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DOES ECONOMIC GROWTH CONTRIBUTE TO POVERTY REDUCTION? AN EMPIRICAL ANALYSIS EVIDENCE FROM RWANDA

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ABSTRACT

This study empirically analyzes whether economic growth contributed to poverty reduction in Rwanda over the period of 1980-2016. The study applied the Autoregressive - Distribution Lag bounds approach to testing for cointegration, as well Toda and Yamamoto (TY) Granger causality was used in testing for the directional causality among the variables in the study. The Autoregressive - Distribution Lag bounds test results confirm the cointegration between Household final consumption expenditure, Arable land growth rate (hectares), Gross capital formation growth rate (% of GDP), Government final consumption expenditure growth rate (% of GDP) and Service value-added growth rate, when the Household final consumption expenditure, Arable land growth rate and Gross capital formation growth rate are used as dependent variable. Additional, the results from Toda and Yamamoto Granger causality confirms a no evidence of causality association linking the poverty reduction to economic growth and vice versa while considering log Household final consumption expenditure and Arable land growth rate as dependent variables. This means that the neutrality hypothesis grips for Rwanda in the period covered by the study. Furthermore, the study finds out a proof of unidirectional causality running from Gross capital formation growth rate to government final consumption expenditure growth rate, as well as unidirectional causality running from Arable land growth rate to Government final consumption expenditure growth rate and Service value-added growth to Government final consumption expenditure growth rate. The study findings suggested that the government should adopt policy's objective which is focusing on poverty reduction and economic growth.

Contribution/ Originality: This study contributes in the existing literature on poverty in developing countries by investigating the causal relationship between economic growth and poverty reduction in Rwanda. It is also providing the basis for inspiration to both researcher and policymakers in line with the contribution of economic development towards poverty lessening.

1. INTRODUCTION

Poverty reduction is the central concern of every country especially developing countries where Rwanda is included. The main target of Rwanda development is focusing on poverty reduction. The change in poverty depends on various factors which include growth and also the amendment of income distribution that affect the

level of income inequality among the citizens in which turn build upon program and policies implemented. Nerveless, poverty in Rwanda is a result of both economic and historical backgrounds. Economic sufferings happened a long time ago as highlighted with evidence from 1980 and early 1990 that top to severe physical hitches. Additionally, the 1994 Tutsi genocide left the country into a terrible legacy which is not only the loss of human being but also a destroyed economy and horrific situations of poverty.

After all, the country has been putting more effort into implementing different economic policy reforms which target poverty reduction as well as economic growth. Currently, there is no or very limited empirical research that was undertaken to identify the contribution of economic progress on poverty decrease in Rwanda. This study was motivated by the research work of scholar (Bourguignon, 2003) who conducted much analysis on poverty, measuring the levels towards the economic growth that reduce poverty. Under this backdrop, the present study investigates empirically if economic growth contributes to poverty reduction in Rwanda. The main contribution of the paper consists of providing the basis for inspiration to both researcher and policymakers in line with the contribution of economic development towards poverty lessening. The paper also supplements the literature on poverty in developing countries by inspecting the fundamental linkage between economic progress and poverty reduction in Rwanda. We applied to time series data got from the Africa Development Bank dataset covering the period 1980 - 2016. Interested variables in the study were selected and empirically analyzed. To our understanding, this study is among others that analyzed in a detailed way the connection between economic growth and poverty reduction in Rwanda by use of contemporary time series methods.

The remaining of the paper is organized as follows; section two deals with the review of literature in relation to the research paper, the situation of poverty reduction in Rwanda and review of implemented programs and its achievements. Part three states the method used, while part four deals with the findings, discussions, and the final part highlights the conclusion.

2. REVIEW OF LITERATURE

No one can ignore the close connection involving economic growth and poverty slowdown in the literature. Different economic theories highlighted that economic growth performances play an important part in poverty lessening in any particular country. The supporters of this opinion believed that the profit increase in economic growth contributes to dropping down of the number of the poor people in the country. The current empirical study shepherding the contributions of macroeconomic growth in poverty reduction pointed out that the economic growth is a vital condition to carry out poverty decrease (Dollar and Kraay, 2002).

According to Adams (2004) in his research, highlighted inverse relationship between economic growth and poverty reduction. As economic growth increased, it contributed to a sustainable improvement in production capacity, a creation of opportunities which enable the population to improve their well-being. Definitely, this process contributed to poverty reduction due with the respect those poor individuals get means that help them get out from the poverty situations.

Current research analysis on time series data has resulted in an affirmative correlation between economic growth and poverty reduction (Dollar and Kraay, 2002; Janvry and Sadoulet, 2009; Balakrishnan *et al*., 2013). Poverty is a multi-dimensional concept and also difficult to define. Poverty can be explained by lack of means to safe drinking water, hygiene services, and facilities, shelter, health, food, and other basic necessary services. The update change in poverty reduction depends on economic growth and change in income allocation among the population as well (Bigsten and Drott, 2006).

Poverty is a worldwide issue which disturbs all nations and their respective population but in different levels (Oloyede, 2014) therefore every country can be a candidate for being poor but depending on how their government is committed to deal with poverty. Then, the intensity and prevalence of poverty will differ. Scholars contributed in to explain what poverty is and provided a different standing point of view. According to United Nations

Development Programme (UNDP) (2016) poverty is a complaint of scarce resources to attain the fundamental needs for humans such as nutrition, shelter, education, health, and others necessary to achieve the minimum standards of living conditions. Also, UNDP (1999) highlighted the human development index as a quantifier of poverty into three main dimensions like life expectancy at birth, education, and improvement in the standard of living measured by income per capita.

Sen (1993) explained poverty by using capability approach, shows that poverty is not understood as a problem of lack of income for obtaining the basic need but as a deprivation of human basic capabilities. While Americana (1989), explained poverty into two perspectives: (i) "money-less-ness" which can be understood as low financial resource and definitely there is a permanent deficiency of resource to meet the basic need, (ii) "powerlessness" understood as lack of freedom and choice available to them and their living conditions depend on and controlled by others.

The level of poverty depends on two important factors which are; an approximation of income and income inequality level, then as income increases, it leads to the reduction of poverty which differs from an increase in income inequality that contributes to poverty increment (Kakwani, 2000). United Nations (1995) highlighted that, poverty may be manifested in different forms such as absent or low income, scare resources for livelihoods, lack of food, sickness, low access to education, lack of means to clean water, insecure, deteriorated environment and social isolation and segregations. According to Anyanwu and Erhijakpor (2010) found positive and significant Gini coefficient index which indicated that high inequality is linked to high poverty. The findings were similar to the research results of Agénor (2002).

