UNIVERSITY of RWANDA COLLEGE OF SCIENCE AND TECHNOLOGY ACE-ESD AFRICAN CENTER OF EXCELLENCE IN ENERGY FOR SUSTAINABLE DEVELOPMENT

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Title of the thesis: RURAL ELECTRIFICATION AND EMPLOYMENT IN RWANDA

A thesis submitted to the African center of excellence in energy for sustainable development (ACE-ESD)

In partial fulfillment of the requirement for the degree of masters of Science in energy economics

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Declaration

I, UMUGWANEZA Angelique, the undersigned, declare that this Project proposal is my original work, and has not been presented for a degree in University of Rwanda or any other universities. All sources of materials that will be used for the thesis work will have been fully acknowledged.

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Signature

Date of Submission: 16 November 2021

This thesis has been submitted for examination with my approval as a university advisor.

Dr. KABANDA RICHARD

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ACRYNOMS AND ABBREVIATION

ACEESD: African center of excellence in energy for sustainable development.

ARDL: Estimation results from the Auto-Regression Distributed Lags

FDI: Foreign development investment

GDP: Gross domestic product

Mininfra: Minisrty of infrastructure

MW: Mega watt

WDI: World development indicators

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ABSTRACT

The data from 2003 to 2020 were used in the study, and the autoregressive distributed lags with error correction term were used as the analysis method. The findings revealed that rural electrification access has a significant negative effect on unemployment and, in contrast to positive effect on employment in long run, the education index has a positive effect on unemployment rate and thus reduces the employment rate, while foreign direct investment has a negative effect on employment rate and thus increases the employment rate.

The study recommends and invites more foreign direct investors in the energy sector and infrastructural development such as rural electrification program to increase electrification rates, which will positively impact employment rates, the Government should improve the incentives and subsidy schemes to make it easier for residents to purchase and access off grid solutions

1. INTRODUCTION

1.1. Background

From 79 percent in 2000 to 85 percent in 2012, the percentage of the global population with access to electricity increased steadily. In recent years, South Asia, South-East Asia, and Sub-Saharan Africa have all made big progress. Despite these accomplishments, 1.1 billion people, including more than 65 percent of the population of Sub-Saharan Africa and 70 percent of the population of Oceania, continue to lack access to this critical service.(Africa et al., 2016). Access to public sector services and infrastructure, like (water, roads, power, and telecommunications), appears to be critical in improving welfare in remote areas. (Salmon & Tanguy, 2016).

Over half of these people are thought to live in Sub-Saharan Africa, with 482 million in rural areas and another 105 million in urban areas. Continuous and dependable access to electricity is a critical component of modern life since it is integrated in practically everything we do and need, such as housing, food production, education, and health care. These societal functions are frequently neglected or non-existent in states and localities where access to electricity is limited or non-existent(Blimpo& Cosgrove-Davies, 2019).

Rwanda is making progress toward its development goals, which include energy access. Through its power sector, Rwandan government has set goals to increase installed capacity for power generation to 512 MW from the present 216 MW and achieving universal access (100 percent) by the years 2023/24 .It is also put in place that by 2023/24, 52 percent of connections will be on-grid and 48 percent will be off-grid (Samuel Bimenyimana , Godwin N. O. Asemota2 and Lingling Li, 2018)

Electricity provision can have an impact on labor outcomes via a variety of methods. For instance, it could be viewed as a technological shock that boosts home productivity indicates a longer timeframe allocation so everybody can work at night (rather than just during the day), may encourage the creation of new enterprises by letting households to conduct business that require the use of equipment, and may encourage the creation of new enterprises by enabling households to produce goods and services that demand the use of equipment. (Salmon & Tanguy, 2016).

1.2 Statement of the problem

Energy is an essential need for mankind and a driving force for the development of all sectors (Vernet et al., 2019). Sub-Saharan Africa has the greatest disparity between urban and rural areas of any region on the planet. Urban areas are electrified at a rate of 63 percent, while rural areas are only 19 percent. (Hallander, 2017).Access to electricity, in theory, has the ability to improve economic situations in developing nations by influencing key aspects of poverty such as health, education, income, and the environment. (Kanagawa and Nakata, 2008).

In Rwanda, as in other developing countries, a lack of access to electricity in remote areas continues to cause unemployment. Due to a lack of access to electricity in remote areas, these areas remain underdeveloped, with many people unable to find employment, likely to result in rural-urban migration. Rural-urban migration is an issue that every country faces, and one factor that contributes to it, is unemployment. People travel to cities in search of jobs that are not available in rural areas. Many people wondered why there are so few workers in rural areas. Since many jobs need electricity, the best factor for having many jobs in the city is easy access to electricity(Fay & Opal, 2000).

