discovered that, contrary to H–O theory, the United States—the world's most capital-abundant country—exported commodities that were more labor-intensive than capital-intensive. The validity of the Heckscher–Ohlin theorem (H–O) hypothesis, which predicted that trade patterns would be based on countries' comparative advantage in key components of production, was questioned by many economists due to Leontief's paradox (such as capital and labor). Many

economists have discarded the H–O theory in favor of a more Ricardian model based on technical differences. According to these economists, the United States has a competitive advantage in highly skilled workers rather than capital. This might be interpreted as a broader definition of "capital," which includes human capital. Using this definition, the exports of the United States are very (human) capital-intensive, and not particularly intensive in (unskilled) labor.

2.3.3. Theory of Comparative Advantage in international trade (Heckscher-Ohlin Theory)

Heckscher-Ohlin theory, in economics, a theory of comparative advantage in international trade according to which countries in which capital is relatively plentiful and labor relatively scarce will tend to export capital-intensive products and import labor-intensive products, while countries in which labor is relatively plentiful and capital relatively scarce will tend to export labor-intensive products and import capital-intensive products. This theory, developed by Swedish economist Bertil Ohlin (1899–1979) based on the groundwork of his teacher Eli Filip Heckscher (Samuelson, 1981).

Some countries are relatively well-endowed with capital: the typical worker has plenty of machinery and equipment to assist with the work. In such countries, wage rates generally are high; as a result, the costs of producing labor-intensive goods—such as textiles, sporting goods, and simple consumer electronics—tend to be more expensive than in countries with plentiful labor and low wage rates. On the other hand, goods requiring much capital and only a little labor (automobiles and chemicals, for example) tend to be relatively inexpensive in countries with plentiful and cheap capital. Thus, countries with abundant capital should generally be able to produce capital-intensive goods relatively inexpensively, exporting them to pay for imports of labor-intensive goods.

2.3.4. Gravity Approach in International Trade

There has been a notable surge in studying the determinants of international trade using gravity models. Gravity models can be theoretically derived from different classes of trade theories, including factor-endowment theories (Deardorff, 2010), home preferences (Anderson, 2014; Deardorff, 2010; Groizard et al., 2014; Wincoop, 2003), increasing returns to scale (Evenett &

Keller, 2002; E. H. and P. Krugman, 1987), incomplete specialization models (Cieślik & Goczek, 2018) and a micro-founded general equilibrium framework (Jacks et al., 2010). Empirical applications include the study of trade protection (Harrigan, 1993), exchange rate variability (Chit et al., 2011; J. Frankel & Wei, 1993), currency unions (J. A. Frankel & Rose, 2005), regional versus multilateral trade agreements (Cipollina & Salvatici, 2019; Lmaurice & Wvinters, 2003; Subramanian A. & Wei, 2007), home bias (John Whalley, 2006), democracy (Jerome et al., 2009; Yu et al., 2010), corruption (Musila, 2013), development aid (Vollmer et al., 2009), cultural specificities (Felbermayr & Toubal, 2010; Tadesse & White, 2010) and institutional reforms and their impact on trade (Babetskaia-Kukharchuk & Maurel, 2004).

A basic analytical model for analyzing bilateral trade flows between geographical entities is the gravity equation. The gravity model for trade is similar to the function of Newtonian physics that defines the gravity force. The model defines the trade flow between a pair of countries as being proportional and inversely proportional to their economic mass (national income) to the distance between them.

This research has highlighted several specification and estimation issues. (Wincoop, 2003) derive a theoretical gravity equation and show that it is important to include country-specific trade resistance terms if unbiased coefficients are to be obtained. The researcher chooses a gravity equation with country-specific dummies to represent country-specific trade resistance. In explaining bilateral trade intensity, one approach would be to define variables for each of the obstacles to trade and to introduce these directly in a regression of the ratio of trade to GDP. The introduction of regional dummies could then illustrate whether transition economies show a degree of openness that is significantly different from that in other regions when these obstacles are accounted for. This is essentially the approach followed by (Lev Freinkman, Evgeny Polykov, 2004). However, the trade barriers and transport and transit obstacles faced by traders depend very much on the trade route chosen and on the trading partner for the specific transaction. An aggregation to the level of a country's total trade misses this important variation.6 A gravity model explains the degree of bilateral trade between two countries, taking into account their location relative to each other, the nature of the trade route (e.g. how many borders need to be crossed, or

how good the transport infrastructure is) and trade policies and institutional quality in both the home and the sending country. This is the approach pursued in this study.

2.4. Empirical Literature Review

An empirical literature review is more commonly called a systematic literature review, and it examines past empirical studies related to the research topic. In this study, it focuses on reviews related to economic growth and trade, Geography, Distance and trade, Population growth and trade promotion, Exchange rate and Trade and Trade Agreement and trade policies.

2.4.1. Economic Growth and Trade

Many researchers and economic policymakers have studied the relationship between economic growth and trade. These studies mostly concentrate on the foreign sector, especially the relationship between GDP growth, imports, and exports. Historically, proponents of mercantilism claimed that trade surpluses were the only source of profit for a nation involved in international trade. However, more recent studies have placed an emphasis on variables like GDP, since higher-income economies are more likely to specialize and differentiate their products, which affects trade flows between countries. (Edmonds & Fujimura, 2006).

The theory underlying these analyses can be divided into two streams: the first focusses on how trade contributes to economic growth, and the second examines the causal relationship between trade and growth to determine whether trade influences economic growth or the other way around (Rodriguez & Rodrik, 2000).

Schneider, 2009, 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 specialisation for domestic producers as they are exposed to foreign markets where they meet several foreign firms and where the demand is large, which increases their production capacities. International trade also helps domestic producers to access innovative capital inputs so they can increase productivity, such as machine equipment.

Thus, discussing economic development and growth requires an understanding of commerce. Some models have attempted to link various channels of international trade with economic growth, such as endogenous growth models (Schneider, 2009). Marin (1992) asserts that nations that export a significant portion of their GDP grow more quickly than those that do not. Increases in exports stimulate the economy as a whole through externalities like technical spillovers.

Bhagwati (1988) argues that more trade leads to higher incomes, and higher incomes encourage more trade. The "virtuous circle" that results from the causal relationship between production variables and the degree of production that leads to exports is highlighted by the neoclassical trade theory. Also observing this kind of feedback is (Grossman & Helpman, 1990). (Marin, 1992) provide evidence of growth-driven exports in their study on Austria.

Oxley, 1993, examined the relationship between exports and economic growth in Portugal and found no evidence to support the idea that higher exports impacted GDP. Growth in exports is frequently cited as a key factor influencing an economy's ability to produce and create jobs. This "export-led growth" (ELG) idea is supported by (Balassa, 1978).

First, an increase in exports stimulates growth in both output and employment thanks to the international trade multiplier. Second, an economy's capacity to produce can be increased by importing capital goods thanks to the foreign exchange made accessible by growing exports. Third, economies of scale and a faster rate of technological advancement in production are brought about by the size and competitiveness of export markets. Because export growth and openness to international markets generate positive externalities, they are considered important factors in determining economic growth. Once the significance of trade in a nation's economic development was realised, nations started to lower trade restrictions and regulations pertaining to other economic operations in order to facilitate trade and accelerate economic progress.

According to Robert and John (2004), alterations in supply conditions ultimately impact output, export and import quantities, and trade terms by interacting with demand conditions both domestically and internationally. Additionally, it has been proposed that increasing output causes exports to increase (Woo S. Jung, 1985).

In this research, the gravity equation was used. 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 et al., 2005). This model has earlier been used for analyzing the causative factors of trade flows between Rwanda and its main trading partners.

According to Giovani (1998), a gravity model exhibits a relationship between the GDP levels of two nations and the volume of commerce that falls with increasing geographical distance. Economically stronger nations typically engage in greater absolute trade, and distance has a detrimental impact on bilateral trade by raising transportation costs. According to the gravity equation, the GDPs of the two nations are directly multiplied in bilateral commerce. As a result, commerce between larger and more similar-sized nations is more common in larger nations. It is known from Tinbergen's (1962b) work that this equation has good empirical performance.