Poverty is a key concern to every country. Therefore, the country implemented different policies aimed at reducing poverty as well as enhancing economic growth (Ravallion and Chen, 2003; Bourguignon, 2004; Thorbecke, 2013). The high rate of poverty contributed to the delay of a country's economic growth. In that perspective, poverty reduction programs should be designed and implemented with the purpose of tracking out poverty and promote economic growth (Johannes and Tonda, 2011). To sum up, many studies highlighted that, neither economic growth is necessary nor yet a satisfactory condition to fight poverty (Ravallion, 1995; Rodrik, 2000) and also it was indicated that poverty matters are not all linked with economic growth (Ravallion, 1995).

2.1. Linking Economic Growth and Poverty

In exploring an economic growth role in poverty reduction, Dollar and Kraay (2002) highlighted economic progress as a resourceful key for poverty reduction in achieving development of nations. Poverty is the main problem for many underdeveloped countries and also remains thoughtful challenges for the management of the country. More importantly, the involvement of government in poverty reduction has played a significant role during the last decade in different countries. According to Chen and Ravallion (2009) in their research, a close linkage between economic growth and poverty reduction was found highlighting that poverty fell as the average of income increased in China.

Economic growth is defined to be the general rise in the gross domestic product which results from the value rise of total production or total revenue for a state (Angelsen and Wunder, 2006). The study conducted by Dollar and Kraay (2002) on "Growth is good for poor" found that the elasticity of the marginalized with respect to general income average greater than 1, which means that the increase of 1 percent to the general average increased income for the poor by about 1.07 percent. Therefore, an increase in economic growth contributes to poverty decrease (Anyanwu, 2013). In the study of Ulriksen (2012) it was found that the economic growth level denoted a reduced poverty rate in some selected developing countries.

Recent research also found that poverty improvement as a cause of economic growth is an unusual and special arrangement. According to Gary (1989) discovered that the high economic growth had a greater contribution to the poverty reduction. The study conducted by Roemer and Gugerty (1997) in 58 countries that include 26 developing

countries, the findings highlighted the average poor people benefit from economic growth in all of the countries. Certainly, economic growth seems to be the greatest option to deal with poverty reduction. The same study also highlighted the strong contribution of economic growth over the increase in income. Ravallion (1995) spotted a support for the hypothesis that economic growth decreases poverty in low-income countries.

Some other studies recently tried to measure the responsiveness of the change in poverty reduction due to economic progress. In the similar framework, Ravallion and Chen (1997) conducted research using cross-country regression based on selected 62 low-income countries, the result indicated that an average of 1% rise in per capita income contributed to a 3.1% decrease of people living below poverty line. Son and Kakwani (2004) research result showed that economic growth is a significant contributing factor to poverty reduction.

In contrast, Adams (2004); Balakrishnan *et al.* (2013) studies painted the level of effect of economic growth on poverty reduction, relies on preliminary income inequality condition. Therefore, increased growth is not enough to factor for poverty decrease but the way in which it is being distributed among the concerned, play a big role in reduction (Rizwanul, 2004). Also, Ravallion (1997) study indicated that the income inequality among poor people can increase poverty level regardless of good performance in growth.

In conclusion, the economic growth is a vital factor for poverty reduction but not a standalone factor of poverty reduction and, there is a need for proper distribution whereby poor people could benefit from economic growth.

2.2. Poverty Reduction in Rwanda

Poverty in Rwanda like any other African countries has been enlarged over the last few decades, whereas other parts of the world recognized improvement in poverty reduction (Bigsten and Drott, 2006). Rwanda poverty reduction situation replace a chronic failure to achieve high productivity. The problem of failure dated for a long time as evidence of the 1980s and early 1990 followed by 1994 genocide which left a terrible legacy. The inequality level had increased over time from 0.29 to 0.45 respectively in mid of 1980 up to the time of implementation of PRSP in 2000 (Bigsten and Drott, 2006) and also inequality increased in 2001 to 2006 from 0.47 to 0.51. According to Bizimana *et al.* (2012) poor people are the ones who do not have: enough land, low income, shelter, food, and little or no access to the basic needs of human beings. The high rate of inequality had been affecting the performance of Rwandan economy as well as expenditure of poor people.

Rwanda's trend in poverty was positive until the early 1980s, but it had changed due to the different circumstance such as 1994 genocide which claimed the lives of human beings as well as the destruction of the country's economy. The headcount index was around 45.7 percent of the total population in 1985. In 1990, production from agriculture decreased and the coffee price at the international market also declined this affected substantial per capita income. By 1993, the people who were living under poverty line were approximately 53% of the total population while from 1997 to 2000; it reached 70 to 64.1 percent of the total population respectively (The Government of Rwanda, 2000).

Additionally, Rwanda is a densely populated country in East - Central Africa and does not touch any seaport. It is characterized by rapid population growth over time, whereby in 1952 up to 2012 respectively, increased from 2,000,000 up to 10.537,222 total population (NISR, 2014). The population density increased from 321 to 412 persons per km^2 respectively from 2002 to 2012. Majority of the people live in rural areas and 80 percent of population employees are in agriculture sector but their production still very low (Bizimana *et al.*, 2012). The increase of population in Rwanda is a challenge as it is not proportioned to production level. According to the study conducted by McKay *et al.* (2007) on the cause of poverty in Rwanda, it was found that lack of land contributed to 49.5 percent share to poverty while poor soil and weather issue contributed respectively 10.9 to 8.7 percent of share.

Despite all those challenges, the government of Rwanda has committed and continued to implement different programs in line with poverty reduction and the achievements are visible over time to the decrease of poverty.