Investment has been identified as a significant predictor of economic growth in theoretical and empirical research. Furthermore, literature implies that investment could help to accelerate solutions to critical macroeconomic challenges such as unemployment (chikwendu nneka francisca, 2019). In rural areas, there is a low level of investment. Investors are not interested in investing in those areas due to poor or lack of infrastructure like electricity. This leads to the low number of jobs created in rural areas, which also leads to unemployment. Here there are some economic activities such as carpentering and different services that cannot exist in rural areas because these activities need electricity in order to be run

.

1.3 Research hypotheses

1.3.1 Hypothesis one

H0: there is no impact of rural electrification on unemployment

H1: there is impact of rural electrification on unemployment

1.3.2 Hypothesis two

H0: there is no significant effect of foreign direct investment on rural electrification

H1: there is a significant impact of foreign direct investment on rural electrification

1.4 Objectives

1.4.1 General Objective

The main objective of the study is to investigate the impact of rural electrification to the employment in Rwanda.

1.4.2 The Specific Objectives

- To investigate the long term relationship between employment and rural electrification
- To investigate the short term relationship between employment and rural electrification
- Identify the impact of investment on rural electrification in Rwanda

1.4.3 SCOPE OF THE STUDY

This Study examine how electricity can lead to the attractiveness of investment in rural areas and how that investment can lead to an increase in jobs created in rural areas to reduce unemployment. The study assesses the effect of rural electrification on employment in Rwanda for the period from 2000 to 2018. This period corresponds to the availability of data that is used in this study.

1.4.4 Expected Outcomes and Significance of the study

1.4.4.1 .EXPECTED OUTCOME OF THE STUDY

This study demonstrates how increasing access to electricity reduces unemployment by increasing small businesses and extending working hours in rural areas.

1.4.4.2 Significant of the Study

The study analyses how rural electrification helps in creating job opportunities and also provides recommendations that can help policy makers understand to what extent rural electrification contributes to reducing unemployment in Rwanda.

2. LITERATURE REVIEW

This component of the thesis includes the definition of key terms, a review of theoretical literature, and an empirical review.

2.1 DEFINITION OF THE KEY CONCEPTS

The key concepts we have in this research, including rural electrification, investment, and employment.

2.1.1 RURAL ELECTRIFICATION

The process of introducing electricity to rural areas that are far from electricity infrastructure and in remote areas is referred to as rural electrification.. Many of us who depend on electricity on a daily basis seem to take it for granted and are unaware of how much we rely on it. Electricity is needed not only for lighting and heating in rural areas, but also for farming (lloyd, 2017).

2.1.2 INVESTMENT

An investment is a financial asset or item invested with the aim of obtaining income or recognition. In a business aspect, an investment is the purchase of products that are not used now but will be utilized to generate future value

2.1.3 EMPLOYMENT

The employment is an agreement between an employer and an employee in which the employee agrees to complete tasks on the employer’s behalf. In exchange, the employee receives a salary or hourly wage. (Wikipedia).

2.1.4 INFLATION

Inflation is the progressive decrease of a currency's purchasing power. A general price increase, usually expressed as a percentage, indicates that a unit of currency now purchases less than it did before. (Fernando)

2.2. Theoretical literature.

2.2.1 UNEMPLOYMENT THEORY

2.2.2 CLASSICAL ECONOMIC THEORY

Unemployment is regarded as a symptom that classical economic theory is interfering with the smooth operation of the labor market in certain manner. The Classical method suggests that markets behave as specified by the idealized supply-and-demand model: the labor market is viewed as a single, static market with perfect competition, spot transactions, and institutions for bidding in two auctions. (Neva Godwin, Julie nelson, 2006)

Unemployment theories can thus be classified based on their interpretation of why this process fails. First, the company can claim that it does not want to decrease wages. Efficiency-wage theories are those that claim that paying lower wages has both a cost and a profit to the firm. The second argument the company can make is that it wants to reduce salaries but it is to unable to do so due to an overt or implied arrangement with its employees. (Romer, 2012)

Second, Contracting models are theories that explain how negotiation and contracts influence labor market macroeconomics. In response to the unemployed worker's offer, the firm will state that it does not support assumption that the unemployed worker is equivalent to the firm's current employees. The company has the option of accepting the worker's bid, taking into account the existence of long term connections between firms and workers. Firms do not recruit new employees on a regular basis. However, many professions require long term commitments and significant firm specific talents on the part of employees. The prospect of long term connections suggests that the wage does not need to change each time to clear the labor market. Workers are satisfied with staying in their existing positions as long as the income streams they expect to get are preferable to outside options. Their current earnings may be relatively insignificant in this comparison due to their long-term relationships with their employers.

