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Empirical Analysis of the Determinants of Interest Rate in Rwanda

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Abstract: *The purpose of this paper was to analyze empirically the determinants of interest rate in Rwanda. The specific objectives were to analyze the trends of interest rate, Investment, Money supply and National Saving in Rwanda, to find the relationships between, Money supply, Investment, National Saving and Interest rate in Rwanda. The findings showed that there were the upward and downward trends between Interest rate and its Determinants in Rwanda, and Determinants of Interest rate has both short run and long run relationship. Furthermore, interest rate, money supply and national saving have the same trend which was an upward trend and there was a long and short run relationship that exist between interest rate, Money supply and investment but negatively. However, the provided recommendations were to reinforce national saving and money supply in the economy, thus these will have a positive impact on interest rate in Rwanda and the Government of Rwanda should continue to encourage investors to invest in Rwanda and may continue to revive the money supply in order to reduce inflation.*

Keywords: *Determinants, interest rate, Investment, Money supply and National Saving*

1. INTRODUCTION

The Interest Rates presents a very readable account of interest rate trends and lending practices over four millennia of economic history, (Homer, Sylla & Sylla 1996). However, this paper was focusing on time series data analysis to investigate the relationship between interest rate and its determinants in Rwanda from 2000 up to 2015.

2. BACKGROUND

In the past two centuries, interest rates have been variously set either by national governments or central banks. Moreover, many economists theorize that interest rates reflect productivity and profit levels, subject to the risks of lending. However, A century ago, the economic historian attributed the long decline in interest rates since antiquity to the advance of civilization, (Homer, Sylla & Sylla 1996).

The suggestion of that economic historian, these rates declined because the riskiness of investment, for example, had been lessened by improvements in social stability, market efficiency and the security of credit. Also, shrinking profit margins and/or falling yields of cattle or crops would have reduced the ability of debtors to pay interest, (Homer, Sylla&Sylla 1996). Furthermore, the Federal Reserve federal funds rate in the United States has varied between about 0.25% to 19% from 1954 to 2008, while the Bank of England base rate varied between 0.5% and 15% from 1989 to 2009, and Germany experienced rates close to 90% in the 1920s down to about 2% in the 2000s. During an attempt to

tackle spiraling hyperinflation in 2007, the Central Bank of Zimbabwe increased interest rates for borrowing to 800%, (William Ellis and Richard Dawes, 1857).

The interest rates on prime credits in the late 1970s and early 1980s were far higher than had been recorded, higher than previous US peaks since 1800, than British peaks since 1700, or than Dutch peaks since 1600; "since modern capital markets came into existence, there have never been such high long-term rates" as in this period, (William Ellis and Richard Dawes, 1857).

Possibly before modern capital markets, there have been some accounts that savings deposits could achieve an annual return of at least 25% and up to as high as 50%, (William Ellis and Richard Dawes, 1857). Furthermore, In Europe, When the ECB (European Central Bank) was created, it covered a Eurozone of eleven members. In April 2011, the ECB raised interest rates for the first time since 2008 from 1% to 1.25%, with a further increase to 1.50% in July 2011. However, in 2012–2013 the ECB sharply lowered interest rates to encourage economic growth, reaching the historically low 0.25% in November 2013. Soon after the rates were cut to 0.15%, then on 4 September 2014 the central bank reduced the rates by two thirds from 0.15% to 0.05%, the lowest rates on record, (Fairlamb, David; Rossant, John , 2003). Moreover, In South Africa, the interest rates decisions are taken by the South African Reserve Bank's Monetary Policy Committee (MPC). The official interest rate is the repo rate. This is the rate at which central banks lend or discount eligible paper for deposit money banks, typically shown on an end-of-period basis. The South African Reserve Bank left its benchmark repo rate on hold at 7 percent as widely expected, at its July 21st meeting. Policymakers noted the inflation is expected to accelerate further this year and the economy is anticipated to have a weak recovery after the contraction in the first quarter, (Peter Bernholz 2003).

Interest Rate in South Africa averaged 12.90 percent from 1998 until 2016, reaching an all-time high of 23.99 percent in June of 1998 and a record low of 5 percent in July of 2012. Interest Rate in South Africa is reported by the South African Reserve Bank, **(Peter Bernholz 2003).**

In the Nigerian economy has at different times witnessed enormous interest rate swings in different sectors of the economy since the 1970s and mid 1980s under the regulated regime. The preferential interest rates were based on the premise that the market, if freely applied would exclude some priority sectors. Thus, interest rates were adjusted through the "invisible hand" in order to promote increased level of investment in the various preferred sectors of the economy, (Marini and Giancarlo, 2000). Prominent among the preferred sectors were the agricultural, manufacturing and solid mineral sectors which were accorded priority and deposit money banks were directed to charge preferential interest rates on all loans to encourage the upsurge of small-scale industrialization which is a catalyst for economic development (Marini and Giancarlo, 2000).

Closely followed by the regulated interest rate regime was the interest rate reform, a policy evolved under the financial sector liberalization. The policy was put in place to achieve efficiency in the financial sector, thus, engendering financial deepening. In Nigeria, financial sector reforms started with the deregulation of interest rate in August, 1987 (Lee and Prasad, 1994).