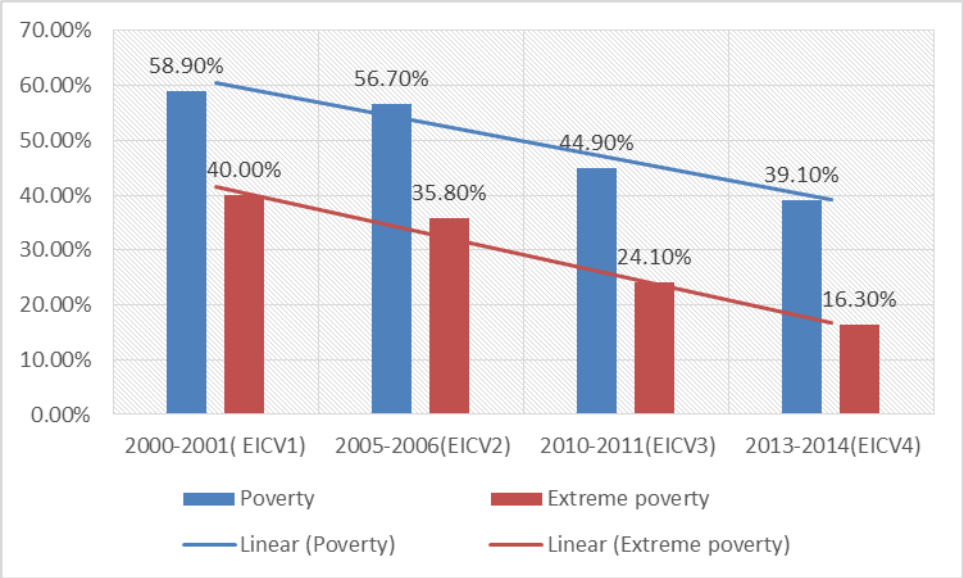

Figure-1. Rwanda distribution of Poverty and extreme poverty over time
Source: National Institute of Statistics of Rwanda (2015) and computed by Author

2.3. Poverty Reduction Programs and Achievements in Rwanda

Poverty is among fundamental hindrances in the development process of Rwanda. It is a result of political, economic as well as social collapses that the country went through. The country's economy organization replicates a chronic failure to get a high production that could be proportional to its rapid population growth. The failure of the economic increase happened in different periods such 1980s and at beginning of 1990 as well as in 1994 genocide (Ministry of Finance and Economic Planning (MINECOFIN), 2002). This situation affected the country and left a huge number of problems which make poverty deeper.

To tackle out those problems of poverty in Rwanda, a series of economic policy reforms were designed and implemented with the purpose of transforming the nation's economy from low income to middle-income country, meaning that from 290 to 900$ per capita income in the year 2000 to 2020 respectively (GoR, 2000b). In this regard, the vision 2020 was elaborated with a target of promoting knowledge-based economy, increased savings, and promotion of private sector, as well as reducing aid dependence from external. The vision was translated into achievable programs basing on the major pillars of vision. The pillars of vision 2020 were displayed in an achievable medium term.

Therefore, form 2001up to 2005, poverty reduction strategic paper (PRSP) was implemented focusing on key selected priorities to speed up poverty reduction process. The priorities were: Upgrading of rural and improve Agriculture, Promotion of Human development, infrastructure, Good governance, promotion of private sector. The program achieved a positive result whereby poverty reduced from 59 to 57% of people living under the poverty line (Ansoms and Rostagno, 2012). Despite the achievements of the program, some fundamental challenges still need to be addressed. Thus, there is a need of proper focus on public expenditure on poverty, improvement of basic services for the poor, rapid population and as well as the low capacity of the institutions that need to be improved since they weaken policy execution.

At the end of PRSP from 2008 to 2012, The Economic Development and Poverty Reduction Strategies I (EDPRS I) was implemented. The purpose of EDPRS I was to speed up economic growth and diversification with more involvement of the private sector. It was focusing on three main programs: Promotion of job creation and export, Vision *Umurenge* Program (VUP) and good governance. The achievement was observed in the economy which was stimulated by the growth of agricultural production, promotion of export and as well as increases in domestic demands. Thus, a significantly reduced poverty rate from 11.8% between 2005/6 and 2010/11 (NISR, 2012) was achieved. Additionally, in 2013- 2018 the EDPRSII was implemented with the purpose of concentrating

on sustainable growth and poverty reduction at countrywide among all categories of the populace. The rural areas were taken as a priority due to the persistence of high poverty and inequalities. EDPRS II also included other relevant programs like macroeconomic stability, food security, education, healthcare, etc… The program is still ongoing.

The mid-term evaluation of the program highlighted a good achievement in poverty reduction whereby poverty reduced from 44.9 to 39.1% respectively in 2010/1 to 2013/4 (NISR, 2016). Also, in the similar time, extreme poverty slowed down from 24.1 to 16.3 percent and also from 0.507 to 0.448 in Gini coefficient. In conclusion, Rwanda implemented programs showed little success stories in poverty reduction which is a good indicator for the government to go by and aspire for future improvement.

3. DATA AND METHODOLOGY

This paper consists of examining whether economic growth contributed to poverty reduction in Rwanda from 1980 to 2016. The paper has used the time series data retrieved from African Development Bank. The concern variables with study are poverty reduction as proxy by Household final consumption expenditure and also economic growth proxy by Arable land growth rate (hectares), Gross capital formation growth rate (% of GDP), Government final consumption expenditure growth rate (% of GDP) and Service value-added growth rate (% of GDP).

To conduct the analysis of whether economic growth affects poverty reduction in Rwanda, the paper specifies the variables such that poverty reduction has a negative and significant association with the economic growth. The linear function of the model is formulated as:

$$\mathrm{POVR} = \mathcal{F}(\mathrm{LALGR}, \mathrm{GCFR}, \mathrm{GFCR}, \mathrm{SVAR}) \quad (1)$$

Thus, the linearization of the above model can be represented as follow as:

$$\Delta POVR_t = \alpha + \beta_1 lALGR_t + \beta_2 GCFR_t + \beta_3 GFC_t + \beta_4 SVAR_t + \varepsilon_t \quad (2)$$

Where $\Delta \boldsymbol{POVR_t} =$ Change of poverty reduction in Rwanda proxy by changes in log household final consumption expenditure (LHFCE).

$\boldsymbol{\alpha} =$ Intercept, $\boldsymbol{LALR_{t=}}$ Log Arable land growth rate at time t (ha), $\boldsymbol{GCFR_t} =$ Gross capital formation growth rate at time t (% of GDP), $\boldsymbol{GFCER_t} =$ Government final consumption expenditure growth rate at time t (% of GDP), $\boldsymbol{SVAR_t} =$ Services value added growth rate at time t (% of GDP), $\boldsymbol{\varepsilon_t} =$ Error term and $\boldsymbol{\beta_1\ to\ \beta_4} =$ Slope which measures the influence of an explanatory variable on the explained variable (poverty).

The study has used ARDL bound testing approach to cointegration and Toda Yamamoto approach for Granger causality analysis.

