Modeling Impact of Interest Rates on Currency In Circulation In Nigeria

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***Abstract*— The paper investigated the relationship between the Currency in Circulation and Interest Rate in Nigeria from the 1984 to 2016. The yearly secondary data for the research were collected from the Word Bank website. Preliminary results on the data revealed that the Interest Rate is of I(0) while the Currency in Circulation is of I(1) , thus the researchers used the Autoregressive Distributed Lag(ARDL) methodology of Time Series to estimate both the long and short run relationships between both variables. The result from the analysis revealed that the lag value of Currency in Circulation best determine its value at any current time. However, interest rate had some limited impact.**

Keywords- *Currency in Circulation, Interest Rate, ARDL, Money Supply.*

I. INTRODUCTION

Currency in Circulation is the part of the over money supply, with a larger portion of the overall supply being stored in checking and savings accounts. Currency in circulation is also the total amount of paper currency, coins, and demand deposits that is held by consumers and businesses (Gordon, 2006). Currency in Circulation increased on annual basis between the years 2009 to 2013 while the ratio of Currency in Circulation to GDP decreased from 2009 to 2013. (CBN, 2013).

Naturally, an increase in the interest rate will lead to a reduction in the demand for money, in the sense that the higher the interest rates, the investors definitely put less of their portfolio in money which has a zero interest rate return and more of their portfolio in interest rate bearing assets. However, it is important to find the equilibrium in the money market; therefore we need to determine the supply of money. The nominal supply of money is determined by the Federal Reserve System (Fed) that decides how much money should be in circulation. Therefore, the supply of money by the Fed is defined as Money Supply; the real value of this money supply is the nominal supply divided by the price level P. Moreover, it is equally important to note that if the interest rate is above the value at equilibrium, the demand for money will be lower than the money supply and this will tend to decrease in the interest rate until the equilibrium interest rate is restored.

Real interest rate which we mean in this paper is the rate of interest an investor, saver or lender receives (or expects to receive) after allowing for inflation. It can be described more formally by the Fisher equation, which states that the real interest rate is approximately the nominal interest rate minus the inflation rate.

Cassino and Barry, (1977) using different modeling techniques, reviewed the result of Currency in Circulation forecasting study in Reserve Bank of New Zealand. They implemented the traditional money demand model alongside two variants of the autoregressive integrated moving average (ARIMA) model; one with the seasonal moving average (SMA) terms and the other with seasonal autoregressive (SAR) terms. Their result revealed that the money in circulation is an integrated process and hence needs differencing.

Babayemi and Asare (2014) opined that the development of real sector (growth in GDP) is a major determinant of Currency in Circulation. Bhattachrya and Joshi (2000) reviewed various techniques of forecasting Currency in Circulation in a bid to determine the best method of predicting the series due to the significance of Currency in Circulation in maintaining monetary stability in the Indian economy.

Albert *et al* (2013) proposed ARIMA $(0,1,1)(0,1,1)^{12}$ model as being the most appropriate for modeling Currency in Circulation in Ghana. They fitted a predictive model for monthly Currency in Circulation in Ghana.

Interest rates have a direct impact on the amount of money in circulation. In the United States, the Federal Reserve raises and lowers the discount rate, which is the interest rate that it charges banks for borrowing money, to

either constrict or expand the money supply First Securities Discount House, FSDH(2012). Naturally a larger money supply lowers market interest rates. Conversely, smaller money supplies tend to raise market interest rates Ang(2008).The current level of liquid money (supply) coordinates with the total demand for liquid money (demand) to help determine interest rates.

Real interest rate = nominal interest rate – inflation rate(1)

The aim of this work is to design a time series model to achieve measure the relationship between Currency in Circulation and the interest Rate ratio using Autoregressive Distributed Lag (ARDL) methodology. In the process, we hope to be able to identify the short and long runs impact of Interest Rate on Currency in Circulation in the presence of exchange rate as an exogenous variable. Finally, we shall determine the extent of the impact of Interest Rate on Currency in Circulation in the presence of exchange rate as an exogenous variable.

II. Materials and Methods

As stated earlier, the focus of this work is to design an ARDL time Series model that will establish the relationship between the Currency in Circulation and the Interest Rates. The econometrics model employed here is given as:

$$lnCIC_t = \beta_0 + \beta_1 t + IR_t + lnEX_t + \varepsilon_t \quad (2)$$

where,ε_t is the stochastic error term, $lnCIC_t$ is the logarithm of currency in circulation, IR_t is interest rate and $lnEX_t$ represents the logarithm of the exchange rate; β_0 and $\beta_1 t$ represent the intercept and the trend respectively.

To investigate the long run and short run association between currency in circulation and interest rate in the presence of exchange rate as an exogenous variable, the work employed the autoregressive distributed lag (ARDL) cointegration test with error correction model (ECM) pioneered by Pesaran*et.al* (2001). As stated in the previous works such as Pesaran and Pesaran (1997); Laurenceson and Chai(2003); Pesaran, Shin, and Smith, (2001); Ang(2008); and Sheriff and Noor(2015).

III. Analysis

The ARDL Model is used for analysis, the advantage of the model include (i) it can be applied when the variables are of different order of integration i.e. independent variables could be I(0), I(1) or a mixture of I(0) and I(1) variables. (ii) the model takes sufficient numbers of lags to capture the data generating a process in a general-to-specific modeling framework. (iii) model can estimate the long-run and short-run dynamics simultaneously by using bounds testing procedures.