In the case of Rwanda, the monetary field direct credit restrictions were removed in 1992. To carry out its monetary policy, the BNR adopted indirect control mechanisms, i.e. the reserve ratio requirement, the discount rate and the interventions on the money market. Interest rates were completely liberalized in 1996, as lending and borrowing rates became freely negotiable between banks and their customers; the money market came into effect in 1997 and the Central Bank lending rate was introduced in 2005, (Nkurunziza J. Désiré 2006).

The aggregate demand of Rwanda reacts slightly to variation of lending interest rate. The interest rate elasticity of GDP and credit demand are low (-0.17 and -0.4 respectively). This situation is due to the low levels of monetization (M2/GDP) and financial intermediation (total bank assets, deposit and credit to GDP), (BNR, Annual report 2013/2014 P15).

Over the period 2003-2006, ratios M2/GDP and credit/GDP varies respectively from 16.4% and 17.5%, and from 9.5% and 10.2%. The weak level of competition of bank system in Rwanda can also explain the low interest rates sensitivity of demand deposits, credit demand and the spread of interest rate which varied between 6% and 9%, over the period 1995-2006, (Etienne Ntaganda, 2006).

The channel works via the influence of monetary policy on the supply of bank loans. In other words, the impact is on the quantity rather than the price of credit. A contractionary monetary policy reduces bank reserves and therefore limits banks' ability to supply loans. Consequently, this lead to a fall in investment by bank dependent borrowers and possibly in consumer spending. However, the high excess reserves can make commercial banks in Rwanda indifferent to restrictive policy measures and limiting the effectiveness of credit channel, (Kigabo, 2009, P.125).

This situation may also reflect the weak relationship between Rwandan economic agents and the banking system in the financing of their activities, in the context of the structure of the economy, the term of available financing, and the importance of the non-bank and informal financial sectors (UBPR, microfinance institutions…). Notably, agriculture, which contributes more than 40% to GDP, accounts of about 3% of total credit volume. With respect to bank deposits, more are in the form of notice (44.6% in 2006) than in term of deposits (29.8%). This situation leads banks to grant more short-term than long-term credits, and such a market cannot satisfy the needs of many borrowers, (Kigabo, 2009, P.125).

The growing importance of the non-bank and informal financial sector is demonstrated by its contribution to the financing of the economy. In 2006, the financing of this sector represented 29.6% of total credit. This constitutes an important limit on the effectiveness of the credit and interest rate channels. Nonetheless, the upward trend of credit demand by the private sector observed for several years, stemming from the dynamism of the Rwandan economy, is evidence of the contribution of the credit channel in recent years, (Kigabo, 2009, P.125).

There was a significant difference between the increase in money supply, M2, (+31.25%) and that of the nominal GDP (+13%). Moreover, this difference is explained by the fast monetization of the economy that took place in 2007, while maintaining inflation at a moderate level. However, Money supply increased by 31.25%, from RWF 285.6 billion to RWF 374.9 billion between December 2006 and December 2007, as a result of the accumulation of net external reserves (+23.4%) and a fast increase in credit to the private sector (+20.9%). On the other hand, over the same period, the net credit to Government dropped by 16.8%, due to the accumulation of its deposits in the banking system, (Kigabo, 2009, P.128).

As regards currency demand, average deposits and fiduciary currency respectively accounted for 82.4% and 17.6% of money supply over the period. In terms of contribution to monetary growth, deposits and fiduciary currency contributed by 86.6% and 13.4%, respectively, (Kigabo, 2009, P.128) The fact that the monetary expansion was coupled with a significant deposit growth and a moderate fiduciary currency growth represented a greater expansion of financial services, which made it possible to bring more households' financial assets into the banking system, (Kigabo, 2009, P.128).

Nevertheless, one could observe a persistence of excess liquidity in the banking system throughout the year. Further to this situation, the interest rates on the money market experienced a significant fall

during the year 2007, both the rate on Open Market Operations and the Treasury bills rates dropped by 2.1% between December 2006 and December 2007, (Kigabo, 2009, P.128).

However, in spite of the fall in interest rates on the money market, banks's lending rates remained the same, fluctuating around 16%, while the discount rates dropped markedly, falling from 8.1% in December 2006 to 7.4% in December 2007, (Kigabo, 2009, P.128).

The decline in repo outstanding was explained by fewer interventions on money markets amid high levels of reserve money targets reducing the need of BNR to frequently intervene on money market. Furthermore, the sustainability in liquidity situation was supported by the government expenditures flowing that the net fiscal injection amounted to FRW 107.3 billion between January and November 2015 versus FRW 91.9 billion during the same period in 2014, (BNR, 2015 P.18).

In line with the sufficient level of liquidity in the banking system and current monetary policy stance, money market interest rates continued to be low in 2015. Both Repo and interbank interest rates stood respectively at 1.83% and 3.45% in November 2015 from 2.80% and 4.70% in December 2014. However, T-bills rate increased to 5.56% from 4.90% during the same period following that the Government continued to significantly rely on domestic borrowing channels including T-bills, in 2015 at total of RWF 43.8 billion of new T-bills were issued, (BNR 2015 P.25).