$$\pi = \mathrm{AF(L)} - \mathrm{WL},$$

Where L : number of workers employed by the firm and w: wage. A is a variable that causes the profit function to shift (technology). Many precise agreements necessarily take this shape; for example, each basic type of agreement simply provides a salary and then allows the firm to choose employment after A is chosen. Unemployment and real wage solidity emerge almost quickly under such a labor contract. A decrease in labor demand causes the firm to reduce employment at the fixed real pay while labor supply remains constant, resulting in unemployment. Because the real wage is assumed to be stable, wage costs do not respond. Employees' real incomes are constant under effective agreements. The model predicts a high level of real wage rigidity in this regard. Indeed, the model shows that the hourly wage is countercyclical, as L rises as A rises. (romer, 2012).

The third model is the search and matching model, which is set up to run indefinitely. The economy is made up of workers and jobs. Each employee has the option of working or being unemployed. A worker generates an exogenous, constant amount y per unit time and is paid an endogenous, potentially time-varying amount w(t) per unit time. Unemployed workers receive an exogenous, continuous income of $b \geq 0$ per unit time. Average unemployment can be explained simply by search and matching models: it may be the outcome of constantly matching workers and jobs in a complex and changing economy. As a result, most of the observed unemployment may be due to what is known as frictional unemployment.

2.2.1 KEYNESIAN THEORY

The principle of effective demand underwrites Keynes' employment theory. In other words, the level of effective demand determines the level of employment in a capitalist economy. As a result, unemployment is caused by a lack of effective demand, and increasing the level of effective demand is the only way to solve the problem. When Keynes spoke of "effective" demand, he was referring to the total demand for goods and services in an economy at various levels of employment. People's total demand for goods and services is the sum of their consumption and expenditure demands. To meet that demand, people are employed to produce a wide range of products, both consumer and investment goods. However, one more aspect of effective demand must be addressed before we can conclude our discussion of effective demand: government

spending. As a result, effective demand is defined as the sum of all expenditures, including consumption, investment, and government spending. (Romer, 2012).

2.2.2 INVESTMENT THEORY

Both John M.Keynes and Irving Fisher advocate investing until the present value of expected future revenues at the margin equals the opportunity cost of capital. To put it another way, investments are made until the net present value equals zero. The investment theories are divided into three categories: neoclassical theory, accelerator theory, and Tobin's theory. All three theories assume optimal decision-making behavior on the part of the decision-maker. Profit/value maximization is explicitly assumed in both neoclassical and Tobin's investment theories. By assuming that investment is determined by an optimal capital stock, the accelerator theory implicitly assumes this. In its most basic model, the accelerator theory of investment assumes that a certain quantity of capital stock is required to produce a specific quantity of output.

Mankiw (2010) suggested that Investment is positively related to realize earnings because it is assumed dependent on predicted profits. He also classified investment spending into three groups fixed investment in a business that refers to the equipment and structures that a company purchases for use in manufacturing, Residential investment that comprises both new housing purchased by individuals for personal use and new homes purchased by landlords for resale and Inventory investment that involves things kept in storage by enterprises, such as materials and supplies, work in progress, and finished goods.

2.2.3 PHILPS CURVE

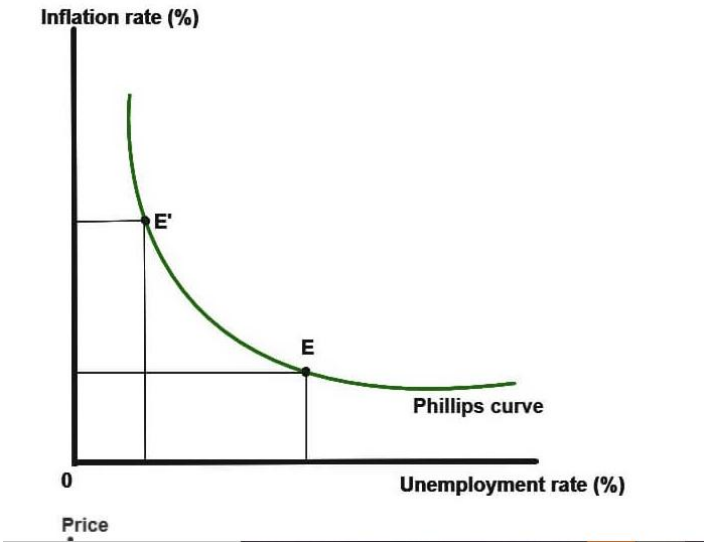
In economics, inflation is defined as a significant rise in an economy's general price level of goods and services. Unemployment occurs when people are out of work but willing to work at current wages. Inflation and unemployment are two of the most important economic matters during an economic cycle, both are important indicators of a country's economic performance and, at least in the short run, are related. Inflation affects a country's economic unemployment rate. When monetary or fiscal decision makers increase aggregate demand by moving the aggregate-supply curve upward, this is referred to as monetary or fiscal policy, aggregate output rises and unemployment falls .This comes at the expense of rising prices (Demand pull inflation).

