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Research Paper

Interest Rateand Nigeria Economic Growth Nexus: ARDL Bounds Test Technique

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ABSTRACT
The anticipation of any country is to have the capability of high output but in the presence of high interest rate (IR) such expectation is unattainable because high IR is a sign of a stiff economic system. In this research the impact of IR movement on Nigeria economic growth (EG) is studied for the period of 1986 to 2018 using an Autoregressive Distributed Lag (ARDL) Bounds test technique to determine the co-integration existence between IR and EG and determine the long run effect through the approach of Error Correction Model (ECM). The results obtained showed that an ARDL (4, 3) model was the best fitted model for the sampled data based on the smallest Akaike's Information Criterion (AIC) value obtained. Also, it was found that IR significantly impacted on Nigeria EG positively on the long and short run dynamics with a stable estimation as portrayed by the CUSUM square chart.
KEYWORDS: *ARDL, Interest rate, Economic growth, Co-integration, Error correction model, AIC*

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I. INTRODUCTION

Interest rate (IR) is one of the macroeconomic developmental variables. Its dwindling instability is strictly connected with inflation rates. Their rate at high or low level influences the economic bang (high gross domestic product [GDP]) and economic growth (EG) rate. In commerce turfs, it is often vital to correctly forecast interest rate tendencies. Researchers have shown that an upsurge in federal government debt equal to one percent of GDP, all else equal, could raise the long-term actual IR by about three root points [1]. Asstated by [2] that IR can be described simply as the cost of deriving cash in an economy and it's the key determining factor of cost of credits in the economy. [3] stated that diverse sorts of IR are connected to each other and they influence the running of the financial markets and their international dealings illuminate a worthy transaction of IR variations. This is why it has been considered as an important aspect of capital cost that influences the level of loanable money to the entire public.[4] stated clearly that the removal of restrictions on IR will influence EG using the channel of its control on increase in financial services. [5] noted that when IR increases, investments drop because it is more expensive to borrow money and more tempting to save money. Therefore, consumption decreases and it results to decreasing demand.[6] opined that the impact of this to EG brings about slow EG movement because financial equity is not enough to adequately sponsor the economy production activities. According to [7], IR is "the price a borrower pays for the use of money they borrow from a lender, for instance a small company might borrow capital from a bank to buy new assets for their business, and the return a lender receives for deferring the use of funds, by lending it to the borrower". Also, IR is essential to a capitalist society and a vital tool of monetary policy taken into account when dealing with variables like investment, inflation, and unemployment.

Like other prices, IR execute a rationing utility by allocating limited supply of credit among the many competing demands [8].An important feature of IR is that it determines the drive for investments and entrepreneurships development. The private sector plays a very important role in EG because investors do not only set up businesses with their money but help in reducing unemployment in a country. Business expansion or start-ups entails huge money investment and in most cases the only way to source funds is through banks.

Discouragements suffice when IR for lending is high. According to [9], rise in real IR increases the cost ofborrowing and thus discourages new investment and growth of GDP.

In this research the movement of Nigeria real IR on the growth of her GDP is studied through the application ofAutoregressive Distributed Lag (ARDL) Bounds test to determine the co-integration existence between IR and EcoG and determine the long run effect through the approach of Error Correction Model (ECM). The reason for the methodology adoption is the flexibility it exhibit in controlling small sample size studies and unit root test on the data to excuse for stationarity is needless (see [10]). The objective of the research is to isolate the best far and near run model that best define the effect of Nigeria IR on her EG.

II. METHODOLOGY

The objective of this section is to examine theeffect of IR movement on EG (using GDP as the proxy) of Nigeria. This study will use both descriptive and econometric analysis. The descriptive approach will be used to show the trend and variation of IR and GDP so as to give a clear view on how the variables move over time for Nigeria. Also, the econometric approach will be used to investigate the movement of IR on EG. The ARDL bounds test methodology for testing the existence or absence of co-integration between the variables and Error Correction Model (ECM) will be used to investigate the causal bond between IR and GDP.The study employs a secondary data. The annual time series data are collected from Nigeria Bureau of Statistics (NBS), Central Bank of Nigeria (CBN) and other journals and articles which covers the period 1986-2018.

Model Specification

On a general form, the model specification is a formulation of GDP as a function of variability (relationship) with IR. The representation of the model specification is presented below as follows.

$$GDP = \varphi\left(IR\right); \varphi_1 < 0 \quad (1)$$

A priori expectation of IR for this study is negative or less than zero. This is because in a far-run IR effect on EG is paramount. If it go higher than required threshold of tolerance its impact will definitely be of concern. On the near-run the effect could be positive and greater than zero but it's not a reliable point to classify IR impact as adverse. Theoretically, it is expected that a low and stable IR supports EG and vice versa.