2.4.2. Geography, Distance and Trade

A landlocked nation's ability to conduct business is restricted, and it becomes dependent on the transit nations (Rica & Salvador, 2015). As a result, the nation's ability to regulate the location, extent, and calibre of its transportation infrastructure to facilitate trade is limited. Nor are the laws and rules governing the logistics and transportation industries. The transit states must be consulted on these, and the results may differ from what the landlocked nation would have selected. Political and financial incentives may also exist for transit countries to levy costs on landlocked nations.

Trade obstacles, transaction costs, and transit expenses are examples of barriers and frictions that need be taken into account in addition to the factors that determine trade. These barriers manifest as a divergence between domestic and foreign prices, as demonstrated by Leamer (1984). The Heckscher-Ohlin-Vanek model is enhanced by (Bernstein & Weinstein, 1998) by incorporating a trade cost measure using a gravity equation. The majority of trade models that take into account transportation costs, or "iceberg costs," opine that these expenses are commensurate with the cost of the transferred commodity (Samuelson, 1954). The relative prices of items are not affected by

transportation costs; rather, they create a wedge between origin and destination prices. As a result, increased transportation costs lower trade volume without necessarily altering trade composition.

A large number of crucial factors can have an impact on transportation costs. They comprise the physical characteristics of the nations, the amount and calibre of the physical infrastructure supporting transportation services, the protocols and laws governing the transfer of goods between nations, the level of competition in the transportation industry, the rate of technological advancements in the field, and the price of fuel (Rica & Salvador, 2015). Transport expenses are also influenced by the properties of the goods being shipped. The gravity model is used in a number of studies, such as the one on Singapore by Blomqvist & Palme (2020), to highlight the impact of geographic distance on trade. They claim that factors influencing cross-border trade include population, proximity to trading partners, and cultural differences. Most economists have investigated the negative relationship between geographic distance and bilateral commerce (E. E. Leamer & Levinsohn, 1995), although it is unclear what information exactly is in the distance coefficients. According to (Filippini & Molini, 2003), geography had less of an impact on trade than distance did. They went on to say that social interactions, language, and culture have all influenced trade between trading partners throughout history. These results show that the variables' inclusion of distance described the factors influencing trade flows between nations, and that trade declines sharply with distance, as noted by (Heckman & Leamer, 2007) in his evaluation of Krugman's study.

Furthermore, (P. Krugman, 2000) believes that a key factor determining the choice of geographic trading partners is the distance between two countries. He discovered that when trading partners are spread apart geographically, there is a decrease in bilateral trade volume due to high trade expenses. Supporting evidence for this idea (Papazoglou et al., 2006) also suggests that trade between two trading partners will decrease with increasing distance. Furthermore, even & Röller (1991) and Jacquemin & Saqir (1988) confirm that the volume of foreign trade and transportation costs are negatively correlated, emphasising that higher transportation costs lead to lower trade.

Blum & Goldfarb, 2006, came to the conclusion that trade was impacted by distance even in free trade zones after studying the impacts of distance on trade. According to (J. A. Frankel & Rose, 2000) and (Clark & Bjornstad, 2004), a nation's distance from its trading partner will have a detrimental impact on bilateral trade between the two. (Tinbergen, 1962a) used the gravity model to investigate the connection between bilateral trade and distance. His findings demonstrate that trade between nations was adversely impacted by distance.

According to (Berthelon & Freund, 2004), the global distance coefficient is raised by differences in the distance coefficients between industries.

2.4.3. Population Growth and Trade

Population variations have been studied globally, and the results suggest that these variations may have a role in the differences in trade and comparative advantage. A country with a low rate of population increase is capital-rich, whereas a country with a high rate of population growth is labor-rich in the long run, according to certain theoretical study (Rica & Salvador, 2015). This is in line with research by De Ferranti et al. (2002), which demonstrates that trade growth is influenced by a number of factors, including population increase. As per Nuroglu (2014), the populations of trading partners can be incorporated into the gravity model to observe the impact of population fluctuations on bilateral trade flows between nations. An increasing population might be viewed as an increased import market. The outcome will have an effect on the whole of commerce. Higher GDP per capita, however, also corresponds to a higher demand for distinctive goods, which raises import levels. Economic growth can be positively or negatively impacted by population growth. According to Todaro (1994), larger populations provide the aggregate demand (the "size" impact) required to generate favourable manufacturing economies of scale, reduced production costs, and a sufficient labour supply to achieve higher output levels. Moreover, the contribution of human capital yields advantageous outcomes from population growth. However, if investment is decreased due to the younger generation's dependence on the population, population growth could be harmful to economic growth. The basic gravity model can be extended to incorporate the populations of exporting and importing countries in order to study how population impacts bilateral trade flows between two countries.

By creating advantages from specialization, population growth is said to increase trade and the level of specialization (Matyas, 1997). On the other hand, (Bergstrand, 1989) found that GDP per capita had a positive effect, suggesting a negative correlation between trade flows and population and a capital-intensive process for producing imports and exports. Short-term trade flows might be benefited by a quicker rate of population expansion since it would lead to a larger labor force, more specialization, and more exportable goods. However, as time goes on, a growing number of individuals likely to have lower incomes per capita, which makes everyone in the world poorer and could cause output and exports to drop. Moreover, imports decline in countries with low GDP per capita.

2.4.4. Exchange Rate and Trade

Another factor that numerous theorists contend ought to affect the amount of international trade is the exchange rate. Many academics have examined how exchange rate volatility impacts international trade using two methodologies. The first approach does not support the second approach's claim that exchange rate uncertainty and volatility affect business. The amount of trade between the US, Germany, France, Japan, and the UK was studied by Gotur (1985); the impact of exchange rate uncertainty on the volume of US-German trade was investigated by Hooper & Kohlhagen (1978). The findings of both studies demonstrate that the economy was not significantly impacted by the exchange rate.

According to a similar conclusion, most of the study on the relationship between a change in exchange rate and trade volume supported the earlier claim, even though it did not establish the association did not exist. Recent evidence supporting this view came from the discovery (Hooper & Kohlhagen, 1978) that exchange rate uncertainty had no appreciable effect on business.

As to Éthier (1973), any ambiguity regarding the exchange rate in the future has an adverse effect on trade volume. An investigation of 14 bilateral trade flows between highly industrialized nations by Cushman (1985) demonstrated a notable negative effect of exchange rates on trade. Additionally, it was found that trade and exchange rates were negatively correlated (Akhtar & Hilton, 1984).

Analysis of the effects of changes in actual exchange rates on trade volume showed that an increase in exchange rates reduced trade volume. Research is conducted to find out if trading partners' proximity to one another affects a change in exchange rates. (De Grauwe, 1987) conducted research on trade among members of the European Economic Community for the years 1960–1969 and 1973–1984 and found a negative link between exchange rates and bilateral commerce. Furthermore, (Lane & Milesi-Ferretti, 2002) looked at how exchange rate volatility affected trade and concluded that trade would profit if the real exchange rate declined.

2.4.5. Trade Agreements and Trade Policies

The concept of trade creation and trade diversion, along with the impact of a custom union, was initially introduced by Viner (1950). Viner noted that the potential benefits or drawbacks of regional trade agreements for participating countries were contingent upon the degree to which trade arrangements engendered trade creation and trade diversion. commerce diversion is the movement of commerce from a more efficient (or less expensive) foreign producer to less efficient producers inside the trading bloc, whereas trade creation is the movement of trade inside the trade arrangement from more expensive to less expensive manufacturers.

If members facilitate a more competitive and complementary trading environment, regional integration will become more intriguing. Large cost differences in the items they produce, initially high tariffs between partner states and low tariffs for the outside world, and highly elastic demand and supply curves are the main areas they can concentrate on to build an enabling environment. Based on their answers to targeted surveys, producers and consumers can be successfully targeted if the topic is handled appropriately. The benefits of these agreements can be increased by adding more regional participants; that is, the more trading partners, the greater the potential for traded goods following integration.

Upon examining these variables and their interactions within the East African Community (EAC), one is forced to conclude that the overall impact is either unknown or not very significant. Since the EAC economies do not act to promote trade within the union, they cannot be classified as competitive or complementing economies. Despite the fact that there are now five member

countries instead of the previous three, the impact of this growth is not apparent. Furthermore, there hasn't been much progress made by regional integration's effects on commerce development and diversion.

