Modeling Determinants of Broad Money in Nigeria Between 1995 to 2018 Using Autoregressive Distributed Lag (ARDL) Bound Test Technique

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ABSTRACT

The present study model determinant of broad money in Nigeria between 1995 to 2018 using auto regressive distributed lag (ALDL) Bound test techniques. In an attempt to achieve the desire results the study target were to establish a suitable ARDL model in modeling Broad money in Nigeria, to examine the long-run relationship between broad money with its determinants and to compare the performers of ARDL models on the basic of their Akaike and Schwarz information criteria. Therefore, two research questions and hypotheses will set to guides the study. The data for the study conserved between 1995 to 2018 and it was extracted from the Central Bank of Nigeria (CBN) online statistical billion. The data prints for the study was nine hundred and seventy two (828). The data for the study were analysed using Econometric view software (Eviews) version ten. The results revealed that there is both theoretical and prove implication for the direction of the interaction between broad money and it's determinants. Also it was found that in the long-run the speed of adjustment was – 1.093 which is an indication that about 109.3% of any movements into disequilibrium between broad money and its determinants are corrected with one month. In like manner, the result shows that there is an interaction between broad money and its determinants. Sequel to the above findings recommendations were made in the study for decision and policy making.

Key words :Determinants, Broad Money , Autoregressive Distributed Lag , Bound Test Technique

1.1 introduction

It is well noted in empirical literature that there exist dynamic interactions among macroeconomic variables and most financial indicators such as, income, level of price, inflation, exchange rate, interest rate, broad money etc. The existence of this interactions and causality between these macroeconomic variables however may differ with different school of thoughts. For example like the classical, the new theorist and the Keynesians have propounded several different explanations interaction and relationships (Fatukasi*et al.* 2015).

Similarly, Nigeriaas one of the fastest growing economy her the apex Bank (Central bank) seek to understand the causal relationship between money, income, and other macroeconomic variables.

The understanding of the dynamics interactions between the futures, past and present movement is relevant in defining the reality in the economy in order to propose a formidable monetary policy that can handle exigency that may arise.

According to Phibian (2010), Broad Money otherwise refers to as money supply , and other microeconomic variables such as Interest rate and inflation rate are key determinants of high economic growth rate capable of creating employment opportunities, reducing poverty, increase per capita income and standard of living that culminate into economic development. However, over the years the achievement of this macroeconomic objective has been challenging in Nigeria. Some of the reason for Nigeria not been able to achieve her desire set objective had been attributed to lack of proper of empirical understanding of the dynamicsinteractions andrelationship between these variables. Therefore, understandingof the fundamental connections, dynamics interactions and relationship between these variables and theresultant effect as well becomes very important. The reason for this is because understanding this relationship may help in revealing the most suitable monetary policies that maybe useful in achieving preferred economic performance.

Similarly, according to Wuyah and Amwe (2016)the ultimate effect of money on the real economy has always been of great concern to economists and monetary policymakers. Although, the new classical and classical economics, namely the traditional approach had in the past proposed that money supply has no significant implication on interest rates. This approach completely relies on the quantitative theory of money and assumes a dichotomy between monetary and real sectors, known as classical dichotomy (Wuyah*et al,* 2016).

The main hypothesis of this theory sees demand for real money has been fixed, and as such there is a direct relation between money supply and price level in the economy. A situation in which change in money supply induces a corresponding change in price level and this occur through the same direction and in the same proportion. In an attempt to achieve this, Ogunmuyiwa and Francis (2010) suggested that several monetary policies were adopted in Nigeria and these monetary policies include; the exchange rate regime policies(1959-1973) among others. In a specific term Inflation targeting policies introduced by Central Bank of Nigeria in 2007 aimed at maintaining the price levels at a target rate as a means of achieving desired economic growth.

However, the Central Bank of Nigeria could not achieve their desire target of maintaining the price levels   as a means of achieving desired economic growth.Although, there have been several divergent views in literature on the determinants of growth and broad money in Nigeria and other countries. Some of these studies have tried to examine the implication of inflation and money supply as part of a group of independent variables with similar individual effect on growth but the linkage has been observed to be neglected in a number of studies (See Odedokun (1997), Levine (1997), Ghosh and Philips (1998), Moosa (1982), Teriba (2006), Moser (1995), Balakrishanan (1991), Grauwe and magdacena (2005), Lucas (2000), Ireland (1994), Kaldor (1959), Bessler (1984),Morooney (2002) among others), while some of these studies suggests that there is the existence of a negative relationship between broad money, inflation and growth, others have found a positive relationship at different significance level in both cases. On the other hand , much explanation has not offered good explanations about determinants of broad money in Nigeria and/or its implication for the country's long term economic development, quite a little is known about the relationship between Broad money and macroeconomic variables in Nigeria using Autoregressive Distributed Lag(ARDL) co-integration technique bound test. Sequel to the above

facts, this study model determinants of broad money in Nigeria between 1995 to 2018 using autoregressive distributed lag (ARDL) bound test technique. The major aimof this study was todeveloped a suitable ARDL modeling long-run relationship between Broad money, Interest rate and Exchange rate in Nigeria, while theobjectives include to: establish a suitable ARDL model in modeling Broad Money in Nigeria and examine the long-run relationship between broad money with its determinants.