ARDL Model for GDP and IR

Based on the model specification as formulated in equation (1), the research model is a formulation of the ARDL model which captures GDP and IR. Therefore, the research model is as follows,

$$\Delta ln(GDP) = \beta_0 + \beta_1 ln\left(GDP\right)_{t-1} + \beta_2 ln\left(IR\right)_{t-1} + \sum_{i=1}^{j}\theta_{1i}\Delta ln\left(GDP\right)_{t-i}$$

$$+\sum_{i=1}^{j}\theta_{2i}\Delta ln\left(IR\right)_{t-i} + \varepsilon_t \quad (2)$$

where, Δ is the first difference operator, *ln*(*GDP*) is the logarithm of GDP, β_0 is the intercept, β_1 and β_1 are constant elasticity coefficient with respect to logarithm of GDP and *IR* and ε is the error term. The apriori expectations for the model parameters are $\beta_0 > 0$, $\beta_1 > 0$ and $\beta_2 < 0$.

Bounds Test

Next is the bounds test hypothesis for testing the long-run effect between the independent variable and the dependent variable based on the F-test which tests the combined significance of the parameter estimates at one period lagged level of the variables in equation (2). The test hypothesis is H_0: $\beta_1 = \beta_2 = 0$ verse H_1: $\beta_1 \neq \beta_2 \neq 0$. The asymptotic distribution of critical values is gotten for cases in which all regressors are strictly $I(1)$ and when the regressors are strictly $I(0)$ or jointly co-integrated [10].

[11] as well as in [12] reported two sets of critical values. The two sets of critical values give critical value bounds for categorizing the regressors into purely $I(1)$, purely $I(0)$ or mutually co-integrated. However, [11] and [12] sets of critical values were for large sample sizes. A correction was made and offered by [13] and [14] for small sample sizes ranging from n = 31. The null hypothesis of no co-integration is rejected if the computed F statistics is greater than the upper bound of the critical values. Also, if the bounds test confirms the existence of a co-integration bond between the variables then it implies that there is a far-run relationship between GDP and IR In determining the far-run relationship, an error correction model is to be established and implemented [10].

Error Correction Model (ECM)for GDP against IR

In this study, the error correction model within bivariate relationship system is used to examine the movement of IR on GDP. Also, the ECM has an interesting property of capturing the velocity of adjustment of growth and the independent variables considered for this research. The ECM is chosen over other alternative techniques because of its favorable response to both large and small samples.If GDP and IR are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta GDP_t = a_0 + \sum_{i=1}^{n} a_{1i}\Delta GDP_{t-i} + \sum_{i=1}^{n} a_{2i}\Delta IR_{t-i} + a_3 EC_{t-1} + \mu_t \qquad (3)$$

where, EC_{t-1} is a one period lagged error correction term captured from the integration regression, GDP_t is the gross domestic product at time *t* and IR_t is inflation rate at time *t*.

III. RESULTS AND DISCUSSION

Table 1 shows the descriptive statistic of the variables before logarithm transformation. Real GDP shows a positive skewness while IR is highly leptokurtic since the kurtosis is greater than three (3). The result of Jarque-Bera statistic revealed that the GDP and IRare normally distributed since their respective p-value of 0.141 and 0.351are greater than 5%.

Table 1: Empirical Analysis of Real GDP and IR

Statistic	Real GDP	IR
Mean	36832.50	18.08970
Median	28957.71	17.95000
Maximum	70536.35	31.65000
Minimum	15237.99	9.930000
Std. Dev.	19717.32	4.713098
Skewness	0.576463	0.563405
Kurtosis	1.767269	3.504476
Jarque-Bera	3.917186	2.095771
P-Value	0.141057	0.350678
Observations	33	33

Figure 1A and IB below shows the empirical plots of the variables. The plots shows that GDP is on a geometric increase while IR is on a stationary pattern