3.1. Correlation Exploration

The relationships among the variables in this study were measured using correlation analysis. The paper adopts the Pearson correlation coefficient. This coefficient will show the statistical associations among the variables. The correlation is measured by applying the value between 1 and – 1 and may show positive or negative linkages. The variation of the coefficient is between 0.9 to 1 for strong positive correlation and 0.0 to 0.2 for weak positive correlation.

3.2. Test for Stationary

To test the nature of stationary or non-stationary as well as the order of integration in macroeconomic time series variable exhibit, a different test has been performed for instance Augmented Dickey-Fuller (ADF) test, Phillips-Perron test, and Ng-Perron test. By the truthfulness from the results in the model analysis of time series for stationary, more than one test has been used to test and confirm the result. This is an essential stage in the causality analysis.

Using the above tests, all variables in this study were tested at the level and first difference for stationarity. Error term in the series is referred to as white noise (Makarenko and Gordieieva, 2015). It is also assumed to be a series of uncorrelated variables with mean 0 and constant variance and Dickey-Fuller suggests an increase of test which includes extra lagged to predictor variable for avoiding autocorrelation.

Under this study, the ADF test considered three possible equation forms to test:

$$\Delta Y_t = \beta_1 Y_{t-1} + \sum_{j=1}^{p} \psi_i \Delta Y_{t-j} + \varpi_t \quad (3)$$

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{j=1}^{p} \psi_j \Delta Y_{t-j} + \varpi_t \quad (4)$$

$$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 t + \sum_{j=1}^{p} \psi_j \Delta Y_{t-j} + \varpi_t \quad (5)$$

Where Y_t stands for the variable under consideration in the study, Δ is differenced operator, ϖ_t represents the white noise error term while β_1, β_2, ψ_j stand for parameters.

3.3. Cointegration_ ARDL Bounds Test

In this paper, the current developed Autoregressive Distribution Lag bounds testing approach is applied in analyzing the long run cointegration association linking poverty reduction as a proxy by log Household final consumption expenditure and economic growth proxy by log Arable land growth rate (hectares), Gross capital formation growth rate (percentage of GDP), Government final consumption expenditure growth rate (percentage of GDP) and Service value-added growth rate (% of GDP) in Rwanda. This study uses ARDL bounds testing for cointegration as suggested by Pesaran *et al.* (2001). There exists various importance for using this approach that allows testing for cointegration despite the order of I (1) or I (0) or combining both. Next, it can be even applied if the sample size is small different from Johansen approach to cointegration. Lastly, Autoregressive Distribution Lag approach offers unbiased long-run estimates even if some of the variables are endogenous (Adom, 2011).

The Autoregressive Distribution Lag bounds testing approach involves the approximation of unrestricted error correction model as specified in the structure below where every variable comes in turn as a predicted variable:

$$\Delta lHFCE_t = \rho_0 + \sum_{i=1}^{a} \rho_{1i}\, \Delta lHFCE_{t-1} + \sum_{i=0}^{b} \rho_{2i}\, \Delta lALGR_{t-1} + \sum_{i=0}^{c} \rho_{3i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{d} \rho_{4i}\, \Delta GFC_{t-1} + \sum_{i=0}^{e} \rho_{5i}\, \Delta SVAR_{t-1} + \rho_6 lHFCE_{t-1} + \rho_7 lALGR_{t-1} + \rho_9 GCFR_{t-1} + \rho_{10} GFC_{t-1} + \rho_{11} SVAR_{t-1} + \omega_t \quad (6)$$

$$\Delta lALGR_t = \gamma_0 + \sum_{i=1}^{a} \gamma_{1i}\, \Delta lALGR_{t-1} + \sum_{i=0}^{b} \gamma_{2i}\, \Delta lHFCE_{t-1} + \sum_{i=0}^{c} \gamma_{3i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{d} \gamma_{4i}\, \Delta GFC_{t-1} + \sum_{i=0}^{e} \gamma_{5i}\, \Delta SVAR_{t-1} + \gamma_6 lHFCE_{t-1} + \gamma_7 lALGR_{t-1} + \gamma_9 GCFR_{t-1} + \gamma_{10} GFC_{t-1} + \gamma_{11} SVAR_{t-1} + \varpi_t \quad (7)$$

$$\Delta GCFR_t = \lambda_0 + \sum_{i=1}^{a} \lambda_{1i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{b} \lambda_{2i}\, \Delta lHFCE_{t-1} + \sum_{i=0}^{c} \lambda_{3i}\, \Delta lALGR_{t-1} + \sum_{i=0}^{d} \lambda_{4i}\, \Delta GFC_{t-1} + \sum_{i=0}^{e} \lambda_{5i}\, \Delta SVAR_{t-1} + \lambda_6 lHFCE_{t-1} + \lambda_7 lALGR_{t-1} + \lambda_9 GCFR_{t-1} + \lambda_{10} GFC_{t-1} + \lambda_{11} SVAR_{t-1} + \Psi_t \quad (8)$$

$$\Delta GFC_t = \kappa_0 + \sum_{i=1}^{a} \kappa_{1i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{b} \kappa_{2i}\, \Delta lHFCE_{t-1} + \sum_{i=0}^{c} \kappa_{3i}\, \Delta lALGR_{t-1} + \sum_{i=0}^{d} \kappa_{4i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{e} \kappa_{5i}\, \Delta SVAR_{t-1} + \kappa_6 lHFCE_{t-1} + \kappa_7 lALGR_{t-1} + \kappa_9 GCFR_{t-1} + \kappa_{10} GFC_{t-1} + \kappa_{11} SVAR_{t-1} + \phi_t \quad (9)$$

$$\Delta SVAR_t = \varphi_0 + \sum_{i=1}^{a} \varphi_{1i}\, \Delta SVAR_{t-1} + \sum_{i=0}^{b} \varphi_{2i}\, \Delta lHFCE_{t-1} + \sum_{i=0}^{c} \varphi_{3i}\, \Delta lALGR_{t-1} + \sum_{i=0}^{d} \varphi_{4i}\, \Delta GCFR_{t-1} + \sum_{i=0}^{e} \varphi_{5i}\, \Delta GFC_{t-1} + \varphi_6 lHFCE_{t-1} + \varphi_7 lALGR_{t-1} + \varphi_9 GCFR_{t-1} + \varphi_{10} GFC_{t-1} + \varphi_{11} SVAR_{t-1} + \Omega_t \quad (10)$$

Where, Δ stands for first difference operators, from **a** to **e** are number of lagged order of the variable, $\rho_{1i} \dots \dots \rho_{5i}; \gamma_{1i} \dots \dots \gamma_{5i}; \lambda_{1i} \dots \dots \lambda_{5i}; \kappa_{1i} \dots \dots \kappa_{5i}$ *and* $\varphi_{1i} \dots \dots \dots \varphi_{5i}$ stand for short-run coefficient, while

$\rho_6 \dots \dots \rho_{11}; \gamma_6 \dots \gamma_{11}; \lambda_6 \dots \lambda_{11}; \kappa_6 \dots \dots \kappa_{11}$ *and* $\varphi_6 \dots \dots \dots \varphi_{11}$ are the long run coefficients relationship, $\omega_t, \varpi_t, \Psi_t$, *and* Ω_t are the write noise errors.