As a result, there is a cost-benefit trade-off between inflation and unemployment. Reduced unemployment is offset by increased inflationary pressures in the economy as explained by Philips curve.

In 1958, economist A.W. Phillips revealed the trade-off between unemployment and inflation first and foremost. As per A.W. Phillips, policymakers in an economy can aim for either a low unemployment rate or a low inflation rate, but not both. A.W. Phillips' concept was published in 1958 in the article "The Relationship between Unemployment and the Rate of Change of Money Wages in the United Kingdom, 1861-1957." In this article, he drew a graph displaying the relationship between the unemployment rate and the rate of inflation in the United Kingdom from 1861 to 1957.

Paul Samuelson and Robert Solow performed a study of the relationship between unemployment and inflation in the United States of America in 1960, using data from 1990 to 1960. They also discovered a stable non-linear relationship between unemployment and inflation.

Figure 1: PHILIPS CURVE



The Phillips curve illustrates the inverse relationship between inflation and unemployment. Both must fall as one rises.

2.2.4 TAYLOR RULES

The Taylor rule is an econometric model that investigates the relationship between the Federal Reserve's operating objectives and inflation and GDP growth rates. The Taylor rule was used to guide monetary policy in response to changing economic conditions as both a predictive tool and a fixed regulation policy. The rule is a formula that links the Fed's short-term interest rate operating target to two variables: current and desired inflation rates, as well as real and desired GDP growth rates. As an outcome, according to Taylor's original version of the rule, the nominal interest rate must respond to differences between actual and target inflation rates, as well as actual and potential GDP:

$$i_t = \pi_t + r_t^* + a_\pi(\pi_t - \pi_t^*) + a_y(y_t - \bar{y}_t).$$

In this equation $\mathbf{i_t}$ is the target short term nominal interest rate, π_t is the rate of inflation as measured by the GDP deflator, π_t^* is the desired rate of inflation, r_t^* the assumed equilibrium real interest rate,

y_t the logarithm of real GDP and $\bar{y}_t$ is the logarithm of potential output as defined by a linear trend. (wikipedia)

2.3 EMPERICAL LITERATURE

Around the world, many studies have been conducted to analyze the influence of rural electrification and investment on employment.

According to a Peruvian research, impact of a rural electrification program on jobs is being investigated. They used differences-in-differences and fixed-effects methodologies to access the influence of electrification on labor market outcomes, taking advantage of the program's gradual rollout across districts. According to their preferred specification, the software increases work hours and reduces the likelihood of males getting a second job. Female employment and earnings are increased as a result of the treatment, as is the likelihood of working outside the agricultural sector.. (Rosamaria Dasso and Fernando fernandez, 2015).

The primary goal of TarynDinkelman's study on the effects of rural electrification on employment in South Africa, which he conducted in 2011, was to analyze the influence of new access to modern energy on results of great interest: the poor's capacity to use their labor resources for market production. The author estimated the causal impact of household electrification on rural employment growth by studying rural electrification roll-out in post-apartheid South Africa. Within five years, electrification significantly increases female employment, according to the author. Within five years, electrification significantly increases female employment, according to the author. Men and women's working hours are being increased, while female wages are being reduced and male earnings are increasing.

In addition, Gunther Bensch, JochenKluve, and Jörg Peters (2011) conducted a study in Rwanda on the impacts of rural electrification, with the main goal of the survey being to assess before project implementation the impacts that can be expected from the installation of micro-hydro mini-grids by using a probit model to compare non-electrified project areas with households in comparable non-project regions that already have access to electricity, providing baseline data to be used in future studies. The authors identify counterfactual households based on these probabilities and find strong evidence for positive effects on lighting usage. When regional differences are taken into account, the effects on income and children's home study become insignificant..

