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Determinants of Deposit and Lending Interest Rates in Rwanda: Econometric Approach

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Abstract: ***Economic history teaches us that Irving Fisher has studied the influence of expected inflation on interest rates. Many researchers have also contributed to this field of study. Many financial controversies and works of literature have analyzed this relationship. In Rwanda's context, few studies have been done in this regard as interest liberalizations are of recent past. In 1995, Rwanda has gained the full financial liberalization which had started in the early 1990s. The objective of this study is to analyze the determinants of bank interest rates. Generally, the commercial banks' lending interest rate is mainly determined, together with the deposit interest rate, by Gross Domestic Product (GDP), Money supply (M2), exchange rate, time, inflation, business environment, and risk. Therefore, this study's aim is to explore the relationship between macro-economic variables (GDP, M2, and Inflation) with the lending and deposit interest rates of commercial banks in Rwanda. The period 2006-2017 has been considered for the study. Macro-economic variables and lending rate satisfy Dickey-Fuller Test. Later, the dependent variables, lending, and deposit interest rates are regressed with the independent variables. The obtained residuals are again subjected to the Augmented Dickey-Fuller test. The result shows that the residuals are stationary, and the co-integration test proves that during the period of study, there is a significant relationship between the lending interest rate and Rwanda's macro-economic variables. The same was found for the deposit interest rate.***

Keywords: Gross domestic product, inflation rate, lending interest rate, deposit interest rate, co-integration, money supply, Rwanda

1. Introduction

Capital markets play a very important role because the company consults its services for its creation, operation, and development. Today, it is rare that the entrepreneur has sufficient capital to set up a powerful business. Therefore, it is economically essential to assess the cost of its borrowings. In general, the cost of borrowing takes the name of interest. Furthermore, if the interest referred to is that of a capital of 100 monetary units per unit of time, usually one year, interest is called interest rate.

From Plato, the legitimacy of the interest was a philosophical and moral problem (Frantzen, 1978: p34). The loan was never intended for investment in antiquity; Plato proposed that the loan remains friendly service while Aristotle took interest as a levy on excessive work of others; this conviction lasted for more than fifteen centuries after (Cedras, 1978: p8). St. Thomas Aquinas (1225-1274) argues as Aristotle that money cannot generate money. He says that interest is illegitimate. However, he accepts that there are possibilities of compensation for loss, lost profits, delay in maturity, and even major risk and that this is not selling the use of money, but receiving compensation (Frantzen, op.cit.pp64-7). It should be noted that in the early Middle Ages, only the bankers were money changers. After that, their activity has spread to the capital custody on which they charge a custody fee. During the Middle Ages, what the Church calls the development of artificial wealth through exchange and the handling of money is even more reprehensible that it opposes the spirit of detachment. However, the development of societies has put interest in business practice until the time when the goldsmiths became deposit-taking institutions. It was only a matter of time before arriving at the final stage of the modern bank by becoming lenders.

Indeed, bankers noted that withdrawals of bullion, previously deposited by their customers, compared with the new deposits were completely predictable. Thus, as they held gold reserves and money to cover any withdrawals, they could, without running much risk, lend money that they held in excess quantity. Thus, banks ceased to require a custody fee, and therefore they remunerate deposits with a lower interest rate than that applied to loans they grant to generate a profit while covering all costs related to their functions of financial intermediation. A more realistic understanding of the economy has emerged since the late Middle Ages where several authors have begun to defend the existence of the interest; Molina (1535-1600), John Calvin, Martin Luther, Josiah Child, William Petty, John Locke and Barbon (1690) among others for them there is the price of money lent. At the end of the Physiocrats Turgot was able to demonstrate that interest is the price of capital and not the price of money, thus ending the conviction imposed by Aristotle (CEDRAS, J. 1978: P12-86).