From the above equations (6) to (10) the ARDL bounds testing method involves the test of the following null hypothesis of no cointegration between analyzed variables:

H_0:

$$\rho_6 = \rho_7 = \dots = \rho_{11} = 0; \gamma_6 = \gamma_7 \dots = \gamma_{11} = 0; \lambda_6 = \lambda_7 = \dots = \lambda_{11} = 0; \kappa_6 = \kappa_7 = \dots = \kappa_{11} = 0 \text{ and } \varphi_6 = \varphi_7 = \dots = \varphi_{11}$$

=0 contrary to alternative hypothesis of cointegration

H_1:

$$\rho_6 \neq \rho_7 \neq \dots \neq \rho_{11} \neq 0; \gamma_6 \neq \gamma_7 \dots \neq \gamma_{11} \neq 0; \lambda_6 \neq \lambda_7 \neq \dots \neq \lambda_{11} \neq 0; \kappa_6 \neq \kappa_7 \neq \dots \neq \kappa_{11} \neq 0 \text{ and } \varphi_6 \neq \varphi_7 \neq \dots \neq \varphi_{11} \neq$$

0

Based on calculated two critical values (lower and upper bound) by Pesaran *et al.* (2001) provide a test for cointegration. If the calculated f- statistic is more than upper bound value, then the null hypothesis is rejected, this shows an existence of cointegration among examined variables. Alternatively, if calculated f- statistic is below the lower bound critical value, the study failed to reject the null hypothesis which indicates a non-existence of cointegration between the concerned variable. Contrary, if calculated f- statistic lies between lower and upper bounds, so, the cointegration test befits indecisive.

3.4. The Toda and Yamamoto Approach to Granger Causality Test

The present study has used the Toda and Yamamoto (1995) approach to examine the causality between the variables concern with the study. This method approximates a VAR equation in level variables instead of differenced variables, importantly decreases the risk of incorrect identification order of integration (Wolde-Rufael, 2006). The main feature of the Toda and Yamamoto method is to increase the VAR equation using the maximum order of integration ($k+d_{max}$). The process involved in this method, first of all, decides the maximum order of integration for the collection of variables. Next is the specification of the VAR equation. Formulated as follows:

$$\begin{aligned} LHFCE_t = \vartheta_0 &+ \sum_{i=1}^{k} \beta_{1i} LHFCE_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_{2j} LHFCE_{t-j} + \sum_{i=1}^{k} \gamma_{1i} lALGR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \gamma_{2j} lALGR_{t-j} \\ &+ \sum_{i=1}^{k} \delta_{1i} GCFR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \delta_{2j} GCFR_{t-i} + \sum_{i=1}^{k} \eta_{1i} GFC_{t-i} + \sum_{j=k+1}^{k+d_{max}} \eta_{2j} GFC_{t-i} + \sum_{i=1}^{k} \zeta_{1i} SVAR_{t-i} \\ &+ \sum_{j=k+1}^{k+d_{max}} \zeta_{2j} SVAR_{t-i} + \varpi_{1t} \end{aligned} \quad (11)$$

$$LALGR_t = \tau_0 + \sum_{i=1}^{k} \rho_{1i}\, \mathrm{LHFCE}_{t-i} + \sum_{j=k+1}^{k+d_{max}} \rho_{2j}\, \mathrm{LHFCE}_{t-j} + \sum_{i=1}^{k} \varrho_{1i}\, lALGR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \varrho_{2j}\, lALGR_{t-j} + \sum_{i=1}^{k} \sigma_{1i}\, GCFR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \sigma_{2j}\, GCFR_{t-i} + \sum_{i=1}^{k} h_{1i}\, GFC_{t-i} + \sum_{j=k+1}^{k+d_{max}} h_{2j}\, GFC_{t-i} + \sum_{i=1}^{k} \mu_{1i}\, SVAR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \mu_{2j}\, SVAR_{t-i} + \varpi_{2t} \quad (12)$$

$$GCFR_t = \phi_0 + \sum_{i=1}^{k} \nu_{1i}\, \mathrm{LHFCE}_{t-i} + \sum_{j=k+1}^{k+d_{max}} \nu_{2j}\, \mathrm{LHFCE}_{t-j} + \sum_{i=1}^{k} \pi_{1i}\, lALGR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \pi_{2j}\, lALGR_{t-j} + \sum_{i=1}^{k} \psi_{1i}\, GCFR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \psi_{2j}\, GCFR_{t-i} + \sum_{i=1}^{k} \chi_{1i}\, GFC_{t-i} + \sum_{j=k+1}^{k+d_{max}} \chi_{2j}\, GFC_{t-i} + \sum_{i=1}^{k} \varphi_{1i}\, SVAR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \varphi_{2j}\, SVAR_{t-i} + \varpi_{3t} \quad (13)$$

$$GCF_t = \kappa_0 + \sum_{i=1}^{k} \varepsilon_{1i}\, \mathrm{LHFCE}_{t-i} + \sum_{j=k+1}^{k+d_{max}} \varepsilon_{2j}\, \mathrm{LHFCE}_{t-j} + \sum_{i=1}^{k} \varsigma_{1i}\, lALGR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \varsigma_{2j}\, lALGR_{t-j} + \sum_{i=1}^{k} \omega_{1i}\, GCFR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \omega_{2j}\, GCFR_{t-i} + \sum_{i=1}^{k} \alpha_{1i}\, GFC_{t-i} + \sum_{j=k+1}^{k+d_{max}} \alpha_{2j}\, GFC_{t-i} + \sum_{i=1}^{k} \Gamma_{1i}\, SVAR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \Gamma_{2j}\, SVAR_{t-i} + \varpi_{4t} \quad (14)$$