In the first ten months of 2015, the cost of deposits was stable as the deposit rate stood at 8.3% on average from 8.3% during the same period of last year, indicating that deposits rates would have not influenced the lending rates movements during the period under review. In terms of their different maturities, except 2 years' deposit rate which has beenmore volatile, other deposit rates were generally stable during 2015, (BNR 2015 P.25). Regarding commercial banks' lending rates, they averaged around 17.4% in first eleven months of 2015 from 17.2% during the same period of last year, thus an increase of 20 basis points. This was due to high risk premium averaging around 12.8% in 2015 from 11.5% in 2014, non-performing loans ratio which has been still above the requirement of 5% as the latest figure stood at 6.3% for September 2015, and persistent market power especially for some corporate borrowers which are capable to negotiate for low interest rates more than individual borrowers, (BNR, 2014-2015, P.25). This paper have been selected because it has many important meaningful to the economic agents and political authorities as well as the benchmakers, policymakers and government.

3. PROBLEM STATEMENT

In Rwanda National Saving, Investment and inflation as the determinants of interest rate can have different challenges to the interest rate which means that the inflation cause the decrease of interest rate whereas the increase of interest rate causes the increase of National Saving and also investment rise, Nkurunziza, (2013-2014).

In developed economies, interest-rate adjustments are thus made to keep inflation within a target range for the health of economic activities or cap the interest rate concurrently with economic growth to safeguard economic momentum, Bradley, (2005).The lawmakers' argument was that since BNR had kept its repo rate (interest rate charged when commercial banks borrow from BNR constant), slightly over 6%, it should be reflected in the rates banks charge their clients. From the onset, Parliament worked on the wrong premise that the Governor could arm twist commercial banks. However, free market factors have the final say; they alone can influence the financial characteristics when accessing credit, MINECOFIN, (2010).

One of the many reasons fronted by banks to justify their rates are high overhead costs involved in running a bank such as high rent and employee salaries. Those two are non-starters from the

beginning as they should have factored in the banks' feasibility studies. For banks to retain the best skilled manpower in the sector, it is obvious they will have to offer attractive packages. As for the high rental costs, that will soon be history as most banks acquire their own premises, BNR, Annual report (2013/2014, p.55). However, the journey towards lowering interest rates will have to bring all stakeholders on board, not just leaving BNR and banks to tackle the issue alone. Among the issues that can be addressed are the high risks of non-performing loans and the poor savings culture where long term deposits are still low. That is where parliament should shift its attention. Non-performing loans could be caused by high interest rates, and vice-versa. So, if there were concerted efforts to sensitize the public on the benefits of honoring financial obligations and adopting a more robust savings culture, half the journey will have been covered, BNR, Annual report (2013/2014, p.55).

Going by the recently-released central bank monetary policy and financial stability statement, the average lending interest rates of banks stood at 17.03 per cent as of December 2015. This compares to the previous year when the average lending rate was at 17.66 per cent. Despite this, a large section of borrowers accuses banks of charging high interest rates, a situation that has caused many would-be borrowers to shy away from applying for loans, MINECOFIN, (2015).

Rwanda's savings rate is very low meaning that both domestic and foreign saving are less mobilized. This indicates that saving instruments are underdeveloped. Due to low levels of savings, Rwanda depends a lot on foreign assistance and this creates a deficit problem where by the needed investment in the country cannot be covered by the available savings, (MINECOFIN, 2015). However, the low domestic saving rates in Rwanda have been partly due to a low saving culture, limited access to banking facilities especially in the rural areas and low incomes which translates into low savings for a significant portion of the unbanked population. Otherwise the resumption of normal economic activities, requiring the clearing of domestic and foreign payments and use of deposit accounts will severely be impeded. The government of Rwanda encouraged the reopening of banks to not only mobilize funds for personal finance but also for business development, Ntaganda, (2006). However, this renders the employees" lack of savings for facility banks to offer loans. The banks' interest rates are also very high and cannot offer an opportunity for an individual to access credit facilities, IPAR, (2012). The market forces controlled by the private sector play a much larger role in determining housing provision and in this way exploiting the economically weak groups in dire lack. The difficulties of the lower saving rate from the lower levels of income in Rwanda country can also cause the different banks to impose high interest rate charged to the borrowers as the reason why some projects fail to pay their credits, IPAR, (2012). However, the above highlighted challenges faced by different commercial banks in Rwanda have pushed the interest rate to fluctuate over time and grow at high space. For that reasons this paper will contribute empirically analyze the determinants of interest rate in Rwanda , with the aim of Figuring out the factors among the expected determinants of interest rate seems to contribute significantly to the interest rate and show the relationship that exist among interest rate and its expected determinants.

4. LITERATURE REVIEW

4.1. Determinant

According to Longman Dictionary, determinant refers to a factor which decisively affects the nature or outcome of something. Furthermore, In this paper a determinant refers to the factor that controls or influence directly or decides what will happen.

4.2. Empirical Analysis

Empirical research is a way of gaining knowledge by means of direct and indirect observation or experience. Empirical evidence can be analyzed quantitatively or qualitatively. However, through quantifying the evidence or making sense of it in qualitative form, a researcher can answer empirical questions, which should be clearly defined and answerable with the evidence collected usually called data. Jeanie Straub, (2011, p24)

4.3. Interest Rate

According to Keynes 1936, defines the rate of interest as the reward for parting with liquidity for a specified period of time. However, In the view of this paper, Interest rate is the percentage at which paid by borrowers for the use of money that they borrow from creditors.