During the 20th century, John Maynard Keynes opposed the classical tradition according to which the interest rate is the factor that leads to balance investment demand and willingness to save, arguing that it is the price of giving up the liquidity and that it is based on demand and non-financial agents of the money supply in the banking system (Keynes, 1979: pp178-86). Within this framework, several

theories have been developed to identify the determinants of interest rates. Regarding the structure of interest rates, there are generally the term structure (term) and risk structure of interest rates. Note that the general theory of interest highlights four determinants that may influence the decision process in determining the lending interest rate (income) and the borrowing interest rate (expenses): preference time, the marginal productivity of capital, the money supply, and liquidity preference.

In the eighties, studies on developing countries found that in almost all of these countries the interest rates on loans and deposits were capped. For Rwanda, the minimum lending rate set by the National Bank of Rwanda, the review of July 1987, consisted of the following: financial cost of resources, 3%; loans management fee, 4%; risk premium, 1%; profit margin, 1%; that is the minimum lending rate of 9% in the financial sector (Kabayanja, 1988: pp104-110). Thus, in Rwanda, to control the interest rate there has been the use of restrictive credit policy and interest rates. But in the early nineties, there was carried out liberalization of the interest rate policy by the structural adjustment program, which let interest rates to fluctuate freely. So after such a period, it is important to consider the mechanisms that govern the determination of the level of interest rates on the financial market in Rwanda by examining the influence of major macroeconomic determinants of the lending interest rates in Rwanda. Finally, this research will help in updating all studies that have been carried out on interest rates in Rwanda.

2. Literature Review

2.1. Introduction

Interest has been variously defined and interpreted. Firstly, interest was conceived by Classical economists as the earnings of capital, that is, the rate of return on Capital. In other words, the marginal productivity of capital was called the rate of interest. Some Classical economists distinguished between the natural or real rate of interest and the market rate of interest. The market rate of interest is the rate at which funds can be borrowed in the market, while the natural or real rate of interest is the rate of return (marginal productivity of capital) on capital. When the natural rate of interest is higher than the market rate of interest, there will be greater investment in the capital with the result that the natural rate of interest (that is, the rate of return on capital) will fall. The equilibrium will be established when the natural rate of interest becomes equal to the market rate of interest.

Though Classical economists visualized interest as marginal productivity of physical capital, physical capital has to be purchased with monetary funds. Hence interest rate becomes a return on money invested in physical capital. But since the money to be invested in physical capital has to be saved by someone, interest also becomes the price for abstinence or waiting or time preference involved in the act of saving and lending it to others for investment in physical capital. Some of the Classical economists explained interest rates from the standpoint of the supply side, that is, savings and therefore emphasized the role of abstinence, or waiting or time preference in the determination of interest rate. On the other hand, Night and Clark explained the phenomenon of interest only from the viewpoint of demand for capital and laid stress on the productivity of capital as the determining factor of interest. Others like Irving Fisher, Böhm-Bawerk took into consideration both the demand aspects and supply factors in determining interest rates. It may be seen that the classical economists laid much stress on real factors such a thrift (that is, abstinence or waiting), time preference and productivity of capital in determining the interest rate. Therefore, Classical theory is also known as the real theory of interest.
Keynes considered interest as a monetary phenomenon and as such, it is determined by the demand for money (that is, liquidity preference) and the supply of money. According to Keynes, interest is a price not for the sacrifice of waiting or time preference but the price for parting with liquidity. Since Keynes emphasized the role of liquidity preference in the determination of interest rate, his theory is known as the liquidity preference theory of interest. Thus, the Keynesian theory of interest is purely a monetary theory. It is worth noting that all theories of interest seek to explain the determination of interest rates through the equilibrium between the forces of demand and supply. According to the Classicals, the demand for and supply of savings determine the rate of interest. Similarly, the Keynesian theory of interest explains the determination of interest through equilibrium between the demand for and supply of money.