The study done by (simone Tagliapietra, Giovanni Occhiali, Enrico Nano, Robert Kalcik, 2020) improving knowledge of the impact of electricity access on Nigerian labor market outcomes. To assess the impact on the proportion of employed working-age components of a family, a rigorous econometric study employing probity, biprobit, and propensity score matching is used. They looked at both male and female employment, as well as agricultural and non-agricultural employment, to see how rural and urban households differed. After potential endogeneity in the relationships under consideration is addressed, the findings suggest that having reliable electricity has a significant effect on specific labor market outcomes. They discovered a coherent shift away from agricultural work of around 7% and into nonagricultural work of around 15%, with some facts of a positive effect on overall labor participation.

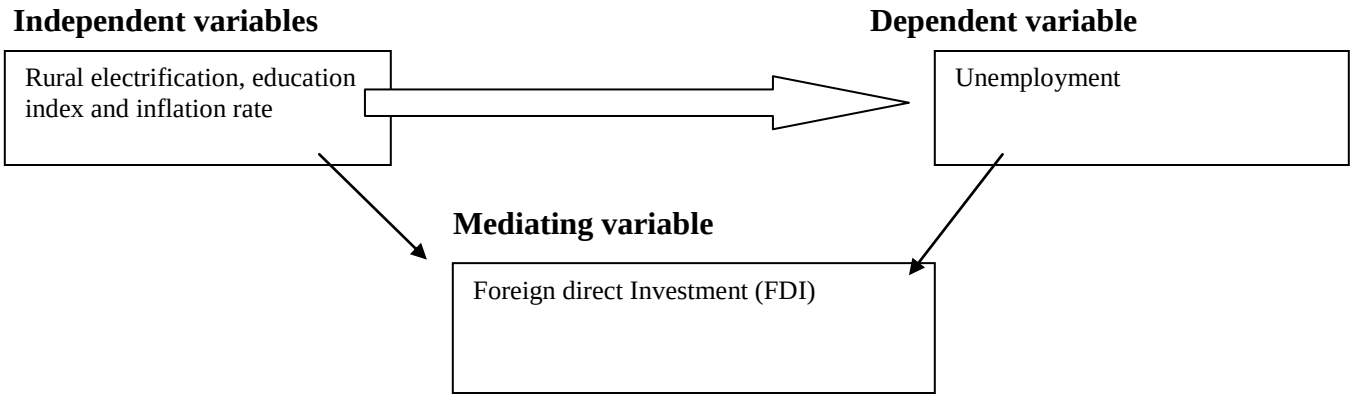
The study done by (louise Grogan and Asha Sadanand, 2012), Rural electrification and employment in poor countries evidence from Nicaragua shows that, even in the apparent lack of labor-saving appliances, electrification is associated with significant changes in the time use of men and women in Nicaragua. Electricity has been shown to increase rural Nicaraguan women's willingness to work outside the home by 23% while having no effect on male employment. These results pointed to significant potential benefits of rural electrification that are typically overlooked in cost–benefit analyses, such as increased women's earnings and reduced deforestation.

Despite previous research into the relationships between rural electrification and employment, there is still a need for ongoing research and development. Many studies are being conducted to determine whether rural electrification leads to job opportunities in rural areas. Previous researchers on this topic discovered a positive relationship between rural electrification and employment, but they did not show how electrification leads to employment. In this thesis, we will look out how electrification leads to employment through investment.

2.4 CONCEPTUAL FRAMEWORK

To visualize the impact rural electrification will have on employment accessibility through investment, I used the chart which highlighted the leading variables that make up the research topic. I tried to develop other variables and they are presented in the figure below.

Figure 2: conceptual framework



Source: Researcher's conception, 2021

3. METHODOLOGY

3.1 INTRODUCTION

The methods and tools used to collect and analyze data on rural electrification, investment, and employment in Rwanda are discussed in this section. It discusses the theoretical framework, the empirical model, data collection methods, and data analysis methods.

3.2 Theoretical framework

Theories are developed to explain, predict, and possibly understand phenomena, as well as, in many cases, to challenge and extend existing knowledge within the confines of critical boundary assumptions. The theoretical framework is the structure that holds or supports the theory of a research study. The theory that explains why the research problem exists is the analysis's form. This section investigates the policy implications of the relationship between rural electrification, investment, and employment.

John Maynard Keynes (1936) developed two basic employment theories: neoclassical and Keynesian. The neoclassical theory approaches unemployment through standard demand-and-supply analysis. The classical Theory of Employment differs slightly from the Keynesian Theory of Employment. Keynes defined employment as the point at which aggregate demand equals aggregate supply. In the short term, Keynes proposed that aggregate demand and aggregate supply in the country determine the level of national income and thus employment. National income reaches equilibrium when aggregate demand equals aggregate supply. This point of equilibrium is also referred to as the effective demand point.