Dynamic consequences, on the other hand, include reduced monopolies, economies of scale, specialization, increased investment levels, and better earnings from factor mobility in a competitive market. But the main objective of our research is to examine the static impacts of EAC. The two main theoretical underpinnings of this research are the Viner, 1950) model of trade creation and diversion effects and the Ricardian models of comparative advantage. Lastly, it also depends on the "politics of free trade agreements (FTA)" perspective of Grossman & Helpman (1990). Similar to the model that is utilized, in their theoretical political-economy study, two governments form a free trade agreement (FTA) when there are significant economic welfare gains for the typical voter in each nation. Trade liberalization and open borders have long been supported by the canonical literature on international trade, which maintains that everyone benefits from open borders provided appropriate compensation plans are put in place (E. H. and P. 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 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 (Ancharaz, 2009) is that the formation of RTAs has resulted in an increase in intraregional 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. (Blanchard, 2010) 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 influenced 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.

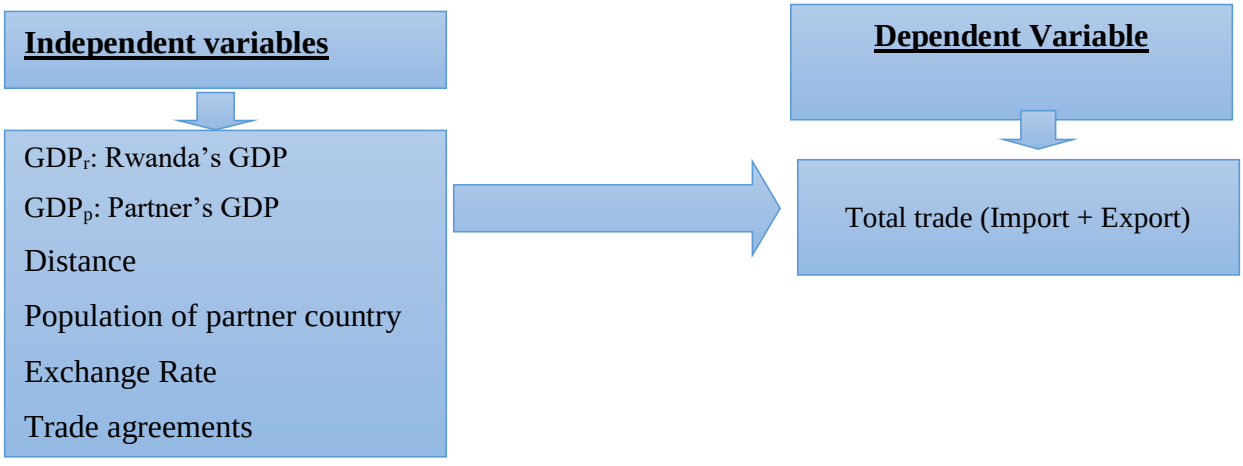
Since the 1990s, several countries in Africa have worked hard to open up their economies to external competition through trade liberalization. Many RTAs have been signed to achieve this. According to WTO, the African continent had 30 RTAs. Trade agreements are projected to nurture trade and investment 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.

The welfare impact of RTAs is contingent upon their economic effects—that is, whether they will increase or decrease commerce among the member nations (Viner 1950). As a result, joining an RTA has an influence on the economy that is both beneficial and bad; therefore, the net impact is what defines the total effect. RTAs do, however, have ambiguous welfare benefits for both the member states and the global community (Jayasinghe & Sarker, 2008). According to (Bhagwati, 1988), there are two schools of thought about RTAs. The effects can also be skewed by locational or regional considerations. This will become clearer with time and additional research. Customers can travel overseas and take advantage of opportunities to purchase goods from international companies in addition to expanding their interests and making domestic purchases. Domestic producers may benefit from rivals in overseas markets in addition to selling to domestic consumers. However, this market development may cause domestic companies who shift from the domestic to international markets to lose their current clientele (Shackmurove, 2004).

2.5. Conceptual Framework

Below are indicated independent and depending on variables included in the research topic determinants of Rwanda's trade pattern.

Figure 1: Conceptual Framework



2.6. Critical Review

The approach adopted by the critics is basically one of analyzing the outcomes and trade implications of behavior of firms operating in conditions which fall short of the ideals of perfect competition (monopolistic competition, imperfect competition, presence of increasing returns to scale). Much of the literature in this category represents sympathetic attempts to relax the basic assumptions of the H-O model and test its robustness (Kierzkowski, 1987). In this context, monopolistic competition and other forms of imperfect competition have come to be central to the literature on trade theory largely reflecting the persistence of intra-industry trade. At one extreme there are those who equate countries to single firms and analyze the oligopolistic interactions and attempt to link the instruments and concepts of industrial organization and the general equilibrium model (Caves, 1998; P. R. Krugman, 1987). Other approaches have tried to formalize equilibrium trade patterns with endogenous technological change and monopolistic competition in the innovative intermediate inputs (Ethier, 1973; Grossman & Helpman, 1990)

For the case of Rwanda, (Umutesi, 2018) conducted a study titled "Analysis of the Causative Factors of Trade Flows between Rwanda and its Main Trading Partners." The primary objective of her research was to identify the factors influencing trade flows between Rwanda and its principal trading partners, while also examining the potential for trade expansion between Rwanda and these countries. Umutesi employed the gravity model and utilized data from six countries covering the years 2000 to 2015. Her focus was specifically on the territory of the East African Community and two primary trading partners, namely China and Belgium. However, expanding the scope to include additional trading partners and distinguishing between imports and exports could offer more comprehensive insights. The data utilized in her study represented 31.8 percent of total trade, with only 15.2 percent attributed to China. Therefore, there is a necessity for research employing larger-scale data to provide a more representative depiction of countries and a broader timeframe.

2.7. Research gap

This study is analyzing the determinant of Rwanda's trade pattern. While similar research has been conducted worldwide, Rwanda has received relatively little attention in this regard. Previous studies on Rwanda have explored trade patterns with a limited number of partners, with recommendations for further investigation involving a broader range of trading partners. Trade patterns can be analyzed from geographical and commodity perspectives, with this study specifically focusing on the gravitational theory aspect.

In line with the previous studies conducted for the case of Rwanda, the study Trade Policies and Their Impact, carried out in 2016 by NISR and the Ministry of Trade and Industry, this study looked at how trade policies affected Rwanda's trade performance, with an emphasis on tariffs, non-tariff trade obstacles, and trade liberalization. It emphasized the changes in Rwanda's trade policy throughout time and their effects on patterns and volumes of trade. Rwanda's Integration into the East African Community (EAC): Implications for Trade Patterns was a 2017 study done by the EAC Secretariat. The incorporation of Rwanda into the EAC and its effects on trade patterns were the main subjects of this study. It examined how imports and exports changed over time and determined which important commodities were impacted by regional integration. The World Bank carried out an analysis of Rwanda's export diversification and economic growth in 2015. The study examined the connection between Rwanda's economic expansion and export diversification. It emphasized the necessity for Rwanda to broaden its export base beyond conventional agricultural exports and investigated the possibilities for launching new export industries like manufacturing, services, and mining.

However, further exploration of the commodity aspect remains necessary. Recent analysis of trade determinants has introduced the concept of offshoring, where developed economies relocate low-skilled production tasks to countries with lower wages, impacting global trade patterns. Neither this study nor previous ones have addressed this issue. Therefore, this research contributes to understanding Rwanda's trade determinants with the rest of the world by examining the effects of economic mass, distance, population, exchange rates, and trade agreements using the Gravity Model.

CHAPTER THREE:
METHODOLOGY

3.1. Introduction

Based on the previous discussions on international trade, the objective of this chapter will be to reveal the sources of data and set up a model framework suitable for the determinants of Rwanda's trade pattern with the rest of the world. The chapter includes empirical methodology, used data, Model specification and Data analytics methods (descriptive statistics, estimation procedure and Gravity model analysis). The methodology proposed in the below attempts to do so uses aggregate information on global trade and links them to the country of Rwanda.