2.2 Classical theory

As retrieved from http://www.economicsdiscussion.net, the classical theory of interest also known as the demand and supply theory was propounded by economists like Turgot, Ricardo, MountifortLongfield, J. S. Mill, and Irving Fisher. Later on, Pigou, Cassel, Knight, and Taussig worked to modify the theory. According to this theory, the rate of interest is determined by the intersection of demand and supply of savings. It is called the real theory of interest in the sense that it explains the determination of interest by analyzing the real factors like savings and investment. Individuals lend to defer consumption or for the sake of the greater quantity, they will be able to consume at a later date owing to interest earned. They borrow to anticipate consumption (whose relative desirability is reflected by the time value of money), but entrepreneurs also borrow to fund investment and governments borrow for their reasons. The three sources of demand compete for loans. Therefore, classical economists maintained that interest is a price paid for the supply of savings (Manoj K., 2019).

2.3 Keynes' liquidity preference theory of interest rate determination

The determinants of the equilibrium interest rate in the classical model are the 'real' factors of the supply of saving and the demand for investment. On the other hand, in the Keynesian analysis, determinants of the interest rate are the 'monetary' factors alone. Keynes' analysis concentrates on the demand for and supply of money as the determinants of the interest rate. According to Keynes, the rate of interest is a purely monetary phenomenon. Interest is the price paid for borrowed funds. People like to keep cash with them rather

than investing cash in assets. Thus, there is a preference for liquid cash.

2.4 IS-LM model

The IS-LM model, or Hicks-Hansen model, is a macroeconomic tool that shows the relationship between interest rates and assets market. The intersection of the "investment–saving" (IS) and "liquidity preference-money supply" (LM) curves models "general equilibrium" where supposed simultaneous equilibrium occurs in both interest and assets' markets. IS-LM analysis aims to find the level of income and rate of interest at which both the commodity market and money market will be in equilibrium. The IS curve is a locus of points representing all the different combinations of interest rates and income levels consistent with equilibrium in the goods or commodity market. The equilibrium in the two markets is represented graphically by the intersection of the IS and LM curves. The commodity market for a simple two-sector economy is in equilibrium when $Y = C + I$. The money market, on the other hand, is in equilibrium when the supply of money (M_s) equals the demand for money (M_d). The demand for money is in turn made up of the transaction-precautionary demand (M_{DT}) and speculative demand for money (M_{DS}).

3. Need and importance

This research on the determinants of the lending and deposit interest rates in Rwanda is undertaken; with the interest to understand how the lending and deposit interest rates are formed in Rwanda through savings and investment. Generally, there exists the role of the interest rates on the growth and economic development of countries in general. Therefore, this research main aim is to find out if actually, the process of fixing the lending and deposit interest rates in Rwanda takes into account macroeconomic theories that are suggested by different studies.

4. Methodology

The purpose of this section is to empirically verify the validity of theories developed in all that has preceded as far as economic practices are concerned in Rwanda. This will be achieved through statistical techniques for collecting and analyzing data, as well as methods of estimating econometric models, to identify the main determinants or factors that influence the level of lending and deposit interest rates in Rwanda.

The method is defined as "all the intellectual operations by which a discipline seeks to achieve the truths it continues, showing and verifying them (Grawitz, 1979: p. 344). The techniques are rigorous operative procedures, well-defined, transmittable, that could be applied again under the same conditions adapted to similar problems and phenomena in question (GRAWITZ, M., op.cit. P345).

This research has used methods, such as comparative, dialectic, and systemic together with documentary, statistical and econometric techniques in verifying the formulated hypotheses. This study has been carried out based on secondary data collected from the official web sites of the National Bank of Rwanda and the National Institute of Statistics of Rwanda to analyze the relationship between macroeconomic variables and bank interest rates for 12 years from 2006 to 2017. The stationarity of data has been tested by using augmented dickey fuller and further processed these data to test the relationship between the variables (lending interest rate, deposit interest rate, GDP, inflation and M2) by using Engle-Granger Co-integration technique.

Augmented Dickey-Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey-Fuller test for a larger and more complicated set of time series models. The augmented Dickey-Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. The testing procedure for the ADF test is the same as for the Dickey-Fuller test but it is applied to the model $\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$.