$$SVAR_t = \Upsilon_0 + \sum_{i=1}^{k} \Omega_{1i}\, \mathrm{LHFCE}_{t-i} + \sum_{j=k+1}^{k+d_{max}} \Omega_{2j}\, \mathrm{LHFCE}_{t-j} + \sum_{i=1}^{k} \Pi_{1i}\, lALGR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \Pi_{2j}\, lALGR_{t-j} + \sum_{i=1}^{k} \Lambda_{1i}\, GCFR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \Lambda_{2j}\, GCFR_{t-i} + \sum_{i=1}^{k} s_{1i}\, GFC_{t-i} + \sum_{j=k+1}^{k+d_{max}} s_{2j}\, GFC_{t-i} + \sum_{i=1}^{k} \mathrm{Z}_{1i}\, SVAR_{t-i} + \sum_{j=k+1}^{k+d_{max}} \mathrm{Z}_{2j}\, SVAR_{t-i} + \varpi_{5t} \quad (15)$$

Where k represents the optimal lag span of the VAR model, d_{max} stands for the maximum order of integration of the variables. Then, next stage is about determining the optimum number of lags to apply in the equation. The lag selection criteria were chosen after a reviewing Akaike Info criterion (AIC). To determine the Granger causality test on the above equations (10)-(15), the below null hypothesis for eq. (10) were tested:

H_0: $\gamma_{1i} = 0, \delta_{1i} = 0, \quad \eta_{1i} = 0, \zeta_{1i} = 0$

In contrast to the alternative hypothesis:

H_1: $\gamma_{1i} \neq 0, \delta_{1i} \neq 0, \quad \eta_{1i} \neq 0, \zeta_{1i} \neq 0$

This above hypothesis is also applied to the remaining equations. Thus, the rejection or acceptance of the null hypothesis will be focused on the Wald test. The steadiness of the equation will be tested using the CUSUM test and CUSUM squares test. When the plots line of CUSUM and CUSUM squares lies within the 5% significance level, this implies that there is significance and stable association among variables.

4. EMPIRICAL ANALYSIS RESULT

This part of the paper focuses on an empirical analysis of data and the findings on whether economic growth contributes to poverty reduction in Rwanda. By analysis, we started first with highlighting the level of integration of the series by performing different tests like Augmented Dickey-Fuller, Phillips and Perron test and also Ng-Perron unit root tests before conducting further econometric analysis due to the fact that sometimes the variables are non-stationary which may lead to overturning the standard of empirical outcomes. The study also uses Autoregressive Distribution Lag bounds testing approach for analyzing the long run cointegration among the variables and Toda and Yamamoto approach as well for examining Granger causality.

4.1. Descriptive Statistics and Correlation Matrix

Table 1 summarizes results of descriptive statistics and correlation coefficient among the concern variables with the study. The result shows that there is no problem of multicollinearity among explanatory variables. Results highlight a very strong negative linkage between log household final consumption expenditure and Log Arable land growth rate which means that if the increase of 1% in arable land growth rate (ha) contributed by 0.87% to decrease of poverty proxy by log household final consumption expenditure. Also, there is a strong negative association between Gross capital formation growth rates, Services value added growth rate to the poverty reduction (proxy by log household final consumption expenditure). This correlation outcomes show that if Gross capital formation, Services value added increase, this contributes to the reduction of poverty.

Finally, the results also disclose a moderate negative relationship between log household final consumption expenditure and Government final consumption expenditure growth rate.

Table-1. Descriptive Statistics and Correlation

Variables	LHFCRT	LNALRT	GCFRT	GFCT	SVART
Mean	1.9323	5.9737	17.9461	13.7018	45.4402
Median	1.9370	5.9445	16.6667	13.1892	46.9122
Maximum	2.0633	6.1065	26.5419	19.2097	51.5485
Minimum	1.8664	5.8451	9.9394	8.0332	29.0712
Std. Dev.	0.0447	0.0773	4.4030	2.9691	5.2458
LHFCRT	1.0000				
LNALRT	-0.8711	1.0000			
GCFRT	-0.7079	0.7061	1.0000		
GFCT	-0.5730	0.4966	0.0638	1.0000	
SVART	-0.8053	0.6862	0.5881	0.3435	1.0000

Source: Computed by author

4.2. Stationarity Tests Result

Even if the Autoregressive Distribution Lag bounds testing method does not need involving all variables in this study analysis to be held in the same rank of integration, it may need either that the variable should be integrated of order zero or one. But it would not be possible to apply this ARDL bounds test when the variables in the analysis are integrated on order two or more. Thus, imperative that in time series analysis before performing any causality test, the stationary must be checked for being sure that none is I(2) or even more than. In this perspective, the study used ADF test, PP test, and Ng-Perron test. Results of the performed tests are shown in the tables 2-3 below.

The findings highlighted in table 2 and 3 indicate that all variables are not stationary at levels [I (0)]. This indicates that the results reject the stationarity in the level of series variables respectively at 1%, 5% and 10% asymptotic critical values of significance.

Table-2. Unit Root Test Analysis: ADF and Phillips- Perron

	Augmented Dickey-Fuller (ADF)		Phillips Perron(PP)			
Variables	**Level**	**1st difference**	**Level**	**1st difference**	**Integration order**	**Conclusion**
LALR	-0.7309	-4.0432***	-0.4836	-3.9903***	I(1)	Stationary
GCFR	-1.8191	-5.5836***	-1.6717	-7.4458***	I(1)	Stationary
GFCER	-2.5052	-5.9092***	-2.5952	-5.9092***	I(1)	Stationary
SVAR	-2.8764	-8.3797***	-2.7785	-9.0184***	I(1)	Stationary
LHFCE	-1.7275	-7.32972***	-1.5479	-7.7430***	I(1)	Stationary

Notes: *** level of significance @ 1% *MacKinnon (1996) one-sided p-values selected lag based on AIC (Akaike Info Criterion) for ADF and Newy-west Bandwith for PP **Source:** Computed by author

Table-3. Ng-Perron test for Stationary on the first difference

Variables	**Ng-Perron test(include tend)**				**Decision**
	MZa	**MZt**	**MSB**	**MPT**	
DLALR	-15.487	-2.78132	0.17959	1.58722	Stationary
DGCFR	-16.4108	-2.86379	0.17451	1.49559	Stationary
DGFCER	-17.4861	-2.9568	0.16909	1.40135	Stationary
DSVAR	-16.7568	-2.88773	0.17233	1.48725	Stationary
LHFCE	-16.4981	-2.86703	0.17378	1.50384	Stationary
Critical values	Ng-Perron (2001, Table 1)				
1%	-13.8	-2.58	0.174	1.78	
5%	-8.1	-1.98	0.233	3.17	
10%	-5.7	-1.62	0.275	4.45	

Source: Computed by author

Thereafter, the variables were differentiated on the first difference and all of the variables turn into stationary as reported in tables 2 and 3 above. This implies that ADF test, PP test and Ng-Perron test used for the first difference of data series rejected the null hypothesis of non-stationary of the total variables under consideration in the current paper. Consequently, it is more important to conclude that, none of the variables employed in this study I (2) or higher.