3.2. Theoretical Framework

Over the last half-century, the gravity model has become the workhorse of applied international trade literature. Starting with (Salette & Tinbergen, 1965), the gravity model has given rise to literally thousands of publications and working papers covering a wide variety of regions, time periods, and sectors. For example, (Disdier & Head, 2008) in their meta-analysis of the effect of distance on trade cover 1,052 separate estimates in 78 papers. By linking trade flows directly with economic size and inversely with trade costs, usually proxied by geographical distance as an indicator of transport costs, the gravity model captures some deep regularities in the pattern of international trade and production. Indeed, (E. Leamer & Levinsohn, 1995) have argued that the gravity model has produced "some of the clearest and most robust findings in empirical economics.

(Hsiao et al., 2014) 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 individual heterogeneity is necessary because it leads to biased estimates.

The gravity model suggests that the level of GDP influences trade positively, but trade is influenced negatively by the distance between trading partners. This is displayed as:

$$T_{rpt} = C\ x\ \frac{GDP_{rt}\ x\ GDP_{pt}}{D_{rp}} + EXR_{pt} + EAC + Pop_{pt}$$

where, C is a constant term, T_{rpt} is the volume of trade flows between the importing country *r* and the exporting country *p*, where GDP_{rt} and GDP_{pt} are the levels of the trading partners' economic size and D_{rp} is the distance between them (Goldberg et al., 2014). According to the gravity model, large economies spend more on imports and exports. Therefore, higher GDP means more trade for a country.

3.3. Empirical Methodology

The gravity model is a key tool for researchers interested in the effects of trade-related policies. It provides a convenient testing bed on which to assess the trade impacts of different policies. Gravity models now routinely include variables far beyond those such as tariffs, which are imposed at the border, to cover behind the border barriers as well. Regulatory policies, as well as deep political and institutional characteristics of countries, have been shown to influence trade as modeled in the gravity framework. Moreover, the gravity model is no longer concerned only with trade in goods but has recently been applied with success to trade in services e.g., (Chaney, 2022). However, due to data availability, this study focuses on area of trade in goods and analyses variables indicated above.

One of the problems is that most studies of international trade are based on cross country regressions, which group together countries with diverse characteristics, such as varying levels of development and size. There are very few studies of the African countries that examine the issue using single country time series data. There is also the problem of reverse causality. Hence the gravity model is a suitable model as it will address all these problems related to heterogeneous characteristics of countries.

3.4. Used data.

In this research, balanced panel data comprising 63 of Rwanda's trade partners was utilized to examine the determinants of Rwanda's trade patterns. The balanced panel data ensures uniformity in the number of time-series and observations for each cross-sectional unit. Specifically, 63 import countries, representing approximately 97 percent of Rwanda's total imports, and 60 export countries, representing around 89 percent of total exports, were analyzed. The list of countries is attached as appendix 1. The panel data framework increases the robustness 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.

The data were sourced from various sources, including the World Bank Development Indicators database for partner trades(World bank, n.d.), the National Bank of Rwanda (BNR) for Rwanda's exchange rate, the National Institute of Statistics of Rwanda (NISR) for detailed trade statistics per partner trade and Rwanda's GDP, and distance data (Distancefromto, n.d.). The dataset spans the period from 2000 to 2022.

3.5. Model specification

Several models related to the gravity model have been developed to account for specific contexts or to address limitations of the basic gravity model. Some of these models and their authors include (Tinbergen, 1962a), who Extends the basic gravity model by incorporating additional variables such as language, common colonial history, and trade agreements to better explain international trade flows. (Bergstrand, 1989; Egger, 2004), Augments the basic gravity model by including additional variables such as bilateral exchange rate volatility, cultural factors, and institutional arrangements to improve its predictive power in explaining trade patterns. Santos Silva and (Sylva & Tenreyro, 2013), Incorporates time dynamics into the gravity model framework, allowing for the estimation of how trade flows evolve over time and how shocks affect trade relationships. (Chaney, 2018), Considers the network structure of trade relationships by accounting for indirect

trade links through third-party countries. This model recognizes that trade flows are influenced not only by bilateral factors but also by the broader network of international trade connections. (Elhanan Helpman et al., 2007), Applies the gravity model framework at the firm level to analyze the determinants of individual firm-level trade flows, considering firm-specific factors such as productivity, firm size, and export experience. Anderson and van Wincoop extends the gravity model to account for spatial dependence and spatial autocorrelation in trade flows by incorporating geographical factors and spatial interactions between regions (Wincoop, 2003).

Building upon Newton's law of gravitation, which relates the force of attraction between two objects to their mass and inversely to the distance between them, Salette and Tinbergen in 1965 introduced the Gravity model into economic analysis (Salette & Tinbergen, 1965). This model forms the basis for understanding international trade dynamics. These models, among others, have contributed to the refinement and extension of the basic gravity model, a widely employed empirical tool in economics, notably for analyzing international trade, migration trends, and tourism movements. This model is based on the principle that the magnitude of interaction between two entities (such as countries or cities) is directly correlated with their economic magnitude (like GDP or population) and inversely correlated with the distance separating them. Therefore, this model is utilized due to its ability to offer more precise and nuanced insights into trade patterns, migration flows, and various interactions between different locations. In this study, the model is extended for the Rwandan context to capture the influences of factors such as the economic size or mass of Rwanda and its trading partners, the distance, market size or population in trade partners, exchange rates, participation in regional agreements (EAC), and the presence or absence of a common border with trading partners. The proposed model explains the determinants of trade flows between Rwanda and its global trading partners as follows:

$$lntr_{rpt} = \beta_0 + \beta_1 ln(GDP_{rt}.GDP_{pt}) + \beta_2 lndist_{rp} + \beta_3 lnexr_{pt} + \beta_4 lnpop_{pt} + \beta_5 EAC + \varepsilon_{rpt}$$

The data used to estimate the determinants of Rwanda's trade patterns include both dependent and independent variables. The dependent variable, total trade in USD ($lntr_{rpt}$), is defined as the sum of exports and imports between Rwanda and its trading partners. The independent variables are Rwanda's real GDP represented by ($lnGDP_{rt}$), real GDP of Rwanda's trading partners represented

by ($\ln GDP_{pt}$), real exchange rate represented by ($\ln exr_{rpt}$), Rwanda's population growth represented by ($\ln pop_{pt}$) and that of Rwanda's trading partners represented by ($\ln pop_{pt}$). Additionally, the factor variable ($\ln dist_{pt}$) represents the distance between trading partners. If the coefficient of the trend variable is significant, it indicates that trade changes over time. Dummy variables, such as the trade agreement (EAC), are also included. The EAC dummy variable is coded as 1 for EAC member countries and 0 for non-members.

The logarithmic transformation of total trade, GDP, population, distance and exchange rate was done as recommended in order to stabilize the variance between cross sectional data, help the linearization and be able to express results as elasticities (Gujarati, 1972).

3.6. Data analytics methods

This section presents how the results of the empirical analysis were done. It attempts to assess determinants of Rwanda's trade pattern with the rest of the world. The analysis was done by using the Gravity model, which aims at analyzing how the economic mass and distance in kilometers are influencing the Rwanda's total trade and analyzing how the exchange rate and population influence trade flows between countries in trade.

3.6.1. Hausman pacification tests

The regression model estimation using panel data involves three main approaches: pooled model, random effects model (REM), and fixed effects model (FEM). In order to decide to choose which model, we need to consider the properties of the data as well as based on the results of tests. Each entity has its individual characteristic which can affect its explanatory variables, called the individual effects. For example, the factor of preference or infrastructure, although not being mentioned in the model, will still affect trade flows of each country. If individual effects do not exist, the pooled model will be the best choice. However, if they exist and must be reflected in the model, the FEM and REM will be more preferred. The Hausman test, employed in this study, helps determine whether a Fixed Effect or Random Effect model is more appropriate. It was conducted to test the null hypothesis: $H_0 =$ Select Random Effect Model ($P > 0.05$) against the

alternative hypothesis: $H_1 = \text{Select Fixed Effect Model: } (P > 0.05)$ and the gravity model regression was done based on the results of the test.