The ARDL model by Pesaran (2001) is thus given as:

$$\Delta lnCIC_t = \alpha + \sum_{i=0}^{n} \beta_{1i} \Delta lnCIC_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta IR_{t-i} + \sum_{i0}^{n} \beta_{3i} \Delta ln\, EX_{t-i} + \beta_4 IR_{t-1} + \beta_5 lnEX_{t-1} + \varepsilon_{1t} \quad (3)$$

where, β_{1i}, …,β_{3i} measure the short run dynamics in the model and β_4, β_5 measure the long run dynamics. n is the optimal lag. Wald test or F-statistic is computed to test the null hypothesis based on

$$H_0: \beta_4 = \beta_5 = 0 \quad (4)$$

If the computed Wald or F-statistic exceeds the upper bound I(1), the null hypothesis of no cointegration can be rejected. It means that there exist long-run associations among all the series. However, if the Wald or F-statistic falls between the upper and lower bounds, no conclusive inference can be made. If the computed Wald or F-statistic falls below the lower bound I(0), the null hypothesis of no cointegration cannot be rejected.

IV. Results

This section discusses the results from the analysis carried out.

Table 1: Descriptive Statistics of Currency in Circulation, Interest Rate and Exchange Rate.

Vateriable	Mean	StdDev	Kurtosis	Skewness	Jarque-Bere Test
lnCIC	3.0403	0.2853	2.2181	0.3203	1.405083(0.4953)
IR	-0.1740	13.569	2.6880	-0.2323	0.430387(0.8063)
LnEX	4.7110	0.5805	3.9904	1.2936	9.85560(0.00720)

The means of both currency in circulation and interest rate stand at 3.040368and -0.174075respectively. The exchange rate depicts highest value of kurtosis of 9.85560 which typical characteristic of a financial macroeconomic variables. However, the interest rate and currency in circulation tend to be normal.

All the variables are tested at 5% level of significance with selection of suitable lag value by Schwarz Information Criterion(SIC) and the t-statistics revealed the interest rate as I(0); currency in circulation and exchange rate are revealed as I(1) each. The ARDL(3,2) estimates selected based Schwarz Information Criterion was carried out The results tend to reject the null hypothesis of no level effect since the F-statistic tend to be greater than the upper bound of the ARDL Error Correction Bounds for cointegration Analysis. This implies that there exist cointegration relationship among the variables.

Table 2: Estimated Long Run Coefficients using the ARDL Approach

Dependent Variable: LNCIC			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio[Prob]**
IR	.085591	.053161	1.6100[.123]
C	.31581	2.3953	.13184[.896]
T	-.040321	.023577	-1.7102[.103]
LNEX	-.059582	.42746	-.13938[.891]
LNEX(-1)	.82203	.67759	1.2132[.239]

Testing for existence of a level relationship among the variables in the ARDL model

F-statistic	95% Lower Bound	95% Upper Bound	90% Lower Bound	90% Upper Bound
9.5722	8.1704	9.1124	6.5890	7.4798
W-statistic	**95% Lower Bound**	**95% Upper Bound**	**90% Lower Bound**	**90% Upper Bound**
19.1445	16.3407	18.2249	13.1781	14.9595

The results indicated that the relationship among these variables in the long-run is insignificant. However, in short run, these variables tend to exhibit strong relationship as this can be seen in Table 6 below.

The results in Table 2 revealed the diagnostic test for the long-run relationship among the variables under investigation. There are no issues as regard all the tests implemented. This implies the ARDL(3, 2) model is well fitted. Similarly, the Error Correction Representation for the Selected ARDL Model (Short run Dynamics).

The results in Table 2 reveal that there exists short run effect among the variables under investigation. Here, the lag values of currency in circulation tend to best determine its value at any current time. Lag transformation values of currency in circulation revealed almost 100% effect of increment/decrease in its current value in the short run (i.e 96.4% for the increment and 87.7% for the decrease). However, interest rate had some limited impact, since only 1% of its lag value tends to result increment in the current value of currency in circulation. The exchange rate exhibited insignificant effect both in the short run and long run dynamics.

V. Conclusion

It is concluded that any of the link functions of the binary response analysis is as suitable as its counterparts in fitting a model for the participation in cybercrime among youth that portrays a zero inflated response data. While the simulated data suggests that the Cloglog performs better than the other two link functions which are as a result of the nature of the data.

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APPENDIX

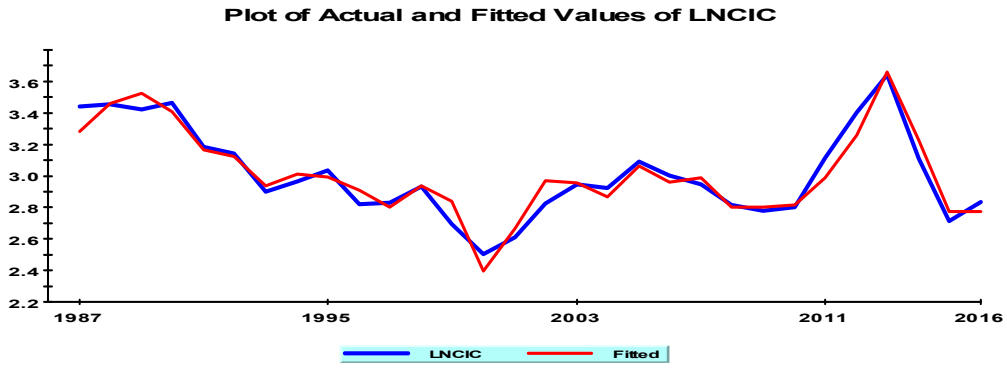

Figure 1: Plot of Actual and Fitted Values of LNCIC