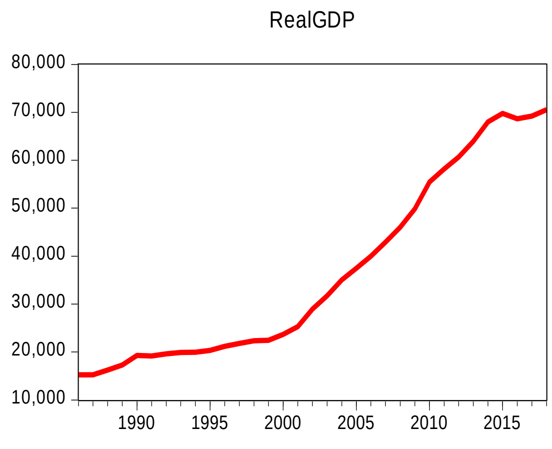

Figure 1A: Plot of GDP against Years

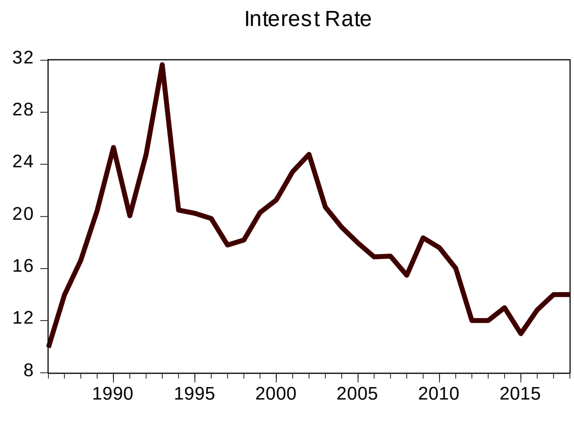

Figure 1B: Plot of IR against Years

Bound Test for GDP and Interest Rate (IR)

The bound test result is to examine the existence of co-integration between GDP and IR. The result of the bound test for the relationship between GDP and IR as shown in Table 2 indicates that the computed F-statistic is 3.8249. This value is less than the upper bounds critical value of 4.16 at 5% significance level. This implies that GDP and IR are not co-integrated. Thus, we can infer that there is no long run relationship between GDP and IR since the F-Statistic computed = 3.8249 is less than the 5% F-Statistic = 4.16.

Table 2: Bounds Test for GDP and IR Relationship

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.824899	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

Estimated ARDL Model for GDP and IR

The ARDL Model selection for GDP and IR is ARDL (4, 3) as displayed in Figure 2 since it has the smallest AIC value. The result in Table 3a shows that there is a significant positive effect of the current IR and third lag of the IR on GDP, implying that the current IR will affect GDP positively in the next 3 years, the current GDP will still have effect on GDP for the next three and four years. Also, the Durbin-Watson value in Table 3a indicates that the selected model has no serial autocorrelation.The Error Correction Model in Table 3b shows that the estimated coefficient of the lagged value of the residual (ECM_{t-1}) is 0.073939 which is positive. This indicates that the model would not easily adjust to equilibrium. The short run coefficients show that in the short run, the coefficient of current IR is positive and has a significant impact on GDP at 5% significance level (sig. = 0.0005). This indicates that a unit increase in current IR would lead to a corresponding increase in GDP by 16.1744%.

Table: 3a Estimated Long Run (ARDL) Model for GDP and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	**-1.218437**	*0.473418*	*-2.573700*	*0.0181*
RGDP(-1)	**1.605615**	*0.182201*	*8.812341*	*0.0000**
RGDP(-2)	**-0.149552**	*0.325828*	*-0.458992*	*0.6512*
RGDP(-3)	**-1.038100**	*0.334537*	*-3.103094*	*0.0056**
RGDP(-4)	**0.655976**	*0.212531*	*3.086490*	*0.0058**
IR	**0.161744**	*0.45735*	*3.536512*	*0.0021**
IR(-1)	**-0.047481**	*0.050665*	*-0.937143*	*0.3599*
IR(-2)	**-0.043141**	*0.049188*	*-0.877071*	*0.3909*
IR(-3)	**0.09615**	*0.039105*	*2.465567*	*0.0228**
R-squared	0.997884			
F-statistic	1178.709	Durbin-Watson stat		2.059100
Prob(F-statistic)	0.0000			

Table: 3b Short Run Error Correction Model for GDP and IR

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(RGDP(-1))	**0.531676**	*0.175864*	*3.023229*	*0.0067**
D(RGDP(-2))	**0.382124**	*0.184134*	*2.0752252*	*0.0511**
D(RGDP(-3))	**-0.655976**	*0.195710*	*-3.351785*	*0.0032**
D(IR)	**0.161744**	*0.038824*	*4.166075*	*0.0005**
D(IR(-1))	**-0.053274**	*0.040295*	*-1.322089*	*0.2011*
D(IR(-2))	**-0.096415**	*0.036742*	*-2.624089*	*0.0163*
CointEq(-1)*	**0.073939**	*0.020812*	*-3.552769*	*0.0020**
R-squared	**0.637713**			
Durbin-Watson stat	2.059100			