3.6.2. Diagnostic Tests

To check the fitness and stability of the model, the researcher conducted the multicollinearity and Heteroscedasticity tests.

i) Multicollinearity Test

Multicollinearity is a linear association between two explanatory variables. Two variables are perfectly collinear if there is an exact linear relationship between them. For example, X_{1i} X_{2i} are perfectly collinear if there exist parameters β_0 and β_1 such that, for all observations *i*, we have

$$X_{2i} = \beta_0 + \beta_1 X_{1i}$$

For formal detection torelence or the Variance Inflation Factor(VIF) to check multicollineraity $Tolerence = 1 - R_j^2$, and $VIF = \frac{1}{Tolerence}$, where R_j^2 is the coefficient of determination of a regression of explanator *j* on all the other explanators. A tolerance of less than 0.20 or 0.10 and/or a VIF of 10 and above indicates a multicollinearity problem.

ii) Heteroskedasticity Test

This is the basis of the Breusch–Pagan test. It is a chi-squared test: the test statistic is distributed $n\chi^2$ with *k* degrees of freedom. If the test statistic has a p-value below an appropriate threshold (. p<0.05) then the null hypothesis of homoskedasticity is rejected and heteroskedasticity assumed.

3.6.3. Gravity model estimation

In the estimating Gravity model, we employed the structural method based on different research and test of different model starting with ordinary least squares fixed and random effects model up to OLS coefficient estimates with Panel Corrected Standard Errors (PCSE).

$$lntr_{rpt} = \beta_0 + \beta_1 \, ln(\, GDP_{rt}.GDP_{pt}) + \beta_2 \, lndist_{rp} \quad + \beta_3 lnexr_{rpt} + \beta_4 lnpop_{pt} + \beta_5 EAC + \varepsilon_{rpt}$$

As an econometric problem, the objective is to obtain estimates of the unknown β parameters. The logical place to start is with ordinary least squares (OLS), which is the econometric equivalent of the lines of best fit used to show the connection between trade and GDP or trade and distance. As the name suggests, OLS minimizes the sum of squared errors e. Under certain assumptions as to the error term ε_{RPt}, OLS gives parameter estimates that are not only intuitively appealing but have useful statistical properties that enable us to conduct hypothesis tests and draw inferences.

CHAPTER FOUR:
RESULTS AND DISCUSSIONS OF FINDINGS

4.1. Introduction

In this chapter, the balanced panel data were used to assess the determinants of Rwanda's trade pattern with the rest of the world. It includes results of different diagnostic tests performed and results of the regression model, and results interpretation in line with the specific objectives of this study which are: to assess the effect of economic mass (GDP) on Rwanda's trade pattern, to assess how distance affect Rwanda's trade pattern, to measure the effects of exchange rate on Rwanda's trade pattern, to examine partner trade population size affect Rwanda's trade pattern, and to assess if trade agreements are significantly influencing Rwanda's trade pattern.

4.2. Diagnostic tests

Priar to running the regression, several diagnostic tests were conducted: firstly, correlation analysis indicated significant relationships between Rwanda's trade levels and various independent variables including economic size (GDP), trade agreements (EAC), exchange rate, population, and distance to trade partners. Secondly, multicollinearity analysis using Variance Inflation Factor (VIF) was conducted to assess the degree of correlation among independent variables. The results demonstrated low correlations among the independent variables, suggesting no multicollinearity issues. Thirdly, autocorrelation analysis using the Wooldridge test indicated no first-order autocorrelation of error terms, suggesting homoskedasticity in the model. However, a heteroskedasticity test using White's test rejected the null hypothesis of homoskedasticity, indicating the presence of heteroskedasticity in the model.

In conclusion, while the model is free from multicollinearity issues, it exhibits problems with autocorrelation and heteroskedasticity. Therefore, the study recommends using models like fixed effect or random effect models with appropriate corrections (e.g., robust standard errors or clustering) instead of Ordinary Least Squares (OLS) to address these issues effectively (Hoechle, 2007)

4.3. Data Outlook

When analyzing trade patterns, especially in relation to economic mass variables like GDP, the following types of data are commonly used: *Trade (lntr),* variability in trade as the sum of exports and imports between Rwanda and its 63 trading partners. *GDP per Capita (lenGDPpr),* variability in GDP per capita is mostly between countries with some variability within countries over time. The *Exchange Rate (lnexr),* there is significant variability in exchange rates both between countries and within countries over time. *The Population (lnpop),* variability is predominantly between countries with minor variability within countries over time. Rwanda's population growth represented by ($lnpop_{pt}$) and that of Rwanda's trading partners represented by ($lnpop_{pt}$). Additionally, the factor variable *Distance (lndist),* variability is entirely between countries, as expected since distance does not change over time. This dataset provides a comprehensive view of the factors influencing trade patterns, including economic size, population, distance, and exchange rates, with detailed insights into both cross-sectional (between countries) and time-series (within countries over time) variability.

Data Presentation

Variable		Mean	Std. Dev.	Min	Max	Observations
lntr	overall	14.869	2.862	4.690	20.608	N = 1447
	between		2.224	9.815	18.440	n = 63
	within		1.822	7.487	23.422	T-bar = 22.968
lenGDPpr	overall	48.281	2.248	41.930	54.180	N = 1449
	between		1.982	43.752	52.817	n = 63
	within		1.087	45.573	50.515	T = 23
lndist	overall	8.338	0.923	4.568	9.496	N = 1449
	between		0.930	4.568	9.496	n = 63
	within		0	8.338	8.340	T = 23
lnpop	overall	16.988	1.563	12.986	21.072	N = 1449
	between		1.569	13.172	21.018	n = 63
	within		0.138	16.205	17.412	T = 23
lnexr	overall	2.482	2.826	-0.978	10.055	N = 1449
	between		2.808	-0.978	9.845	n = 63
	within		0.468	1.168	9.090	T = 23

4.4. Regression of the model

Fixed effects and random effects regressions were conducted, (Tables 8 and 9 in the appendices), and the corresponding F and Chi-square values were found significant across all levels of significance. Subsequently, the Hausman test, (Table 10 of the appendices), was conducted to test the null hypothesis: the random effects model is consistent and efficient against an alternative hypothesis: the fixed effects model is consistent and efficient. The result of this test provides the chi-square probability value of 0.0009 which is less than all significance levels, suggesting to reject the null hypothesis and retain the alternative hypothesis indicating that the fixed effect model is more suitable. Finally, the presence of cross-sectional dependence was tested for the fixed effect model, as this is often a concern in macro panel datasets.

4.4.1. Cross sectional dependence

Cross-sectional dependence poses a greater challenge in macro panels with extended time series (beyond 20-30 years) compared to micro panels. This dependence can introduce bias into test results (Hoechle, 2015). To assess cross-sectional dependency, Pesaran's test of cross-sectional independence was employed, with the following hypotheses: Null Hypothesis (H0): There is no cross-sectional dependence in the panel data, and Alternative Hypothesis (H1): There is cross-sectional dependence in the panel data.

- Pesaran's CD test of cross-sectional independence = 2.718, Pr = 0.0066
- Average absolute value of the off-diagonal elements = 0.290

Pesaran's test reveals the existence of cross-sectional dependency issues in the model, with an average absolute correlation between residuals of 0.29. The low p-value of 0.0066 provides strong evidence to reject the null hypothesis of cross-sectional independence at the 1 percent significance level. Therefore, based on this test result, it appears that there is significant cross-sectional dependence in the panel data. As a result, it is recommended to estimate the regression using Driscoll-Kraay standard errors, known for their robustness against various forms of cross-sectional and temporal dependence.