4.3. Cointegration Test

The study adopted the use of ARDL bounds test approach for cointegration to test for the existence of cointegration within the variables for the long-run association. To conduct the ARDL bounds test, the suitable lag selection is paramount. To respond to this situation, the study has applied the AIC to choose exact lag length which can support the study in apprehending the active associations to choose the good ARDL model for estimation. Table 4 below shows the outcome from ARDL bounds test analysis. The results show that our calculated F-statistic for the equations (6) (2.8955) falls in between lower and upper bound critical values at 5% and 10% sig level. Consequently, rejecting the null hypothesis of the non-cointegration that implies an existence of cointegration among variables in the equation. Likewise, the results obtained from equation (7) shows that the computed F-statistic is more than upper bound critical values at 10% significance level, which implies that the null hypothesis of no cointegration is rejected, thus concluding that there is cointegration among the variables of equation(7). Results in table 4 also show that for eq. (8) the calculated F-statistic (4.2891) is greater than upper bound critical values at 5% and 10% significant level, rejecting the null hypothesis of the non-cointegration and the study concludes an existence of cointegration among variables in that equation. Contrary, the calculated F - statistic for equations (9) and (10) is lower than the lower bound critical values at 1%, 5%, and 10% significance levels. Therefore, the null hypothesis of no cointegration failure is refused and we confirm a no proof of cointegration. In general the

cointegration between variables in the series for this study confirms that the poverty reduction as proxy by log Household final consumption expenditure and also economic growth proxy by log Arable land growth rate (hectares), Gross capital formation growth rate (% of GDP), Government final consumption expenditure growth rate (% of GDP) and Service value-added growth rate (% of GDP) are cointegrated for long-run association under the period covered by the study in case of Rwanda.

Table-4. Bounds F-test for cointegration

Explained Variable	Function		I(0)----I(1) Bound @ %		
		F-stat	1%	5%	10%
LHFCE	LHFCE(LNALRT,GCFRT,GFCT,SVART)	2.8955	3.74---- 5.06	2.86----- 4.01	2.45--- 3.52
LNALRT	lNALRT (LHFCE, GCFRT, GFCT, SVART)	3.6621	3.74---- 5.06	2.86----- 4.01	2.45--- 3.52
GCFRT	GCFRT(HFCE,LNALRT,GFCT,SVART)	4.2891	3.74---- 5.06	2.86----- 4.01	2.45--- 3.52
GFCT	GFCT(HFCE, LNALRT,GCFRT,SVART)	2.7674	3.74---- 5.06	2.86----- 4.01	2.45--- 3.52
SVART	SVART(HFCE,LNALRT,GCFRT,GFCT)	1.9511	3.74---- 5.06	2.86----- 4.01	2.45--- 3.52

Note: The Critical values for the bounds test were obtained from Pesaran et al., (2001), p.300, Table CI(iii) Case IIII(0) = Lower bound critical Values I(1) = Upper bound critical value.
Source: Computed by author

4.4. Granger Causality Test Results

Due to the existence of cointegration in three equations (8, 9, and 10), the probability of causality is probable. Thus, the study tested the Granger causality by use of Toda and Yamamoto granger causality test analysis. Relying on the findings of the ADF, PP tests, and Ng-Perron tests, all variables in this study became stationary at first difference. Thus, the maximal order of integration d_{max} is integrated at order I (1). Consequently, the selection of optimal lag (k) was selected after appraising Akaike Info Criterion and Schwarz Info Criterion is 4. After deciding the maximal order of integration and lag length k, the autoregressive distributed lag model (VAR) befits (4+1) and is applied to estimate the VAR equations (11)-(15).

The study results from Granger causality are presented in table 5 below. Basing on the findings, the calculated P-value exceeds 0.05 significance level in equations 11 and 12. Thus, implies no proof of causality occurring either from poverty reduction to economic growth or from economic growth (proxy by log Arable land growth rate (hectares), Gross capital formation growth rate (% of GDP), Government final consumption expenditure growth rate (% of GDP) and Service value-added growth rate (% of GDP) to poverty considering log Household final consumption expenditure and Arable land growth rate as dependent variables. Hence, the study concludes that the neutrality hypothesis grips with these concern variables in equations (11) and (12). This means that neither of the policy programs in relation to poverty reduction has any effect on economic growth and vice versa.

Contrary, the study finds a proof of unidirectional causality running from Gross capital formation growth rate to government final consumption expenditure growth rate in the equation. (13). The calculated p-value 0.0363 is lower than 0.05. Thus, implies that the Ho of no causality is rejected and the study accepted the hypothesis of causality between highlighted variables. Similarly, table 5 below indicates the unidirectional causality running from Arable land growth rate to Government final consumption expenditure growth rate and Service value-added growth to Government final consumption expenditure growth rate in Eq. (14). Also, the unidirectional causality was found in Eq.(15) running from Gross capital formation growth rate to Service value-added growth and Government final consumption expenditure growth rate to Service value-added growth.