4.4. Inflation

According to Tsalinski and Kyle (2000), defines inflation as a stage in which value of money is falling i.e. prices are rising. Thus, inflation does not refer to the rise of price of one or two commodities, but the general rise in prices of all goods. However, In the view of this paper, Inflation is the rise over time in the prices of goods and services usually measured as an annual percentage, just like interest rates.

4.5. Money Supply

According to Assïmwe Hebert Mutamba (2009), money supply refers to the cash in the hands of the public (notes and coins) and demand deposits that are available for buying goods and services i.e cash plus money at bank that can be withdrawn on demand. However, Money supply is both a stock and a flow concept. Furthermore, as a stock, money supply refers to the total amount of notes and coins put into circulation by the central bank plus total demand deposit by public in commercial bank. As a flow, money supply is the total amount of money available in an economy over a period of time. the amount depends on the physical stock of money multiplying its velocity, Assïmwe Hebert Mutamba (2009 P. 160).

4.6. Relationship between Interest Rate and Inflation

Inflation is the rise over time in the prices of goods and services usually measured as an annual percentage, just like interest rates.

- Inflation is the natural byproduct of a robust, growing economy.
- No inflation or deflation (the lowering of prices), is actually a much worse economic dsindicator. Also, in a healthy economy, wages rise at the same rate as prices.
- Interest rates is just one factor (but a major driver) affecting the inflation.
- The picture explains the relation between interest rates and economy.

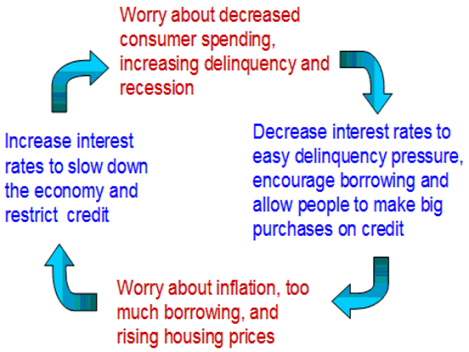

Fig1. *Relation between inflation and economy*

5. RESULTS PRESENTATION AND DISCUSSION

Model specification

In order to examine the empirical evidence of relationship that exist between interest rates and its expected determinants in Rwanda, the researcher followed broadly the approach adopted in Mankiew (1988), that there is no a specific growth model for all economies, the growth model can be modified based on the specificity and structure of a given economy and this is why money supply, investment and national saving were introduced in our model as exogenous variable to see its implication on the interest rate.

The Researcher specifies the determinants of interest rate in Rwanda as follow: interest rate is a function of investment, national saving and money supply. It is precisely expressed as follows:

IR= f (MS, NS, and I) Where:

IRt= Interest Rate at period t

It = Investment at period t

NSt = National Saving at period t

MSt= Money Supply at period t

β0= the Intercept.

β1, β2andβ3 = the coefficient of the model of regression.

μt= error term at period t.

And thus our growth model became as follow:

$LLIRt = \beta 0 + \beta 1\ LLMS + \beta 2 LLNS + \beta 3\ LLI + \mu t$

This study employs annual time series data of the following variables: investment, money supply, national saving and interest rate. The data set spanning the period 2000-2015 was collected from MINECOFIN (2015) from various documents published by the National Bank of Rwanda (Statistical Reports, Annual Reports).

5.1. Test and Analysis of the Data

In this research, we used time series data for the period 2000 up to 2015 and famous test used in econometrics have been performed.

The first test performed by the researcher was stationarity test. It is clear that most of macroeconomic time series data are no stationary. When dependent and independent variables in time series data are non stationary, a non sense regression or spurious regression model is likely to occur. The R-square is high but combined with low Durbin Watson statistic, and as a consequence the coefficients seem to statistically significant while they aren`t. this case can mislead the economic interpretation. In order to avoid obtaining misleading statistical inferences, the researcher performed the stationarity test of all variables used in the model. The long run estimated equation has been elaborated using Eviews7 to see whether there was any relationship that exist between economic growth and its expected determinants after testing the significance of the coefficients estimate, the co-integration test was performed to see whether there is a long run relationship between economic growth and its expected determinants, the ECM was performed to test whether there is a short run relationship between interest rate as dependent variable and independent variables which are investment ,national saving

and money supply and make sure that if errors are found in our model can be collected, the Diagnostic test including stability test and residual test to make sure that the estimators in our model are BLUE(Best Unbiased Estimator).

Stationarity test

The stationality test was perfomesed on the following rules:

The ADF tests follow these rules:

- When$|ADF_{cal}| < |ADF_{crit}|$: we reject H0 and accept H1
- When$|ADF_{cal}| > |ADF_{crit}|$: we accept H0 and reject H1

And the hypotheses of this test were formulated as follow:

H0: The variable is not stationary (there is a unity root)

H1: The variable is stationary (there is no a unity root)

Stationary test of the series at first difference and the second difference

5.2. Unit Root Tests (Augmented Dickey-Fuller tests)

Having constructed the model which contains the time series data, it is therefore important to ensure that the data is stationary. For this case, the unit root test has been used to determine whether the series data are consistent with a stochastic trend or if it is constant with a process that is stationary with a deterministic trend. The ADF test statistics were compared to critical values and where necessary, differencing was carried out.