In 1967, Parks proposed a Feasible Generalized Least Square (FGLS) to address heteroscedasticity and temporal or spatial dependence in time-series cross-section models. However, this method is impractical when the number of cross-sections (63) exceeds the number of periods (23), in addition in 1995, Beck and Katz (Beck & Katz, 1995) demonstrate that the Parks-Kmenta method tends to yield unacceptably small standard error estimates and suggested to rely on OLS coefficient estimates with Panel Corrected Standard Errors (PCSE) (Hoechle, 2007)

4.4.2. Panel Corrected Standard Errors (PCSE)

The regression coefficients of the model are presented in the table below. Independent variables such as the economic size/mass (lenGDP$_{rpt}$), the dummy variable for economic integration (EAC), and the exchange rate (lnEXR$_{rpt}$), exhibit positive effects, aligning with the expectations, therefore they attract trade between countries. The distance between Rwanda and its trade partners (lnDist$_{rp}$) exhibits the anticipated negative effect on trade. However, the population size in trade partner (POP$_{pt}$), serving as another indicator of market size, unexpectedly exhibits a negative effect on trade.

Table 1: Estimation results

lntr	**Coef.**	**St. Err**	**t-value**	**p-value**	**[95% Conf**	**Interval]**
Total trade (lntr$_{rpt}$)	1.098	0.081	13.57	0.000	0.939	1.257
Trade agreement (EAC)	0.793	0.556	1.43	0.154	-0.297	1.883
Exchange rate (lnexr$_{rpt}$)	0.109	0.043	2.56	0.011	0.025	0.192
Population (lnpop$_{pt}$)	-0.241	0.076	-3.19	0.001	-0.389	-0.093
Distance (lndist$_{rp}$)	-1.226	0.172	-7.14	0.000	-1.563	-0.889
Constant	-24.103	2.823	-8.54	0.000	-29.636	-18.569

Mean dependent var	14.869	SD dependent var	2.862
R-squared	0.432	Number of obs	1447
Chi-square	318.536	Prob > chi^2	0.000

The R-squared of 0.432 implies that the independent variables account for 43.2 percent of the variation in the dependent variable. This aligns with expectations, considering that not all factors influencing trade can be encompassed in the model specification, as there are other factors such as infrastructure, culture, or common language to mentions few that play key role in choosing

trade partners. The Chi-Square probability value indicates the statistical significance of the regression results, being significant at the 99 percent confidence level Most individual variables are notably significant at a 99 percent confidence level, except for the dummy variable representing economic integration (EAC), which achieves significance at an 85 percent confidence level.

$$lntr_{rpt} = -24.103 + 1.098\, ln(\, GDP_{rt}.GDP_{pt}) - 1.226\, lndist_{rp} + 0.109 lnexr_{rpt} - 0.241 lnpop_{pt} + 0.793 EAC + \varepsilon_{rpt}$$

4.4.3. Interpretation of variables

1. Effect of Economic size or mass (GDP) on Rwanda's Trade Pattern

The coefficient value of economic mass variable here represented by GDP of both countries, is statistically significant at 99 percent confidence level. This implies that Rwanda's GDP plays a crucial role in determining its level of exports and imports. A higher GDP indicates a higher production capacity which in turn translates into an economy's ability to export more (supply side). This finding aligns with economic theory and is consistent with previous research, such as the work of (Edmonds & Fujimura, 2006), which suggests that higher-income economies are more inclined toward product differentiation and specialization, leading to increased trade. Different other researchers have also extensively analyzed the relationship between trade and economic growth, some arguing that trade directly influences GDP growth (Baldwin, R., & Evenett, 2009; Frankel, Jeffrey A; Romer, 2022), while others revolve around how changes in GDP affect trade volumes globally. Countries with larger GDPs typically experience higher trade volumes due to increased production capacities and consumer demand, which also significantly shapes the composition of traded goods and services (Fatima et al., 2020; Karras, 2003). Moreover, larger economies tend to form more extensive trade agreements, attract foreign direct investment (FDI), and implement policies that influence trade dynamics, including promotion strategies, tariff policies, and infrastructure investments.

As Rwanda's GDP experiences growth, and concurrently, the GDP of its trading partners also grows, there is an anticipated increase in the total trade value between them. The statistical

significance of the estimated coefficients reinforces the reliability of these findings, emphasizing the importance of economic mass variables in shaping the dynamics of international trade. In this case the results suggest that an increase of 1 percent in the economic mass will boost the trade between them by 1.098 percent.

2. Effect of distance on Rwanda's trade pattern: Geographic distance between Rwanda and its trading partners

Trade is expected to be affected by the distance between the two trading countries, mainly due to associated transport costs. For Rwanda, incorporating the distance variable showed a statistically significant impact at the 99 percent confidence level, with a negative 1.226 coefficient indicating that a 1 percent increase in distance results in a 1.226 percent decrease in bilateral trade. This finding aligns with many researchers' conclusions that, despite advancements in telecommunications and the internet fostering international integration, distance still negatively impacts trade and per capita income by limiting market and supplier access. This effect has grown over time, highlighting the ongoing challenge of addressing distance's impact on trade (Died & Model, 2005; Hummels, 2007; S. R. A. J. Venables, 2004). In addition to transport cost other researchers have added issues related to cultural and economic ties between neighboring countries facilitated by ease of communication, coordination, mutual understanding and trust to facilitate (Elhanan Helpman et al., 2007; J. A. Frankel & Rose, 2005)

The above two variables as the main variables of this model present expected results. According to the gravity model, larger country pairs are expected to engage in more trade, while countries that are farther apart are expected to engage in less trade, largely due to higher transport costs.

3. Effects of exchange rate on Rwanda's trade pattern

To assess the effects of exchange rate on Rwanda's trade pattern, the exchange rate variable was incorporated and proved to be significant at around 99 percent confidence level. Specifically, the 1 percent increase in the exchange rate led to an increase of 0.108 percent of trade. This finding aligns with Umutesi's 2020 study, which similarly found that Rwanda's trade increases by 0.7

percent with a 1 percent change in the exchange rate, attributing this effect to Rwanda's exchange rate policies during the study period (Umutesi, 2018).

An increase in the exchange rate indicates currency devaluation for Rwanda, making imports more expensive and exports more competitive. This impact varies across industries, with some benefiting from a weaker currency while others face challenges (Nicita, 2013). It has been argued that developing countries may struggle to maintain a depreciated exchange rate due to potential inflationary pressures and international tensions (Vries, 1966), yet research also suggests that currency undervaluation can boost exports and limit imports, contrasting with the effects of overvaluation (Nicita, 2013). Overall, stability in exchange rates is crucial for fostering trade by reducing uncertainty and improving export predictability, especially in developing nations facing volatility in exchange rate fluctuations (Giovani, 1998; Ozturk, 2006)

4. Influence of trade agreements on Rwanda's trade pattern.

A dummy variable representing the trade agreements between Rwanda and EAC countries was analyzed since 2006 when the customs union was established. The results reveal a positive impact of being in a trade agreement on overall trade, although this impact is statistically less significant, being within an 85 percent confidence interval and accounting for a 0.79 percent increase in trade.

The limited significance of this variable can be attributed to the similar economic structures and sectoral similarities among East African Community member countries, particularly in agriculture. This similarity can limit intra-regional trade potential, as exports are highly concentrated in a few products that are not significant in regional imports (A. J. Venables, 2002; Yeats, 2003). Rwanda primarily exports agricultural products, while its imports largely consist of energy, capital, and intermediate goods essential to its economy but not readily available within the region. This partly explains the variable's relatively weak influence on the overall trade pattern, aligning with (Duncan, 2014) findings on EAC members' regionalism, which reported a limited impact on agricultural exports for Rwanda, Burundi, and Uganda, while Kenya and Tanzania showed more pronounced effects due to increased regionalization efforts. In the same line, in its 2018 report, the UNCTAD highlighted limited intra-EAC trade (UNCTAD, 2018), an observation which is

confirmed by difference EAC reports where the level of intra-EAC trade was around 15 percent in 2022.(EAC, 2022) Another factor contributing to the insignificance of this variable is the influence of trade barriers affecting recent periods of data, particularly impacting trade between Rwanda and two member countries, Burundi, and Uganda.

5. Effect of partner trade population size on Rwanda's trade pattern,

The size of the population in trade partners is assumed to be positively correlated with the level of trade between two countries, as the size of the population determines the market size. However, in this model, the population variable was found to be statistically significant at the 99 percent confidence level, and it negatively impacts the trade level between countries. Specifically, a 1 percent increase in the population of trade partners is associated with a 0.24 percent decrease in the level of trade. This is mainly because Rwanda's total trade is predominant by imports, and economies with larger population tend to satisfy the internal market before exporting.