Where α is a constant, β the coefficient on a time trend and ρ the lag order of the autoregressive process. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modeling a random walk and using the constraint $\beta = 0$ corresponds to modeling a random walk with a drift. By including lags of the order ρ the ADF formulation allows for higher-order autoregressive processes. This means that the lag length ρ has to be determined when applying the test. One possible approach is to test down from high orders and examine the t-values on coefficients. An alternative approach is to examine information criteria such as the Akaikeinformation criterion, Bayesian information criterion or the Hannan-Quinn information criterion.The unit root test is then carried out under the null hypothesis $\gamma = 0$ against the alternative hypothesis of $\gamma < 0$.

$$DF_T = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$

Once a value for the test statistic is computed it can be compared to the relevant critical value for the Dickey-Fuller Test. If the test statistic is less (this test is non-symmetrical so we do not consider an absolute value) than (a larger negative) the critical value, then the null hypothesis of $\gamma = 0$ is rejected and no unit root is present.The intuition behind the test is that if the series is integrated then the lagged level of the series (y_{t-1}) will provide no relevant information in predicting the change in y_t besides the one obtained in the lagged changes(Δy_{t-k}). In that case, the $\gamma = 0$ null hypothesis is not rejected.

Hypothesis on the stationarity of data

Null hypothesis: H_1 : Time Series Data is Stationary

Alternative hypothesis:H_0: Time Series Data is Non-Stationary

5. Results and discussion

5.1 Stationarity test

Testing of stationarity for the lending interest rates:

Null Hypothesis: D(LENDING_INTEREST_RATE) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.195595	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	
*MacKinnon (1996) one-sided p-values.			

The data have revealed that the first difference of the series is stationary at a 5% critical value. The model includes an intercept and is estimated using a sample of 46 observations after adjustments and yields the statistic of −8.19. This is more negative than the tabulated critical value of −2.93 at the 95 percent confidence level. Therefore, the null hypothesis of a unit root is rejected. Also, the probability of the t-statistic is zero which is less than 5% critical value.

Testing of stationarity for the deposit interest rates:

Null Hypothesis: DEPOSIT_INTEREST_RATE has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.583708	0.1034
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D(DEPOSIT_INTEREST_RATE) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.826618	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	
*MacKinnon (1996) one-sided p-values.			

The data have revealed that the first difference of the series is stationary at a 5% critical value. The model includes an intercept and is estimated using a sample of 46 observations after adjustments and yields the statistic of −5.83. This is more negative than the tabulated critical value of −2.93 at the 95 percent confidence level. Therefore, the null hypothesis of a unit root is rejected. Also, the probability of the t-statistic is zero which is less than 5% critical value.

Testing of stationarity for quarterly GDP growth:

Null Hypothesis: GDP_GROWTH has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.180363	0.0018
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

The data have revealed that quarterly GDP growth series is stationary at a 5% critical value. The model includes an intercept and is estimated using a sample of 46 observations after adjustments and yields the statistic of −5.18. This is more negative than the tabulated critical value of −2.93 at the 95 percent confidence level. Therefore, the null hypothesis of a unit root is rejected. Also, the probability of the t-statistic is almost zero (0.0018) which is less than 5% critical value.

Testing of stationarity for CPI

Null Hypothesis: CPI has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.824845	0.3643
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values			

As indicated above CPI levels are not stationary, however, its quarterly growth series is stationary as indicated in the following estimation results. The CPI first difference series is stationary which indicates that CPI level series is integrated of order one.

Null Hypothesis: CPI_GROWTH has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.149515	0.0020
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

The data have revealed that quarterly CPI growth series is stationary at a 5% critical value. The model includes an intercept and is estimated using a sample of 46 observations after adjustments and yields the statistic of −4.15. This is more negative than the tabulated critical value of −2.93 at the 95 percent confidence level. Therefore, the null hypothesis of a unit root is rejected. Also, the probability of the t-statistic is almost zero (0.0020) which is less than 5% critical value.