The table below shows the ADF tests before differencing. This level test provided the results that all data as indicated below were non-stationary hence this called for carrying out a differenced ADF test in order to make sure that the data are stationary.

Table1. *ADF Test at First Differenced*

Variables	ADF test	Critical values 1%	Critical values 5%	Critical values 10%	Results
IR	-2.37989	-3.959148	-3.081002	-2.68133	Non-stationary
I	2.34781	-3.959148	-3.081002	-2.68133	Non-stationary
MS	3.75288	-4.12199	-3.14492	-2.713751	Non-stationary
NS	2.215519	-4.05791	-3.11991	-2.701103	Non-stationary

Source: *E-views output*

According to the above results extracted from E-views 7, the researcher found that all series are non stationary at first differenced but they become stationary after the second differenced.

Table2. *ADF test at second differenced*

Variables	ADF test	Critical values 1%	Critical values 5%	Critical values 10%	Results
IR	-5.419085	-5.124875	-3.933364	-3.42003	STATIONARY
MS	-4.636773	-5.124875	-3.933364	-3.420030	STATIONARY
NS	-5.403299	-5.124875	-3.933364	-3.420030	STATIONARY
I	-5.124875	-4.422782	-3.933364	-3.420030	STATIONARY

After the ADF test was made, data became stationary and hence good to be used for analysis. In summary, ADF tests was carried out in order to know if data are stationary, as ADF test statistics were higher than critical values at 1%, at 5%, and at 10% as indicated in table above. After carrying out the ADF test statistics became much higher than critical values as shown in the table above and thus making data stationary and good to be analyzed.

5.3. Testing for Cointegration

The economic interpretation of cointegration is that if two or more series are to form an equilibrium relationship spanning the long run, then even though the series themselves may 27 contain stochastic trends (be stationary) they will themselves move closely together over time and the difference between them will be stable or stationary (Harris, 1995).

The variables used in the analysis are stationary as the table above shows. Since the data for the variables is stationary, it means the time series has a zero mean and a constant variance thereby implying that variables are cointegrated. The Johansen Cointegration test was carried out to ascertain this and the results are shown in the table below.

Table3. *Cointegration Test Results*

Date: 11/20/16 Time: 08:37				
Sample (adjusted): 2002 2015				
Included observations: 14 after adjustments				
Trend assumption: Linear deterministic trend				
Series: IR I MS NS				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.962200	100.3559	47.85613	0.0000
At most 1 *	0.907042	54.49967	29.79707	0.0000
At most 2 *	0.780124	21.24112	15.49471	0.0061
	0.002530	0.035460	3.841466	0.8506

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

** denotes rejection of the hypothesis at the 0.05 level*

***MacKinnon-Haug-Michelis (1999) p-values*

Source: *E-views output*

This shows that the series are co integrated at level and the long run (L.R) test indicates one co integrating equation at 5% level of significance.

5.4. Granger Causality Test

The Granger causality test is a technique for determining whether one time series is useful in forecasting another. Much as the study was interested in analysing the impact of the private investment on economic growth in Rwanda, the two proxy variables of private investment i.e Domestic savings (DSA) and Foreign Direct Investments (FDI) were only considered under the granger causality test.

Table4. *Granger causality test*

Pairwise Granger Causality Tests			
Date: 11/20/16 Time: 08:49			
Sample: 2000 2015			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
I does not Granger Cause IR	14	0.16765	0.8482
IR does not Granger Cause I		1.39719	0.2962
MS does not Granger Cause IR	14	0.05361	0.9481
IR does not Granger Cause MS		0.40638	0.6777

Source: *E-views output*

The causality test shows that I does not granger cause IR. The same applies that MS does not granger cause IR. In other words, it does not mean that there should always be I and MS in Rwanda so as to have the change of IR.

Causality is tested by conducting the Pair-wise Granger Causality Tests as in the above table and we fail to reject the null hypothesis that I and MS do not Granger cause the change of IR. Out of 16 observations tested allowing a lag of 2 years, the results show that the probability of failing to reject the null hypothesis for I to cause IR variation 84.82% and MS to cause IR variation is 94.81%.

It is also important to note that the second null hypothesis of IR and MS should not be rejected because out of 16 observations tested allowing a lag of 2 years, the results show that the probability of failing to reject null hypothesis is 67.77%.

However, the second null hypothesis on IR and NS should be rejected because out of 16 observations tested allowing a lag of 2 years, the results show that the probability of rejection is 29.62%.

This test provides a platform for testing the research hypotheses as prescribed in chapter three that; Ho: determinants of interest rate do not have a positive impact on interest rate in Rwanda.

Ha: determinants of interest rate have a positive impact on interest rate in Rwanda

From the above test, we accept the Ho and conclude that the determinants(investment and money spply) of interest rate do not have a positive impact on interest rate in Rwanda. However, note that, although regression analysis deals with the dependence of one variable on other variables, it does not necessarily imply causation. But in regressions involving time series data, the situation may be somewhat different because as one author puts it, “time does not run backward- that if event A happens before B, then it is possible that A is causing B. However, it is not possible that B is causing A” Gujarati (2004). The most and reliable technique used to test the hypothesis is the OLS Estimation.

5.5. Testing Multicollinearity

There is no unique method of detecting multicollinearity or its strength. The most used methods by the econometricians are just the rules of thumb like high R-squared usually in excess of 0.8. At this point, the regression tests carried out shows that the R-squared is 0.768080 which is less than 0.8 and this shows that the model does not have multicollinearity, Gujarati (2003).