While larger population sizes in trade partner countries can offer significant market opportunities, various factors can lead to negative impacts on trade patterns. These include trade barriers, market saturation, economic and political instability, infrastructure challenges, import substitution policies, and income distribution issues. Understanding these factors can help policymakers and businesses navigate the complexities of international trade and develop strategies to mitigate potential negative impacts.

4.5 Summary of Key findings

Effect of economic size or GDP on Rwanda's trade pattern is complex and influenced by various factors, including export diversification efforts, import capacity, trade agreements, investment in infrastructure, and policy decisions. As Rwanda's economy continues to grow and evolve, its trade pattern is likely to be shaped by these factors, reflecting the country's changing economic landscape and development priorities. The findings showed that the value of economic mass variable here represented by GDP of both countries, is statistically significant at 99 percent confidence level. This implies that Rwanda's GDP plays a crucial role in determining its level of exports and imports. This is in line with Umutesi, 2018, who conducted a study titled "Analysis of the Causative Factors of Trade Flows between Rwanda and its Main Trading Partners." The primary objective of her research was to identify the factors influencing trade flows between Rwanda and its principal trading partners. Distance plays a significant role in shaping Rwanda's trade pattern by influencing transportation costs, market access, trade costs and barriers, trade preferences, and the effectiveness of regional trade agreements and infrastructure. As Rwanda continues to pursue economic development and integration into global markets, understanding and mitigating the effects of distance on trade will remain crucial for enhancing trade competitiveness and promoting sustainable economic growth. The results were statistically significant at 99 percent confidence level. The negative 1.226 coefficient means that an increase of 1 percent in the distance between Rwanda and its trading partners would lead to 1.226 percent decrease in bilateral trade.

CHAPTER FIVE:
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter presents a summary of the study findings. The chapter ends with conclusions drawn from research objectives and recommendations to help improve international trade. It also highlight areas for further studies related to this domaine.

5.2. Summary of findings

The primary purpose of this study was to evaluate the determinants of Rwanda's trade pattern with the rest of the world. The findings were derived from the assessing five specific objectives: assessing the impact of economic mass (GDP) on Rwanda's trade patterns, examining the influence of distance on Rwanda's trade patterns, gauging the effects of the exchange rate on Rwanda's trade patterns, investigating how the population size of trading partners affects Rwanda's trade patterns, and determining the significant influence of trade agreements on Rwanda's trade patterns.

The gravity model was applied to analyze data spanning 63 countries over the period 2000-2022. The estimated results indicates that trade flows between Rwanda and its trading partners were positively influenced by Rwanda and its trading partners' economic size, Rwanda's exchange rate and, trade agreement especially EAC integration. The population growth in Rwanda's trading partners, distance from one country to another negatively influence the trade flows between Rwanda and its trading partner.

Distance from Rwanda to its trading partner negatively affected trade flows between Rwanda and its trading partners. Population negatively affected Rwanda's trade. The negative effect on one side is that countries with large population sizes tend to produce and consume internally because the market is big and export less. On the other side though countries with large population size imports, Rwanda was found to be a net importer for a longtime.

Rwanda's membership in the EAC did not result in statistically significant impacts on its trade flows, reflecting findings from (UNCTAD, 2018) report, which highlighted the limited role of

intra-EAC trade where by the percentage of exports within the EAC stood at 19 percent between 2010 and 2012. This is also indicated in various EAC reports, by which the intra-EAC trade accounted for 9.9 percent in 2010 and slightly increased to 15 percent by 2022. (EAC, 2022).

5.3. Conclusion

In summary, a number of beneficiaries, including the Government of Rwanda (GoR), the civil society, the general public and fellow researchers, appear to benefit tremendously from this study. The Government of Rwanda is the intended recipient of the findings of this research, as the study quantifies the relationship of Rwanda's trade in goods with the evolution of its economy, as well as the evolution of economies of its trade partners, the related distance as it has impact on the associated transport costs and two variables mainly linked to different economic policies such as exchange rate monitoring and trade agreements. This research provides interesting results that can greatly assist policymakers in gaining a clearer understanding of the factors influencing Rwanda's trade trends, ensuring the realization of its trade potential. Policymakers can leverage these findings to assess the effectiveness of existing trade agreements, identify areas for improvement, and formulate guidelines for evaluating potential trade partners. Despite a robust monetary policy aimed at safeguarding the national currency, the results reveal a positive correlation between Rwanda's trade and an increase in the exchange rate, presenting both opportunities and risks depending on the policies adopted.

5.4. Recommendations

In line with the findings of this study, the researcher provide the follwing recommendations:

1. The economic magnitude of a nation has a major impact on trade patterns, as demonstrated by the statistically significant coefficient of the economic mass variable, or GDP. This relevance is influenced by a number of factors, including infrastructure, technical breakthroughs, infrastructure and trade investment, diversified economies, trade agreements, purchasing power, production capacity, infrastructure, and powerful financial systems. Comprehending these variables contributes to the explanation of why nations with higher GDPs typically

maintain more significant and varied trade ties, hence highlighting the significance of economic mass in the dynamics of international trade.

2. Trade is significantly hampered by Rwanda's geographic isolation from its trading partners, which has a detrimental impact on trade patterns. This detrimental effect is caused by a number of factors, including increased transportation costs, logistical difficulties, supply chain complexity, trade restrictions, restricted market access, time sensitivity, communication difficulties, stability threats, trade facilitation issues, and information barriers. To offset the negative effects of distance, officials and businesses must have a thorough understanding of these issues. Some methods to consider are infrastructure improvement, trade facilitation, and the promotion of closer economic links through regional integration and trade agreements.

3. Through a number of mechanisms, such as price competitiveness, trade balance adjustments, inflationary effects, investment flows, debt servicing costs, exchange rate volatility, governmental policies, international economic conditions, structural factors, and trade agreements, the exchange rate significantly influences Rwanda's trade patterns. The exchange rate is a strong predictor of Rwanda's trade performance, as shown by its statistical significance at a high confidence level, and these elements taken together explain why. Policymakers must comprehend these processes in order to develop practical plans that will improve economic resilience and trade competitiveness.

4. A statistically less significant influence can be attributed to a number of causes, but trade agreements generally have a positive effect on overall trade. This impact is consistent with the positive impact of membership in trade agreements on trade overall, even though it is statistically less significant. These include initial trade obstacles, the size and composition of the economy, regulations and non-tariff barriers, challenges with implementation and compliance, supplementary policies and infrastructure, political and economic stability, market access and competitiveness, and factors pertaining to the global economy. Comprehending these variables can aid policymakers in crafting more efficacious trade accords and supplementary initiatives to optimize their advantages.

5. With certain trade barriers, such as market saturation, economic and political instability, infrastructure challenges, import substitution policies, and income distribution issues, which may be the root cause of this observed negative influence, the population size of Rwanda was found to be statistically significant at the 99 percent confidence level and to have a negative impact on the level of trade between partner countries. By being aware of these variables, companies and policymakers may better negotiate the challenges of global commerce and create plans to reduce any unfavourable effects.

6. The research outcomes reveal a noteworthy influence of economic size and the distance between Rwanda and its trading partners. Given Rwanda's geographical location, the distance to its trade partners serves as a limiting factor on its potential trade levels. Additionally, the findings indicate a positive effect of economic integration through trade agreements, albeit with less significance. We acknowledge the ongoing efforts undertaken by Rwanda to address this situation, recognizing that there is further work to be done. Consequently, Rwanda should build upon these initiatives, fostering continued economic development and diversification to enhance and fortify its trade potential with neighboring countries.

7. The Government of Rwanda should consistently monitor and assess the implementation of internal trade policies, with a particular focus on the effectiveness of the Made in Rwanda Policy. This policy holds significant value as it encourages the consumption of domestically produced goods, aiming to reduce the country's reliance on imports while simultaneously boosting exports.

5.5. Suggestions of further study

This study on determinants of Rwanda’s trade pattern was conducted using aggregated data of total trade However, it did not incorporate disaggregated data that could have been advantageous for comprehending the rationale behind engaging with partners located at a distance. Disaggregated information sheds light on whether partners are selected based on comparative advantages and reveals sectors where Rwanda could invest to address disparities.