The level of employment in the economy is calculated by dividing the total number of employed people by the total labor force.

$$\text{Employment rate} = \frac{\text{employed}}{\text{totallaborforce}}$$

3.4 Empirical model

The model is a simplified version of a complex reality that seeks to consolidate large characters into a reasonable size so that the relationships between them can be understood. By considering how all of these variables interact, the rural electrification, investment-employment nexus can be organized in the model. As a result, it is predicted that the extent of rural electrification will be determined by the factors that influence it.

The scope toward which rural electrification can help increase employment may be determined by the presence of supportive policies, employee potential, and rural residents' capacity to interact in income-generating activities, particularly in relation to gender norms about work. Is it then possible to make broad generalizations about the efficacy of any given rural electrification program? We want to look into how access to electricity in rural areas increases job creation and how that compares to those who do not have access to electricity. We look at the employment situation. Access to electricity is the variable of interest in each case through the following model specification.

$$\Delta\mathbf{unemploy}_{(t)} = \alpha_0 + \sum_{i=1}^{4} \gamma_i \Delta\mathbf{unemploy}_{(t-i)} + \beta_1\mathbf{elect}_t + \beta_2\mathbf{lnFDI}_t + \beta_3\mathbf{INF}_t + \beta_4\mathbf{EDC}_t + \beta_5\mathbf{realinterst\ rate}_t + \varphi_{0_t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where: **unemploy** is the unemployment rate; **elect** is the electricity access;

lnFDI Is the foreign direct investment; **EDC** is the education index and **realinterst** is the real interest rate.

α_0 is the intercept and β_1, $\beta 2$, $\beta 3$, $\beta 4$: are the coefficients of interest indicating the causal effect; **t** is the time period and φ is the error term.

The structural equation above indicates the relationship between the unemployment rate as the dependent variable with the set of independent variables including electricity rate, foreign direct investment, and inflation rate and education index. Here in the study we used the difference approach for taking care of the serial correlation that might occur in between the lags themselves since there are additional predictors (elect, EDC, lnFDI, INF and real interest) the regression

analysis will be carried out using the Auto-Regression Distributed Lags (ARDL) through which we choose the number of lags to be used in the model through lags optimization process.

The empirical analysis is required using annual time series data from World Bank development indicators and United Nations development program. Given the complexities and diversity of the relationships between rural electrification, investment, and employment, an econometric approach based on Auto-Regression Distributed Lags(ARDL) is used which will be run through STATA software tool by testing stationary , co integration, long run relationship and stability between variables(dependents and independents). The goal here is to look for a causal relationship between rural electrification and investment activity, as well as how rural investment affects employment rates. If such an effect is discovered, one must determine whether it is positive or negative, and whether there is any feedback from employment to investment; quantitative data on these aspects is provided.

3.5 Source of data

The overall data in this research was gathered from the World development indicators (WDI) online data published by the world bank and data from united nation development program From 2003-2020.

4. RESULTS AND DISCUSSIONS

This section entails of The result revealing the causal relationship between the unemployment rate and the electricity consumption using the autoregressive distributed lag model for analysis from table1 to table 4 describing the Equation (1) results, the results are summarized into 2 parts first is descriptive statistics of the both endogenous and exogenous variables used in the model (4.1) and empirical estimation results from regression model analysis (4.2)

4.1 Descriptive statistics analysis

Table 1: Data description

Variable	Obs	Mean	Std. Dev.	Min	Max
Unemployment rate	65	1.044	.127	.88	1.35
Electricity access in rural area	65	9.17	8.425	.67	23.62
Education index	65	.422	.048	.32	.49
Inflation rate	65	7.072	4.499	-.31	15.44
Log foreign direct investment	65	18.479	1.434	15.363	19.767
Real interest rate	65	9.374	5.567	-3.638	17.683

From the table1 reports the descriptive statistics of the dependent variable unemployment rate and the independent variables as electricity access in rural area, education index, inflation rate and the natural logarithm of the foreign direct investment in energy sector. The tab le above indicates that the minimum value of the unemployment rate is 0.88 percent while the maximum value is 1.35 percent and then the mean value of the unemployment rate is 1.044 percent, the descriptive statistics shows that the minimum value of electricity access in the rural areas is 0.668 percent while the maximum value is 23.624 percent and its mean value is 9.17 percent. The table 1 shows that the overall education index has the minimum value of 0.316 percent while the maximum value of education index is 0.5 percent and its mean value is 0.421 percent. The description reports that the minimum value of the inflation rate is negative 0.311percent while the maximum value of the

inflation rate is 15.44 percent with the mean value of 7.1 percent. For the foreign direct investment, the table 1 reports that the minimum value of the foreign direct investment is the $e^{(15.363)}$ which is US$4,699,656.6 while the maximum foreign direct investment is the $e^{(19.767)}$which US$ 384,325,343.3 with its mean value of US$ 106,005,337