Testing of stationarity for M2:

Null Hypothesis: M2_BILLION_RWF has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.460300	0.9835
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

As indicated above M2 level are not stationary, however, its quarterly growth series is stationary as indicated in the following estimation results. The M2 first difference series is stationary which indicates that M2 level series is integrated of order one.

Null Hypothesis: M2_GROWTH has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.099071	0.0000
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

The data have revealed that the first difference of the M2 quarterly series is stationary at a 5% critical value. The model includes an intercept and is estimated using a sample of 46 observations after adjustments and yields the statistic of −6.10. This is more negative than the tabulated critical value of −2.93 at the 95 percent confidence level. Therefore, the null hypothesis of a unit root is rejected. Also, the probability of the t-statistic is zero which is less than 5% critical value.

5.2 Co-integration – Lending interest rate

Since the first difference of the data series for the lending interest rate, the gross domestic product, the consumer price index and the money supply are proved to be stationary, the test for co-integration is executed to evaluate if these four variables are linearly related. *Engle-Granger Co-integration* technique is utilized in this study due to its simplicity and reliability. Theresiduals obtained are tested for stationarity using the ADF test. If this residual series is proved to be stationary then it can be said that a relationship exists between the lending interest rates, the gross domestic product, the consumer price index and money supply over the long term.

5.3 Regression– Lending interest rate

A regression of the lending interest rate on GDP, CPI, and M2 is run using E-Views software. The output of the regression is as follows.

Dependent Variable: LENDING_INTEREST_RATE				
Method: Least Squares				
Date: 01/26/19 Time: 14:59				
Sample: 2006Q1 2017Q4				
Included observations: 48				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.88812	0.565302	22.79867	0
GDP_BILLION_RWF	-0.001639	0.000859	-1.907617	0.063
CPI	0.058675	0.012132	4.836347	0
M2_BILLION_RWF	0.000199	0.000212	0.9401	0.3523
R-squared	0.77093	Mean dependent var		16.79653
Adjusted R-squared	0.755312	S.D. dependent var		0.556609
S.E. of regression	0.275332	Akaike info criterion		0.337976
Sum squared resid	3.335537	Schwarz criterion		0.49391
Log-likelihood	-4.111432	Hannan-Quinn criter.		0.396904
F-statistic	49.36038	Durbin-Watson stat		1.355734
Prob(F-statistic)	0			

Next, we check the stationarity of the residuals obtained. If the residuals are stationary, then the four variables are said to co-integrate with each other, i.e., there exists a relationship between the lending interest rate and macroeconomic variables (GDP, CPI, and M2). The results obtained are as follows:

Null Hypothesis: RESID_1 has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.940009	0.0002
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID_1)				
Method: Least Squares				
Date: 01/26/19 Time: 15:25				
Sample (adjusted): 2006Q2 2017Q4				
Included observations: 47 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_1(-1)	-0.691076	0.139894	-4.940009	0
C	0.005651	0.03723	0.151783	0.88
R-squared	0.351619	Mean dependent var		0.004446
Adjusted R-squared	0.337211	S.D. dependent var		0.313507
S.E. of regression	0.255231	Akaike info criterion		0.148329
Sum squared resid	2.93144	Schwarz criterion		0.227059
Log-likelihood	-1.485742	Hannan-Quinn criter.		0.177956
F-statistic	24.40368	Durbin-Watson stat		1.897926
Prob(F-statistic)	0.000011			

5.4 Findings– Lending interest rate

The above results show that residuals are stationary at a 5% critical value. Hence, there is enough evidence of the existence of a relationship between the lending interest rate, the gross domestic product, the consumer price index, and money supply (M2) in Rwanda. Also, keeping in view the regression statistics, i.e., the values of the F-test and significance of the test, it can be said that there is a significant relationship between interest rates, GDP, CPI, and M2 in Rwanda.