3.0 Methodology

3.1 Source of Data

The data used in this research work was obtained from the Central Bank of Nigeria (CBN) statistical database Website (www.cbn.gov.ng). The data was monthly on Nigeria Broad Money, Interest Rate and Inflation within the period 1995-2018. These variables were transformed using natural logarithm in order to liberalize their exponential trend (if any) in the financial data series – since logarithmic transformation is an inverse of an exponential function that neutralized the power of exponentiation in the series (Asteriou and Price, 2001). The software used for the data analysis was Eviewsversion 10.

3.2 Model Specification

The ARDL will be use in modeling the data (economic variables) in a single equation time series set-up. The basic ARDL Model specification for the Bound test methodology order (p q r) takes the form;

$$Y_t = \beta_0 + \sum_{i=1}^{\rho} \beta_i Y_{t-1} + \sum_{i=1}^{q} \alpha_i X_{t-1} + \sum_{i=1}^{r} \eta_i W_{t-1} + \mu_t \qquad (3.1)$$

Where;Y_t = Broad Money (dependent variable)

x_t = Inflation (independent variable)

w_t = Interest rate (independent variable)

u_t = Error term

The model (3.1) is similarly defined for higher order, for example (p q r s...) to involve four or more summations in the right hand side.

3.3 Estimation Technique

The estimation technique and procedure used in testing the model follows the times series, statistical and econometric criteria (Salvatore, 1992). The times series criteria include the following;

3.3.1 Time Plot

This was done to examine the variation from one period to another in each variable under investigation. It will also help in visual examination of the trend involved in the movement of the variables.

3.3.2 Unit Root Test

The Unit root test is carried out to verify the integrating order and level of the variables under investigation. It will also help in showing the stationary level of the data series. As recommended by time series econometricians like Pindyck and Rubinfeld (1998), Enders (1995), Engle and Granger (1987), Dickey and Fuller, (1981) and others. The essence of examining or verifying the

time series properties of the variables to be used is to avoid spurious results. Based on this reason, before estimating our model in equation (3.1), we shall examine the time series properties of the data using Augmented Dickey Fuller (ADF). In other words we have to first confirm that all the variables (series) to be used are integrated of order I(d) with d<2. That is I (d) is either I(0) or I(1)

3.3.3 Co-integration Test

For a co-integrated data set, a standard ECM takes the form;

$$\Delta \mathbf{y_t} = \beta_0 + \sum_{i=1}^{\rho} \beta_i \Delta Y_{t-1} + \sum_{i=1}^{q} \alpha_i \Delta X_{t-1} + \sum_{i=1}^{r} \eta_i \Delta W_{t-1} + \varphi Z_{t-1} + \varepsilon_t \qquad (3.2)$$

Here z, which is the error-correction term also known as the OLS residual obtained from the long-run co-integration regression is specified as;

$$y_t = a_0 + a_1 x_t + a_2 w_t + e_t \qquad (3.3)$$

The equation (3.3) above shows that z_{t-i} is of the form;

$$z_{t-i} = y_{t-1} - a_0 - a_1 x_{t-1} - a_2 w_{t-1} \qquad (3.4)$$

The next step is to formulate the conditional ECM (Pesaram*et al,* 2001), otherwise called unrestricted ECM or unconstrained ECM. It is of the form;

$$\Delta y_t = \beta_0 + \sum_{i=1}^{\rho} \beta_i \Delta Y_{t-1} + \sum_{i=1}^{q} \alpha_i \Delta X_{t-1} + \sum_{i=1}^{r} \eta_i \Delta W_{t-1} + \theta_0 y_{t-1} + \theta_1 x_{t-1} + \theta_2 w_{t-1} + v_t (3.5)$$

The values of p, q, r, are determined using Schwarz (Bayes) criterion (SC). The AIC was also considered for lag selection because it maximizes degree of freedom in the estimation of the parameters in the model. An important assumption in the ARDL/Bound Testing procedure of Pesaram*et al,* (2001) is that errors of equation (3.5) the null hypothesis must be serially independent versus the alternative hypothesis that the errors are either AR (K)or MA (K), for K=1,2,3,…upwards.It is essential to note that the structure of ARDL model is autoregressive; which means there is need to verify the dynamic stability of the model is dynamically stable. Dynamic Stability is attained when all the inverse roots associated with our model lie inside the unit circle.