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APPENDICES

Table 2: Pairwise correlation analysis

Variables	($lntr_{rp}$)	($lnGDP_{rpt}$)	(EAC)	($lnExr_{pt}$)	($lnPop_{pt}$)	($lnDist_{p}$)
Trade ($lntr_{rt}$)	1.000					
Economic Size ($lnGDP_{rpt}$)	0.550*	1.000				
Trade agreements (EAC)	0.213*	-0.138*	1.000			
Exchange rate ($lnExr_{pt}$)	-0.053*	-0.278*	0.312*	1.000		
Population ($lnPop_{pt}$)	0.306*	0.516*	0.037	0.241*	1.000	
Distance ($lnDist_{p}$)	0.024	0.571*	-0.486*	-0.290*	0.101*	1.000

Table 3: Variance inflation factor

	VIF	1/VIF
Economic Size ($lnGDP_{rpt}$)	2.72	0.368
Distance ($lnDist_{p}$)	2.13	0.469
Population ($lnPop_{p}$)	1.87	0.535
Exchange rate ($lnEx_{rpt}$)	1.50	0.667
Trade agreements (EAC)	1.47	0.680
Mean VIF	1.94	.

Table 4: Autocorrelation analysis

F (1, 62)	= 33.404
Prob > F	= 0.000
Ho: no first-order autocorrelation	

Table 5: Heteroscedasticity test

White's test for	Ho: homoskedasticity
Against	Ha: unrestricted heteroskedasticity
chi2(26)	= 168.56
Prob > chi2	= 0.0000

Table 6: Cameron & Trivedi's decomposition of IM-test

Source	chi2	df	p
Heteroskedasticity	181.420	19	0.000
Skewness	34.960	5	0.000
Kurtosis	7.100	1	0.008
Total	223.480	25	0.000

Table 7: Regression results

lntr	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
lenGDPpr	0.640	0.180	3.56	0.000	0.287	0.992	***
EAC	-0.447	0.321	-1.39	0.165	-1.077	0.184	
lnexr	0.263	0.089	2.97	0.003	0.089	0.436	***
lnpop	-0.271	0.462	-0.59	0.558	-1.177	0.636	
Lndist	0	(omitted)					
Period							
2000b	0	.	.	.	.	.	
2001	-0.222	0.251	-0.88	0.377	-0.716	0.271	
2002	0.275	0.251	1.10	0.274	-0.218	0.768	
2003	-0.318	0.256	-1.24	0.214	-0.821	0.184	
2004	-0.211	0.264	-0.80	0.425	-0.730	0.308	
2005	0.080	0.287	0.28	0.781	-0.483	0.643	
2006	0.250	0.309	0.81	0.419	-0.357	0.857	
2007	0.091	0.348	0.26	0.795	-0.593	0.774	
2008	0.466	0.396	1.18	0.240	-0.311	1.244	
2009	0.555	0.399	1.39	0.164	-0.228	1.337	
2010	0.741	0.423	1.75	0.080	-0.088	1.570	*
2011	0.990	0.455	2.18	0.030	0.098	1.881	**
2012	0.942	0.473	1.99	0.046	0.015	1.869	**
2013	0.619	0.482	1.28	0.200	-0.327	1.565	
2014	0.659	0.492	1.34	0.181	-0.306	1.624	
2015	0.851	0.483	1.76	0.078	-0.096	1.798	*
2016	0.724	0.486	1.49	0.137	-0.230	1.677	
2017	1.106	0.505	2.19	0.029	0.116	2.095	**
2018	0.962	0.521	1.85	0.065	-0.060	1.983	*
2019	0.935	0.532	1.76	0.079	-0.109	1.978	*
2020	1.418	0.524	2.71	0.007	0.390	2.446	***
2021	1.641	0.555	2.96	0.003	0.552	2.730	***
2022	1.592	0.588	2.71	0.007	0.438	2.746	***
Constant	-12.666	8.705	-1.46	0.146	-29.743	4.410	

Mean dependent var	14.869	SD dependent var	2.862
R-squared	0.439	Number of obs	1447
F-test	40.793	Prob > F	0.000
Akaike crit. (AIC)	5059.761	Bayesian crit. (BIC)	5202.247

Table 8: Regression results using fixed effect (within) regression.

lntr	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
lenGDPpr	1.0751	0.055	19.62	0.000	0.968	1.183	***
EAC	-0.560	0.319	-1.75	0.080	-1.186	0.067	*
lnexr	0.358	0.084	4.25	0.000	0.193	0.523	***
lnpop	-0.259	0.443	-0.58	0.560	-1.128	0.611	
lndist	0.000	(omitted)	.	.	.	.	
Constant	-33.518	5.796	-5.78	0.000	-44.888	-22.147	***

Mean dependent var	14.869	SD dependent var	2.862
R-squared	0.419	Number of obs	1447
F-test	248.692	Prob > F	0.000
Akaike crit. (AIC)	5065.491	Bayesian crit. (BIC)	5091.877
sigma_u	2.084		
sigma_e	1.421		
rho	0.683		

**** p<.01, ** p<.05, * p<.1*

Table 9: Random-effects GLS regression

lntr	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
lenGDPpr	1.098	0.039	28.29	0.000	1.022	1.174	***
EAC	-0.409	0.312	-1.31	0.189	-1.020	0.202	
lnexr	0.214	0.058	3.71	0.000	0.101	0.327	***
lnpop	-0.271	0.138	-1.97	0.049	-0.541	-0.001	**
lndist	-1.259	0.235	-5.37	0.000	-1.719	-0.799	***
Constant	-23.566	2.631	-8.96	0.000	-28.723	-18.410	***

Mean dependent var	14.869	SD dependent var	2.862
Overall r-squared	0.424	Number of obs	1447
Chi-square	1034.591	Prob > chi2	0.000
R-squared within	0.418	R-squared between	0.429
sigma_u	1.572		
sigma_e	1.421		
rho	0.550		

Table 10: Hausman (1978) specification test

	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	Fixed effects	Random effects	Difference	S. E
lenGDPpr	1.075	1.098	-0.023	0.039
EAC	-0.560	-0.409	-0.150	0.069
lnexr	0.358	0.214	0.144	0.061
lnpop	-0.259	-0.271	0.013	0.421

	Coef.
Chi-square test value	18.765
P-value	0.0009

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(4) = (b - B) ' [(V_b - V_B) ^ (-1)] (b - B)

AppendixII: List of trade parteners

Partner	Imports	Exports
Australia	X	X
Bahrain	X	
Belgium	X	X
Brazil	X	
Burkina Faso	X	X
Burundi	X	X
Cameroon	X	X
Canada	X	X
China	X	X
Congo, Dem. Rep.	X	X
Congo, Rep.	X	X
Cote d'Ivoire	X	X
Denmark	X	X
Egypt, Arab Rep.	X	X
Eswatini	X	X
Ethiopia	X	X
Finland	X	X
France	X	X
Germany	X	X
Ghana	X	X
Greece	X	
Hong Kong SAR	X	X
Hungary	X	X
India	X	X
Indonesia	X	X
Ireland	X	X
Israel	X	X
Italy	X	X
Japan	X	X
Jordan	X	X
Kenya	X	X
Korea, Rep.	X	X
Luxembourg	X	X
Malaysia	X	X
Mauritius	X	X
Netherlands	X	X
Niger	X	X
Nigeria	X	X
Norway	X	X

Partner	Imports	Exports
Oman	X	X
Pakistan	X	X
Poland	X	X
Portugal	X	X
Russian Federation	X	X
Saudi Arabia	X	X
Senegal	X	X
Singapore	X	X
South Africa	X	X
Spain	X	X
Sweden	X	X
Switzerland	X	X
Tanzania	X	X
Thailand	X	X
Tunisia	X	X
Turkey	X	X
Uganda	X	X
Ukraine	X	X
United Arab Emirates	X	X
United Kingdom	X	X
United States	X	X
Vietnam	X	X
Zambia	X	X
Zimbabwe	X	X

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