5.5 Conclusion – Lending interest rate

This paper has attempted to study the existence of a relationship between the lending interest rates, the gross domestic product, the consumer price index and money supply. The data has been tested for stationarity and then put to further use. The stationarity was tested using the Augmented Dickey-Fuller test (ADF) which revealed that the data were integrated of order 1. The persistence of a

relationship between the lending interest rates and the above-mentioned macroeconomic variables was tested using the Engle-Granger co-integration test. This test involves running a regression of long term lending interest rates on the above-mentioned macroeconomic variables. The test has thrown up a list of residuals. These residuals were then tested for stationarity, the result of which proved the existence of a relationship. This test showed a significant relationship between the four variables for the particular study period. From the above ADF and Granger co-integration test, it can be said that there is a significant relationship between the lending interest rates, the gross domestic product, the consumer price index and money supply during the period of study .i.e., from 2006 to 2017.

5.6 Co-integration – Deposit interest rate

Since GDP growth, CPI growth and M2 growth data series are proved to be stationary as well as the first difference of deposit interest rate, now the test for co-integration is executed to evaluate if these four variables are linearly related. *Engel-Granger Co-integration* technique is utilized in this study due to its simplicity and reliability. Theresiduals obtained are tested for stationarity using the ADF test. If this residual series is proved to be stationary then it can be said that a relationship exists between interest rates and inflation over the long term.

5.7 Regression– Deposit interest rate

A regression of the deposit interest rate on quarterly GDP growth, quarterly CPI growth, and quarterly M2 growth is run using E-Views software. The output of the regression is as follows.

Dependent Variable: DEPOSIT_INTEREST_RATE				
Method: Least Squares				
Date: 01/27/19 Time: 17:25				
Sample: 2006Q1 2017Q4				
Included observations: 48				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.713134	0.374083	23.29197	0.0000
GDP_GROWTH	-0.108511	0.045431	-2.388490	0.0213
CPI_GROWTH	-13.19367	9.395603	-1.404239	0.1673
M2_GROWTH	0.021060	0.032158	0.654880	0.5160
R-squared	0.204653	Mean dependent var		7.865924
Adjusted R-squared	0.150424	S.D. dependent var		1.099888
S.E. of regression	1.013793	Akaike info criterion		2.944930
Sum squared resid	45.22217	Schwarz criterion		3.100864
Log-likelihood	-66.67832	Hannan-Quinn criter.		3.003858
F-statistic	3.773911	Durbin-Watson stat		0.768372
Prob(F-statistic)	0.017048			

Next, we check the stationarity of the residuals obtained. If the residuals are stationary, then the four variables are said to co-integrate with each other, i.e., there exists a relationship between the deposit interest rate and key macroeconomic variables (GDP growth, CPI growth, and M2 growth). The results obtained are as follows:

Null Hypothesis: RESID_DEPO has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=0)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.278181	0.0216
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	
*MacKinnon (1996) one-sided p-values.			

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(RESID_DEPO)				
Method: Least Squares				
Date: 01/27/19 Time: 17:35				
Sample (adjusted): 2006Q2 2017Q4				
Included observations: 47 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID_DEPO(-1)	-0.385200	0.117504	-3.278181	0.0020
C	0.003352	0.115163	0.029103	0.9769
R-squared	0.192774	Mean dependent var		0.001081
Adjusted R-squared	0.174836	S.D. dependent var		0.869125
S.E. of regression	0.789500	Akaike info criterion		2.406789
Sum squared resid	28.04899	Schwarz criterion		2.485518
Log-likelihood	-54.55953	Hannan-Quinn criter.		2.436415
F-statistic	10.74647	Durbin-Watson stat		1.866137
Prob(F-statistic)	0.002019			

6. Findings– Deposit interest rate

The above results show that residuals are stationary at a 5% critical value. Hence, there is enough evidence of the existence of a relationship between the deposit interest rate, the gross domestic product growth, the consumer price index growth, and the money supply (M2) growth in Rwanda. Also, keeping in view the regression statistics, i.e., the values of the F-test and significance of the test, it can be said that there is a strong between deposit interest rates, GDP growth, CPI growth, and M2 growth in Rwanda.