3.3.4 Bound Test

To perform the bound test we recall equation (3.5) as follows;

$$\Delta y_t = \beta_0 + \sum_{i=1}^{\rho} \beta_i \Delta Y_{t-1} + \sum_{i=1}^{q} \alpha_i \Delta X_{t-1} + \sum_{i=1}^{r} \eta_i \Delta W_{t-1} + \theta_0 y_{t-1} + \theta_1 x_{t-1} + \theta_2 w_{t-1} + v_t (3.5)$$

We proceed to conduct an F-test of the Null hypothesis $H_{0;} \theta_0 = \theta_1 = \theta_2 = 0$ versus the alternative that H_0 is not true. H_0 is equivalent to absence of long-run equilibrium between variables. This non-existence implies that coefficient of y_{t-1}, x_{t-1} and w_{t-1} are equal to zero. If H_0 is rejected, then it means is a long run relationship exists. Often time's problem encountered at this stage is that the distribution of the test statistics (F) is totally not-standard. The precise critical values for the F-statistics are unavailable for an arbitrary basket of I(0) and I(1) variables. Therefore we resort to Pesaram*et al,*(2001) provision of bounds on the critical values for the asymptotic distribution of the F-statistics. The table of critical values has lower bound and upper bound. The lower bound is of the assumption that all the variables are I(0) while the upper bound is of the assumption that all the variables are I(1).

3.4.5   Result Evaluation

If the calculated F-statistics falls beneath the lower bound, it is an indication that the variables are I(0), and implies no co-integration, on the other hand if it is higher than the upper bound, it is an indication of co-integration. The test is declared inconclusive if the F-statistics lies between the upper and lower bounds.As a way of cross-checking the calculations, it is also necessary to perform a bound t-test. The bound t-test takes the form H_0: $\theta_0=0$ versus H_1: $\theta_0<0$. If the t-statistics in equation (3.5) is higher than the I(1)bound tabulated according to Pesaran et at, (2001), we then uphold the view that a long-run relationship exist between the variables. But if the t-test is lower than the I(0)bound, we would conclude that all the data are stationary. However, a situation where the bound test indicates existence of co-integration, we can now proceed to compute the long-run relationship between the variables.

$$y_t = a_0 + a_1 x_t + a_2 w_t + e_t \qquad\qquad (3.6)$$

and the usual ECM

$$\Delta y_t = \beta_0 + \sum_{i=1}^{\rho}\beta_i \Delta Y_{t-1} + \sum_{i=1}^{q}\alpha_i \Delta X_{t-1} + \sum_{i=1}^{r}\eta_i \Delta W_{t-1} + \varphi Z_{t-1} + \varepsilon_t \qquad\qquad (3.7)$$

Where; $z_{t-I} = y_{t-1}-a_0 - a_1 x_{t-1} -a_2 w_{t-1}$ and the α, η and β are the OLS coefficient estimates in equation (3.7). We can obtain the long-run effect from the unrestricted ECM captured in equation (3.5) and noting that at lung-run equilibrium, $\Delta y_t = \Delta x_t = \Delta w_t = 0$ and the lung-run coefficient for x_t and w_t are $-(\theta_1/\theta_0)$ and (θ_2/θ_0) respectively.

4.0   RESULTS

4.1   Time Series Plot

Preliminary statistical such as time series plot was carried out to verify the trend of data series. Time plot in figure 4.1, 4.2 and 4.3 below are monthly broad money (M_2) exchange rate (Naira/US Dollar) EXCR, and Nigerian monthly interest rate (Naira) inter rate from January, 1995 to December, 2018 respectively.
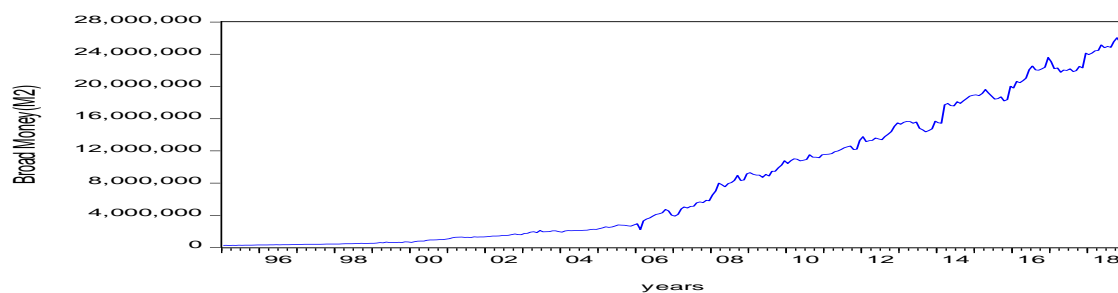