Table5. *Correlation Coefficients Results*

	IR	I	MS	NS
IR	1.000000	-0.355979	-0.3673	-0.261151
I	-0.355979	1.000000	0.986249	0.946723
MS	-0.3673	0.986249	1.000000	0.960835
NS	-0.261151	0.946723	0.960835	1.000000

Source: *E-views output*

Another rule of thumb is high pair-wise correlation coefficients among regressors usually in excess of 0.8. In the pair-wise tests made, the correlation coefficients between the variables are good enough to explain that there was collinearity between variables paired in the tests. However, the table above shows that the correlation coefficients between investment and national saving as the proxy variables of investment and interest rate as endogenous variable are 0.355979 for investment, and 0.261151for national saving, both are below 0.8 hence indicating that there is collinearity. However, based on Blanchard‟s idea as it is in Gujarati (2003), multicollinearity is a data deficiency problem (micronumerosity, again) and sometimes we have no choice over the data we have available for empirical analysis.

5.6. Estimation of the Long Run Model

The long run equation shows the long run relationships in the model and E-views 4.1software provided the estimated long run equation as follows:.

Table6. *Estimation of the long run model*

Dependent Variable: IR				
Method: Least Squares				
Date: 11/24/16 Time: 13:16				
Sample: 1 16				
Included observations: 16				
IR=C(1)+C(2)*MS+C(3)*NS+C(4)*I				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	16.06924	0.074525	215.6216	0
C(2)	0.000608	0.000644	0.944829	0.3634
C(3)	-0.000446	0.000357	-1.24915	0.2354
C(4)	0.000579	0.000519	1.114707	0.2868
R-squared	0.906369	Mean dependent var		16.66063
Adjusted R-squared	0.882961	S.D. dependent var		0.505179
S.E. of regression	0.172826	Akaike info criterion		-0.46074
Sum squared resid	0.358428	Schwarz criterion		-0.26759
Log likelihood	7.685913	Hannan-Quinn criter.		-0.45085
F-statistic	38.72093	Durbin-Watson stat		1.188258
Prob(F-statistic)	0.000002			

The regression result presented in Table above, shows that the parameters are as unexpected, because of our p-values are greater than 5%. It is the reason why we introduce the logalithm in our model in order to detrend.

Table7. *Estimation of the long run model with the first log*

Dependent Variable: LOG(IR)				
Method: Least Squares				
Date: 11/24/16 Time: 13:22				
Sample: 1 16				
Included observations: 16				
LOG(IR)=C(1)+C(2)*LOG(MS)+C(3)*LOG(NS)+C(4)*LOG(I)				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	2.598005	0.023155	112.2008	0
C(2)	0.035101	0.017655	1.988128	0.0701
C(3)	0.002572	0.002449	1.050093	0.3144
C(4)	-0.001509	0.014383	-0.10489	0.9182
R-squared	0.953097	Mean dependent var		2.81262
Adjusted R-squared	0.941371	S.D. dependent var		0.03031
S.E. of regression	0.007338	Akaike info criterion		-6.7792
Sum squared resid	0.000646	Schwarz criterion		-6.586
Log likelihood	58.23353	Hannan-Quinn criter.		-6.7693
F-statistic	81.28191	Durbin-Watson stat		1.15153
Prob(F-statistic)	0			

The regression result presented in Table above, shows that the parameters are as unexpected, because of our p-values are greater than 5%. It is the reason why we introduce the second logarithms in our model in order to detrend because the first cannot be detrend the model.

Table1. *Estimation of long run model with second log*

Dependent Variable: LOG(LOG(IR))				
Method: Least Squares				
Date: 11/24/16 Time: 13:34				
Sample: 1 16				
Included observations: 16				
LOG(LOG(IR))=C(1)+C(2)*LOG(LOG(MS))+C(3)*LOG(LOG(NS))+C(4)*LOG(LOG(I))				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.896582	0.015579	57.54999	0
C(2)	0.086486	0.038278	2.25942	0.0433
C(3)	0.005965	0.003958	1.507035	0.1577
C(4)	-0.014739	0.030846	-0.47784	0.6414
R-squared	0.955196	Mean dependent var		1.034061
Adjusted R-squared	0.943996	S.D. dependent var		0.010774
S.E. of regression	0.00255	Akaike info criterion		-8.89337
Sum squared resid	7.80E-05	Schwarz criterion		-8.70022
Log likelihood	75.14696	Hannan-Quinn criter.		-8.88348
F-statistic	85.27855	Durbin-Watson stat		1.238183
Prob(F-statistic)	0			

Substituted Coefficients:

*L(L(IR))= 0.896582+ 0.086486*L(LMS)+0.005965*L(LNS)F-0.014739*L(LI)*

P Value (0.0000) (0.0433) (0.1577) (0.6414)

$R^2 = 0.955196$

The regression result presented in Table above, shows that the parameters are as expected, implying that IR is positively correlated with money supply and investment but national saving is negatively correlated.

According to these results, the C, L(LMS), LL(NS) and L(LI) are statistically significant as majority of their respective probabilities 0.000, 0.0433, 0.1577 and 0.6414 are less than critical value of 5%. The R2=0.955196 and is greater than 0.6 and close to one showing that our model has a better goodness of fit.