Table-5. Toda and Yamamoto Granger causality findings

Equation	Ho	X^2	df	Prob. value	Conclusion
11	LNALRT≠LHFCE	2.838922	4	0.5□5□	Do not reject H0
	GCFRT ≠ LHFCE	1□377653	□	0.8481	Do not reject H0
	GFCT ≠ LHFCE	2.2127□7	4	0.6967	Do not reject H0
	SVART ≠ LHFCE	1.913508	4	0.7517	Do not reject H0
12	LHFCE ≠ LNALRT	1.523145	4	0.8225	Do not reject H0
	GCFRT ≠ LNALRT	4.□1□306	4	0.4041	Do not reject H0
	GFCT ≠ LNALRT	2.134307	4	0.7111	Do not reject H0
	SVART ≠ LNALRT	1.950235	4	0.7449	Do not reject H0
13	LHFCE ≠ GCFRT	4.013544	4	0.4042	Do not reject H0
	LNALRT ≠ GCFRT	7.291282	4	0.12□3	Do not reject H0
	GFCT ≠ G□FRT	10.25766	4	0.0363	Reject H0
	SVART ≠ GCFRT□	4.518072	4	0.3404	Do not reject H0
14	LHFCE ≠ GFCT	6.678962	4	0.1539	Do not reject H0
	LNALRT ≠ GFCT	18.35055	4	0.0011	Reject H0
	GCFRT ≠ GFCT	5.630629	4	0.2285	Do□not reject H0
	SVART ≠ GFC□	11.76839	4	0.0192	Reject H0
15	LHFCE ≠ SVART	4.905569	4	0.2971	Do not reject H0
	LNALRT≠ SVART	0.885563	4	0.9266	Do not reject H0
	GCFRT ≠ SVART	11.31143	4	0.0233	Reject H0
	GFCT ≠ SVART	10.75062	4	0.0295	Reject□H0

Source: Computed by author

Table-6. Diagnostic test

Test	F□statistic	P-Value
χ2SERIAL	0.6557	0.0541
χ2ARC□	0.7084	0.5250
χ2REMSAY	2.8744	0.1508

Notes: χ2SERIAL stands for Breusch-Godfrey Serial Correlation LM Test, χ2ARCH represents Heteroskedasticity test and χ2REMSAY stand for Ramsey Rest Test **Source:** Computed by author

The study also checked the estimated ARDL model against the problem of serial correlation, heteroskedasticity, Ramsey Rest and the stability of the model. The table 6 above presents the results from those tests. The result from the serial correlation LM Test shows that the calculated p-value is higher than 0.05 significance level, thus, implying a non-problem of serial correlation. Similarly, the χ2ARCH results show the model passes the heteroskedasticity problem. Findings also indicate a well-stated model. The results on model stability using CUSUM and CUSUMSQ statistics highlighted the stability of estimated ARDL parameters since the plotted figures of the two tests are stable within the critical bounds at 5% sign level (see results on figures 2(a) and 2(b).

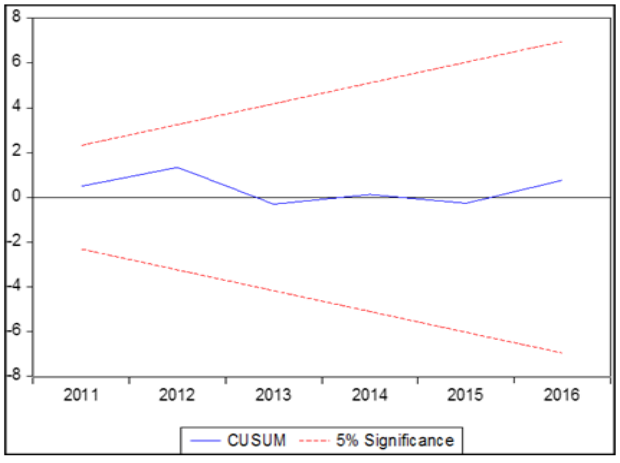

Fig-2(a). The plot of Cumulative Sum of Recursive Residuals
The straight lines stand for critical bounds at 5% significance level
Source: Drawn by the Author With the Aid of Eviews 8.0.

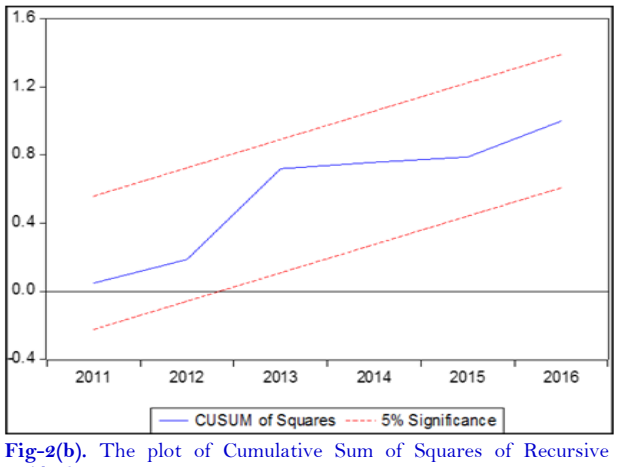

Fig-2(b). The plot of Cumulative Sum of Squares of Recursive Residuals
The straight lines stand for critical bounds at 5% significance level
Source: Drawn by the Author With the Aid of Eviews 8.0.

5. CONCLUSION

This paper analyzes empirically whether the economic growth contributes to poverty reduction in Rwanda from 1980 to 2016 using ARDL bounds test for cointegration, Toda and Yamamoto granger causality test. The study findings from the ARDL bounds test approach revealed the presence of cointegration among the variables. Findings confirm that the poverty reduction as proxy by log Household final consumption expenditure and also economic growth proxy by log Arable land growth rate (hectares), Gross capital formation growth rate (percentage of GDP), Government final consumption expenditure growth rate (percentage of GDP) and Service value-added growth rate (percentage of GDP) are cointegrated for long-run association under the period covered by the study in case of Rwanda.

The empirical results also show a non-existence of causality between the poverty reduction to economic growth and vice versa among variables in equations. (11) to (12). Thus, the findings of the study match with the neutrality hypothesis grips to the concerned variables, it implies that neither of the policy programs in relation to poverty reduction has any effect on economic growth and vice versa. Alternatively, there was a unidirectional causality running from Gross capital formation growth rate to government final consumption expenditure growth rate. This shows that an improvement in Gross capital formation is essential for a country's economic growth, which reduces poverty as well. Similarly, the unidirectional causality was found running from Arable land growth rate to Government final consumption expenditure growth rate and Service value-added growth to Government final consumption expenditure growth rate. In this case, any crisis in productivity of Arable land will affect government economic performance in Rwanda as its economy is based on agriculture. As well the policies promoting service are needed for purpose of strengthening the country economic growth, which could contribute to poverty reduction. The empirical results again found unidirectional causality running from Gross capital formation growth rate to Service value-added growth and Government final consumption expenditure growth rate to Service value-added growth. Generally, this study concludes by suggesting that the government should adopt policy's objective which is focusing on poverty reduction and economic growth.

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