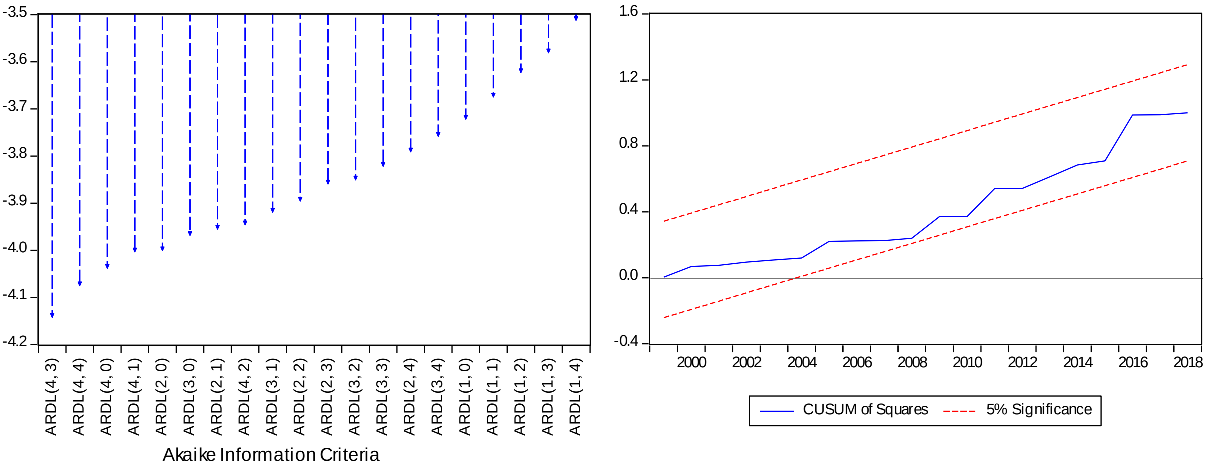

Figure 2: ARDL Model and CUSUM of Squares Charts for GDP and IR

The CUSUM test reveals that the parameters of the GDP and IR in the ARDL model are stable. Clearly, the CUSUM of squares line is in the area between the two critical lines at 5% level of significance. This CUSUM Square parameter stability tests indicate that the parameters are stable during the sample period (1986-2018). Also, the Durbin-Watson statistic value in Table 3b indicates that the selected model has no serial autocorrelation.

IV. DISCUSSION OF FINDINGS

In this research an Autoregresive Distributed Lag (ARDL) model and CUSUM Square parameter stability test was fitted and plotted respectively for GDP versus IR. The results obtained from the analysis performed for the research data that span from 1986 to 2018 showed that an ARDL (4, 3) model was selected as the best fitted model using the Akaike's Information Criterion (AIC) as the selection method. The selected model showed that current IR and at lag 3 are positively significant at 5% on GDP while GDP were significant at first, third and fourth lag at 5% significance level. This implies that current IR will have a positive significant effect on GDP in the next 3 years and current GDP will still affect GDP significantly in the next three and four years.Finally, the CUSUM Square parameter stability test for the fitted model showed that the estimated parameter values are stable during the sample period of 1986 to 2018.

V. CONCLUSION

This paper reconnoiters the effect of IR on Nigeria EG from a sample period of 1986 to 2018 with the application of ARDL bounds test technique for determining the existence of co-integration, long run, and short run dynamics through the use of ECM. Also, A CUSUM square chart approach was used to determine the stability of the estimated parameters. The results from the bonds test suggests no co-integration existence between GDP and IR while the ARDL long run model of ARDL(4, 3) was selected as the best model due to its smallest AIC value. The impact of IR on EG was found to be significantly positive at current and third lag rates in the long run and first lag rate in the short run with a stable estimate as suggested by the CUSUM square chart. This implies that IR in Nigeria is positively contributing to the EG of the country in a stable rate based on the sample period studied. A major policy implication of this result is that the combined effort from policy makers in both the private and public sectors has been sufficient in growing the level of output in key sectors of the economy. The agricultural sector is one of such sector that has received attention through the provision of loans to farmers at low interest rate to boost productivity in agricultural produce.However, this could be a temporal effect due to the high level of inflation in the country which has a negative impact to EG [10]. It is therefore recommended that stringent policy on IR benchmark for borrowers through commercial banks should be set by the Central Bank of Nigeria to help checkmate outrageous high IR to entrepreneurs and investors.

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