From the above findings, the economic interpretation can be stated:

- When **L (LIR)** increase by **1%,** then the **L(LMS)** will increase by **0.086** or **8.6%** and Ceteris paribus.
- When **L(LIR)** increase by **1%,** then the **L(LNS)** will increase by **0.0059** or **0.59%** and Ceteris paribus.
- When **L(LIR)** increase by **1%,** then the **L(LI)** will dicrease by **0.0147** or **0.147%** and Ceteris paribus.
- When the variable in our model are considered to be zero, the L(LIR) is explained by the value of the intercept C which is equal to **0.896582** (contribution of other variable not expressed in our model on economic growth**.**
- The $\mathbf{R^2=0.955196>0.6}$ means that the goodness of fit is better. The variation in L(LIR) is explained at **99.5%** by L(LMS), L(LNS) and L(LI).

5.7. Normality Test

The normality test is performed on residuals to see if they are normally distributed. The two hypotheses of this test are:

- Null hypothesis: Ho: The residuals are not normally distributed
- Alternative hypothesis :H1: The residuals are normally distributed

The researcher, using the E-views 7, performed the test of JARQUE-BERA and found the following result

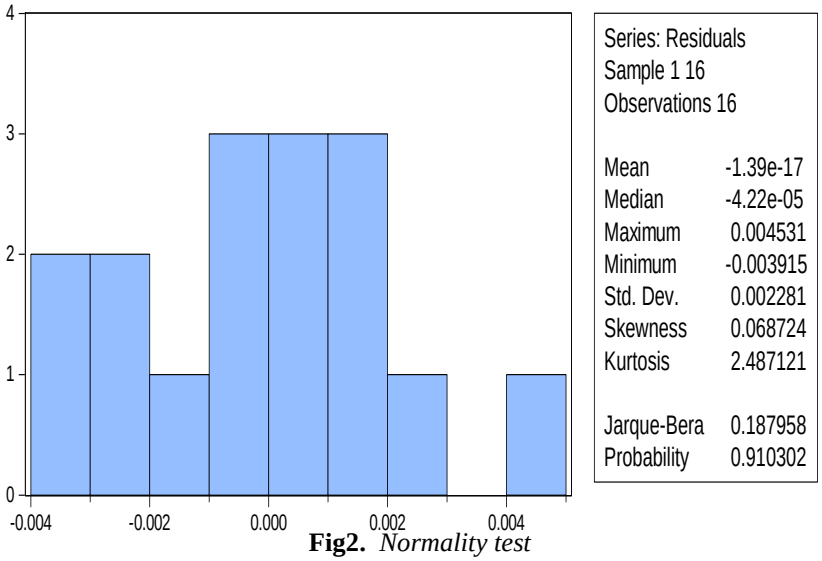

Fig2. *Normality test*

From this table the probability of JARQUE-BERA is equal to **0.910302**, greater than 5%, so when the JARQUE-BERA probability is greater than critical probability 5%, the Ho is rejected . The calculated probability is greater than critical probability 5% level of significance, Ho is rejected and we have accepted H1. The residual are normally distributed. The normality of residuals shows that the residuals are stationary.

5.8. Serial Correlation Test

The researcher performed a test to see whether there is no serial correlation. The no serial correlation is one of the classical assumptions that should be verified to say that the estimation is BLUE. The following are the hypothesis of this test:

Ho: Absence of serial correlation

H1: Presence of serial correlation

The Ho is accepted when the probability is greater than 5%, in the different case, it is rejected and the model has serial correlation.

Table11. *Serial correlation Test*

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	6.04575	Prob. F(2,10)		0.0139
Obs*R-squared	8.757395	Prob. Chi-Square(2)		0.1205

According to the above results, the researcher concludes that there is no serial correlation in the model; the probability is 12.05% means greater than 5%. The null hypothesis of the no serial correlation is accepted because the probability is greater than 5%.

5.9. Heteroskedasticity Test

The heteroskedasticity test was performed to see whether the variance of residuals is constant and if the classical assumption of homoskedasticity is respected. The following are the hypothesis of the test:

Ho: No heteroskedasticity (presence of homoskedasticity)

H1: Presence of heteroskedasticity (absence of homoskedasticity)

Table12. *Heteroskedasticity test*

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.615857	Prob. F(3,12)	0.0992
Obs*R-squared	6.326272	Prob. Chi-Square(3)	0.0968
Scaled explained SS	2.645981	Prob. Chi-Square(3)	0.4495

According to the above results, the probability is equal 9.96% means that greater than 5%, so the null hypothesis of presence of homoskedasticity is accepted. There is homoskedasticity; the variance of residuals of model under consideration is constant.

5.10. Correlogram Squared Residuals

The objective of this test is to show whether the model contains the problem of residuals. The non autocorrelation assumption should be respected in the choice of the model. There is autocorrelation when the error of period t influences the error of the following period t+1. The probability of the errors in period t should be independent of the probability of the occurrence of errors in period t+1. The following are the hypothesis of the test:

Ho: Absence of autocorrelation of errors

H1: Presence of the autocorrelation of errors.