4.2 EMPIRICAL RESULTS

4.2.1 Stationary tests

To avoid the possibility of over fitting, the stationary property of all variables is examined. To ensure that the estimated results are free of spurious inferences, three common methods of examining stationary are used: the augmented Dickey and Fuller (1981) (ADF) test, the Phillips and Perron (1988) (PP) test, and the Phillips and Perron (1988) (PP) test. According to the ADF, PP tests, only the first difference of all variables is stationary at the I(1) level, as shown in the estimated results in the figure below.

Table 2: Stationarity tests

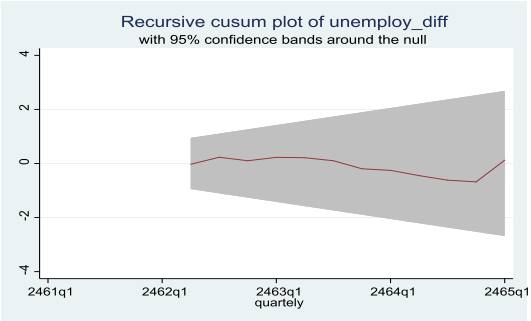
First difference pperron unit root test

Variable	dfuller_ statistic	dfuller_ cvalue	dfuller_ pvalue	dfuller_ lags	pperron_ statistic	pperron_ rho	pperron_ pvalue	pperron_ lags
unemploy_diff	-1.526	-3	0.521	0	-1.397	-12.470	0.583	2
elc_diff	-4.164	-3	0.001	0	-4.173	-17.172	0.001	2
edc_diff	-3.679	-3	0.004	0	-3.639	-15.259	0.005	2
inf_diff	-4.042	-3	0.001	0	-4.350	-13.060	0.000	2
lnfdi_diff	-4.762	-3	0.000	0	-4.699	-21.477	0.000	2
realintrst_diff	-4.706	-3	0.000	0	-5.551	-15.085	0.000	2

4.2.2 Stability test

through the stability test, we can see that the data are stable since they are all bounded along the period at 5 % the level of significance as there is no structural breaking

Figure 3: **Figure 3: stability test**



4.2.3 Bound test

According to Johansen (1995)'s examination of the cointegration property for time series data, there may be a long run relationship between the variables. The bound test confirms the existence of long run relationships for both F-statistics and t-statistics, as shown in the table below. Using the associated bounds testing procedure for the six variables is an appealing alternative to other cointegration tests. As a result, the error correction model should be used to estimate equation (1).

Table 3: Long run and short run test

H0: no levels relationship F = 9.673
t = -2.458

Critical Values (0.1-0.01), **F-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_5	2.26	3.35	2.62	3.79	2.96	4.18	3.41	4.68

accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), **t-statistic**, Case 3

	[I_0] L_1	[I_1] L_1	[I_0] L_05	[I_1] L_05	[I_0] L_025	[I_1] L_025	[I_0] L_01	[I_1] L_01
k_5	-2.57	-3.86	-2.86	-4.19	-3.13	-4.46	-3.43	-4.79

accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

4.2.4 Estimation results from the Auto-Regression Distributed Lags (ARDL) model

Table 4: ARDL model Estimation results with error correction term

VARIABLES	(1) ADJ	(2) LR	(3) SR
L.elc_diff		-0.034*	
		(0.015)	
L.edc_diff		7.101*	
		(3.432)	
L.inf_diff		0.008	
		(0.009)	
L.lnfdi_diff		-0.238*	
		(0.108)	
L.realintrst_diff		-0.022	
		(0.011)	
L.unemploy_diff	-0.762*		
	(0.310)		
D.elc_diff			-0.016**
			(0.005)
D.edc_diff			5.408**
			(1.364)
D.inf_diff			-0.001
			(0.004)
D.lnfdi_diff			-0.073**
			(0.025)
D.realintrst_diff			-0.009**
			(0.003)
Constant			0.065**
			(0.022)

Observations	61	61	61
R-squared	0.941	0.941	0.941

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From the table2 above reports that the relationship between the dependent variable as unemployment rate and the set of predictors or independent variables which are the lags of unemployment, electricity access, inflation rate, education index and the natural logarithm of the foreign direct investment with the error correction term modeling. The table 2 indicating the estimation results from the auto-regressive distributed lags (ARDL) model with the error correction term is composed of the four columns where first column from the left side containing the set of independent variables as predictors, the second column comprise of the speed of adjustment coefficient which indicates how the error correction was made from the baseline autoregressive distributed lags without error correction term with its corresponding standard error , the third column indicating the coefficients indicating the causal relationships between the dependent and independent variables in the long run relationships(LR) with their respective standard errors and the fourth column comprises of the coefficients indicating the causal relationships between the dependent variable and the set of independent variables in the short run relationships(SR).