7. Conclusion– Deposit interest rate

This paper has attempted to study the existence of a relationship between the deposit interest rates, the gross domestic product, the consumer price index and money supply. The data has been tested for stationarity and then put to further use. The stationarity was tested using the Augmented Dickey-Fuller test (ADF) which revealed that the data were stationary. The persistence of a relationship between the deposit interest rates and the above-mentioned macroeconomic variables was tested using the Engle-Granger co-integration test. This test involves running a regression of long term lending interest rates on the above-mentioned macroeconomic variables. The test has thrown up a list of residuals. These residuals were then tested for stationarity, the result of which proved a relationship. This test showed a significant relationship between the four variables for the particular study period.

8. Scope for Further Study

This research has shown the effect of gross domestic product, the consumer price index, and money supply on the lending interest rate and the deposit interest rate. The lending interest rate is always greater than the deposit interest rate to enable the commercial banks to make profits, pay employees, etc, further research can be done to examine the components of Rwanda's deposit and lending interest rates.

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Appendix 1: Interest rates and inflation rates from 2006 to 2017

Quarter	Time	Lending interest rate	Inflation rate
2006 Q1	1	15.45	1.75
2006 Q2	2	15.58	1.76
2006 Q3	3	16.23	1.76
2006 Q4	4	16.2	1.77
2007 Q1	5	15.99	1.77
2007 Q2	6	15.9	1.78
2007 Q3	7	16.05	1.78
2007 Q4	8	15.95	1.79
2008 Q1	9	16.06	1.79
2008 Q2	10	16.24	1.8
2008 Q3	11	16.32	1.8
2008 Q4	12	16.39	1.81
2009 Q1	13	16.08	1.81
2009 Q2	14	16.78	1.82
2009 Q3	15	17.42	1.82
2009 Q4	16	16.61	2.42
2010 Q1	17	16.77	-1.4
2010 Q2	18	17	1.13
2010 Q3	19	16.98	0.01
2010 Q4	20	17.26	0.47
2011 Q1	21	16.37	0.95
2011 Q2	22	16.69	3.63
2011 Q3	23	16.86	1.9
2011 Q4	24	16.75	1.15
2012 Q1	25	16.51	1.07
2012 Q2	26	16.8	2.77
2012 Q3	27	16.91	0.58
2012 Q4	28	16.58	0.13
2013 Q1	29	17.13	1.03
2013 Q2	30	17.49	1.9
2013 Q3	31	17.49	1.11
2013 Q4	32	17.16	0.34
2014 Q1	33	17.12	-0.27
2014 Q2	34	17.39	0.85
2014 Q3	35	17.24	0.05
2014 Q4	36	17.28	0.45
2015 Q1	37	17.44	-0.36
2015 Q2	38	17.49	1.83
2015 Q3	39	17.31	1.06
2015 Q4	40	17.1	1.48
2016 Q1	41	17.12	0.08
2016 Q2	42	17.17	2.24
2016 Q3	43	17.53	2.46
2016 Q4	44	17.35	2.1
2017 Q1	45	17.04	0.75
2017 Q2	46	17.11	0.75
2017 Q3	47	17.41	-0.15
2017 Q4	48	17.12	0.8

Source: National Bank of Rwanda and National Institute of Statistics of Rwanda

Appendix 2

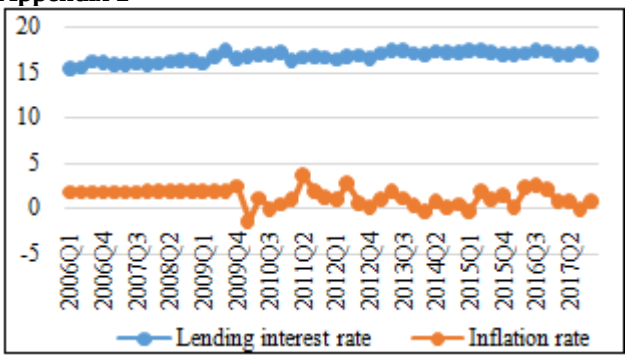

Figure 1: Quarterly inflation and bank lending interest rate