Table13. *Correlogram squared residuals*

Date: 11/24/16 Time: 15:14						
Sample: 1 16						
Included observations: 16						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |** . |	. |** . |	1	0.222	0.222	0.9457	0.331
.***| . |	****| . |	2	-0.443	-0.518	4.9818	0.083
.***| . |	. **| . |	3	-0.42	-0.225	8.8967	0.031
. *| . |	. **| . |	4	-0.174	-0.343	9.6195	0.047
. |* . |	. | . |	5	0.193	-0.038	10.59	0.06
. |***. |	. | . |	6	0.382	0.068	14.796	0.022
. | . |	. *| . |	7	0.056	-0.124	14.898	0.037
.***| . |	. **| . |	8	-0.367	-0.271	19.751	0.011
. *| . |	. | . |	9	-0.198	0	21.358	0.011
. | . |	. **| . |	10	0.007	-0.275	21.361	0.019
. |* . |	. *| . |	11	0.121	-0.173	22.208	0.023
. |* . |	.***| . |	12	0.114	-0.351	23.139	0.027

The results confirm that there is no autocorrelation in the model because of some the probabilities are greater than 5% critical value.

5.11. Stability and Specification Tests

The stability tests are very crucial in econometrical methodology; and the stability condition is determinant in forecasting and policy purpose.

The stability test is done by the COSUM TEST. This test is based on the on the cumulative sum of recursive residuals. However, the cumulative sum is plotted with the 5% critical lines. The parameter instability is found when the cumulative sum goes outside the area between the two critical. The following figure was provided by E-views 7

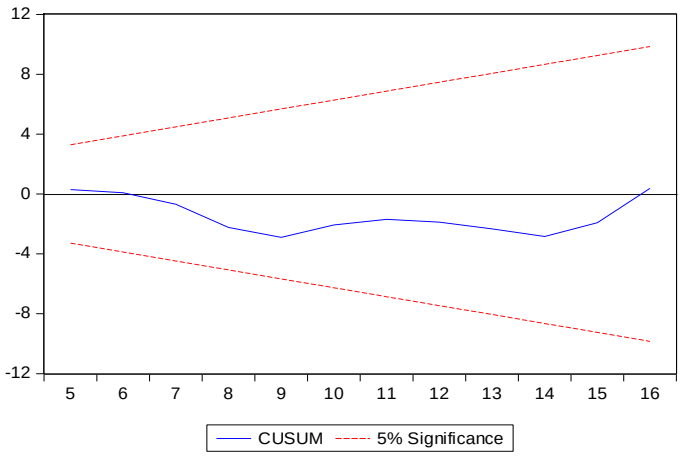

Fig3. *COSUM test for stability of parameter*

The parameters are stable because the cumulative sum does not go outside the area of two critical lines at 5% significance. This test is very important in economics because when the parameters are stable, the predictions or forecasting are possible with the model.

6. CONCLUDING REMARKS

In this paper, the researcher had developed the determinants of interest rate in Rwanda. However, the extent of these determinants was the point of discussion. The theory was based on the idea that interest rate in Rwanda generally requires a mix of national saving savings and investment which actually form a set of interest rate in Rwanda. However, Money supply and national saving are needed in order to accelerate interest rate in Rwanda. The results from the empirical study carried out indicate that national savings and investment which actually form as per this study have positive relationship to interest rate as the theory had predicted it. However, money supply in Rwanda has not penetrated in interest rate and this probably explains the reason why the national savings and money supply have greater impact on interest rate as indicated in the tests conducted in chapter four, even though there is positive relationship between the two.

In Rwanda, money supply and national saving have positive impact on interest rate. Regarding the hypotheses of the study, concluded that determinants of interest rate have a positive impact on interest rate in Rwanda and this calls for the rejection of null hypothesis and acceptance of alternative hypothesis because in the OLS regression test carried out, both the national saving and investment have positive relationship to the interest rate.

The impact however, is still minimal as justified by the OLS regression test and correlation coefficients of the variables under study. The regression results show that national saving impact on interest rate by only 0.59% while money supply impacts on interest rate by only 0.147%. The results for the investment seem to be somewhat significant but not strongly significant as desired.

For investment, the results are poorly significant. This could have been caused by the constraints prevailing in Rwanda today. Furthermore, the recommendations were provided to the of Rwanda:

- Government may encourage foreign investors to invest in Rwanda because investment usually involves putting money into an asset providing in business.
- There is need for the government to retain tight monetary policy to support money supply in order to fight inflation in the economy, since money supply alone may cause inflation and in turn inflation influence investment to shrink and economic growth in general.

- Government should formulate policy that is aimed at raising investments so that it would encourage national savings.
- To promote human capital investment through education and training in order to be in the position of supplying factors of production especially labor to investors so that they can earn additional income.

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APPENDIX

Data used in this paper.

Year	ir	Ms	ns	I
2000	15.77	119	24.2	90
2001	16.07	131	474	102
2002	16.07	147	39.4	108
2003	16.19	178	44	138
2004	16.37	206	100.3	181
2005	16.48	246	126.1	227
2006	16.49	326	31	286
2007	16.51	426	89	391
2008	16.73	466	225	634
2009	16.93	527	133	713
2010	16.94	616	105	771
2011	16.99	781	266	905
2012	17.03	890	371	1148
2013	17.05	1028	493	1291
2014	17.29	1224	545.9	1417
1015	17.66	1482	615.6	1539

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