From the second column, the results indicate that the speed of adjustment coefficient measuring how strongly the unemployment rate reacts to the deviation from the equilibrium relationships in one period and this indicates that the change in unemployment rate the error term was corrected leading to decrease by 76.2 point percent when its first lag increase by 1 percentage at the p<0.1 significance level when other factors are held constant.

The results reported in third column indicating the set of coefficients for the causal relationship between the dependent variable change in unemployment rate and the set of independent variables in the long run relationships (LR). The results indicate that when the first lag of electricity access in the rural areas increased by 1 percent this leads to the decline in the change in unemployment rate

by 3.4 point percent which is significant at p<0.1 in the long run relationships and this goes in line with the fact that when the rural population electrification access increase as an indicator of the infrastructure development this will lead to the businesses and job creations and this will enhance the increase in the employment hence the reduce or decline in the unemployment rate in the long run relationships and ceteris paribus hold.

The results in this column indicates that when the first lag of education index increase by 1 percent this will lead to the increase in the unemployment rate by 7.1 point percent in the long run relationships and this goes in line with the actuality that when the population get education they are expecting to get jobs while increasing the unemployment rate in the long run relationships, so actually when the education index increase this might indicate the increase in the unemployment rate in the long run relationships since the educated people go wrong with their expectation can not engage in some other income generating activities through job creation than waiting to work in offices and bureaus .Surprisingly, The results above discovered that when the first lag of foreign direct investment increases by 1 percent this is associated with the decrease in the unemployment rate by 0.23 point percent which is significant at p<0.1 in the long run relationships and This is consistent with the statement that "foreign direct investment affects economic growth and reduces unemployment." Foreign direct investment has a negative impact on unemployment, according to empirical evidence. Here, we must emphasize that the positive impact on economic growth is dependent on the structure of FDI. (E. Djambaska, 2015)''.

The fourth column entailing the set of coefficients indicating the causal effects in the short run(SR) relationships, the reported results indicate that when the first different in electricity access rate increases by 1 percent this leads to the decline in the change in the unemployment rate by 1.6 point percent which is significant at p<0.05 in the short run relationships and this indicate the negative association between the change in unemployment rate and its first difference electricity access in the short run relationships. the reported results show that when the first difference in the foreign direct investment increases by 1 percent this leads to the decline in the change in the unemployment rate by 0.0073 point percent and this is significant at p<0.05 in the short run relationships and this indicate the negative association between the change in unemployment rate and first difference in foreign direct investment in the short run relationships. The reported results revealed that when the

first difference of change in real interest rate increased by 1 percent this leads to the decline of 0.9 point percent in the change in the unemployment rate in the short run relationships when all other factors are held fixed.

5. CONCLUSION AND RECOMMENDATION

The study carried out was aimed to investigate the effect of rural electrification program on the employment, since the rural electrification program leads to the infrastructural development and the developed infrastructure results to the economic development of the population through effective and economic use of the infrastructure especially the electrification by job and business creations and this leads to the incline in the employment rate resulting from the electricity access in the rural regions and hence the urbanization rate increase. The results revealed that the electricity access has a negative impact on the unemployment rate which enhance employment rate in rural areas. The foreign direct investment in energy sector is indirectly influencing the employment rate where the foreign funds from outside country donors like World Bank, International Monetary Fund (IMF), a crucial attention should be brought in the energy sector for the development of the sector like rural electrification program for rising the electrification rate which is then influence the employment rate positively.

Since the Government of Rwanda has the target of achieving the electrification rate of 100percent by 2024 according to (Mininfra, 2015) the foreign funds, investments and grants are prerequisite in the energy sector for reaching and achieving the goal of the 100 percent electricity access in the country and this rate will lead to the economic growth and increased employment rate resulting from business and jobs creation in different sectors of economy.

After the above results discovered the study recommends and invites more foreign direct investment in the energy sector and infrastructural development, the Government should improve the incentives and subsidy schemes for facilitating the residents to purchase and access the off-grid solutions like solar home systems and mini-grid for accelerating the electrification rate in the country by 2024.

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