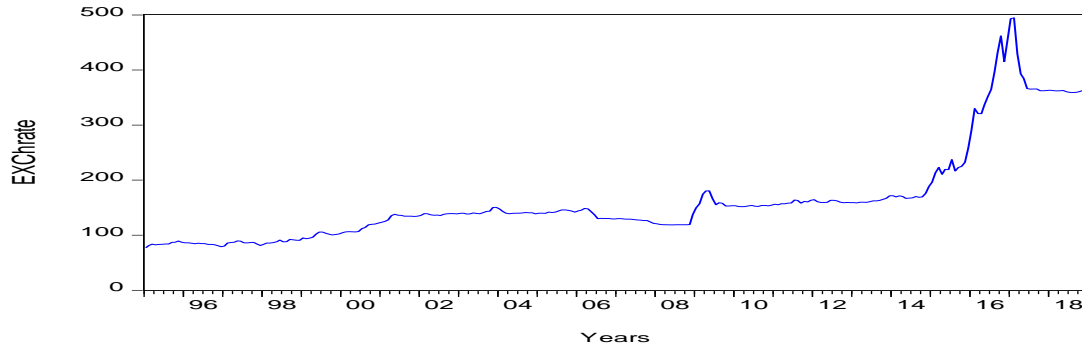Fig. 4.1:   Time Plot on Monthly Broad Money (M2) from January, 1995 to December, 2018.

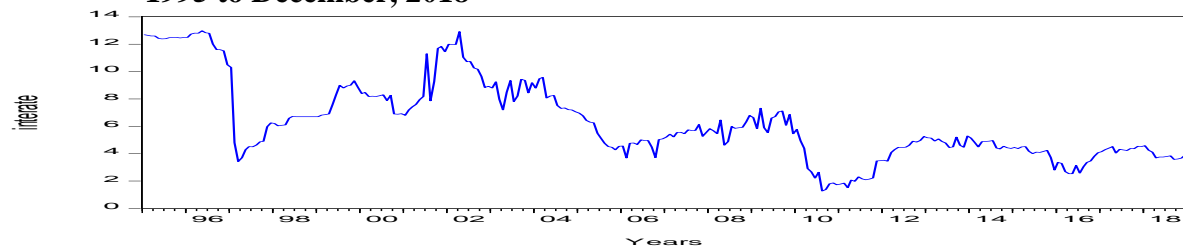**Fig. 4.2:** **Time Plot on Monthly Exchange Rate (Naira/US Dollar) EXCR from January, 1995 to December, 2018**

Fig. 4.3: **Time Plot on Monthly Interest Rate (Naira) from January, 1995 to December, 2018.**

Detrend Series Plot

Preliminary statistical approach such as time series plot was carried out to verify the detrend of data series in figure 4.4 , 4.5 and 4.6 and the graphical representation of the first difference of Broad Money (M_2) first difference or exchange rate (Naira / US Dollar) and first difference interest rate from January, 1995 to December, 2018.
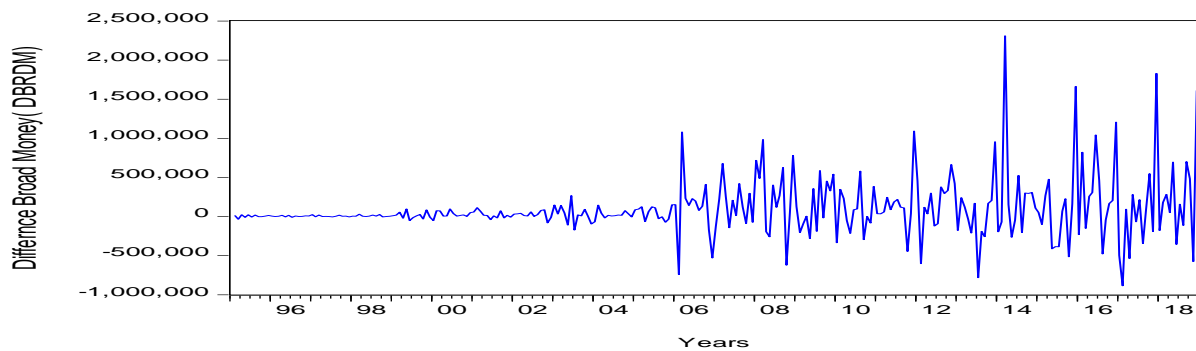

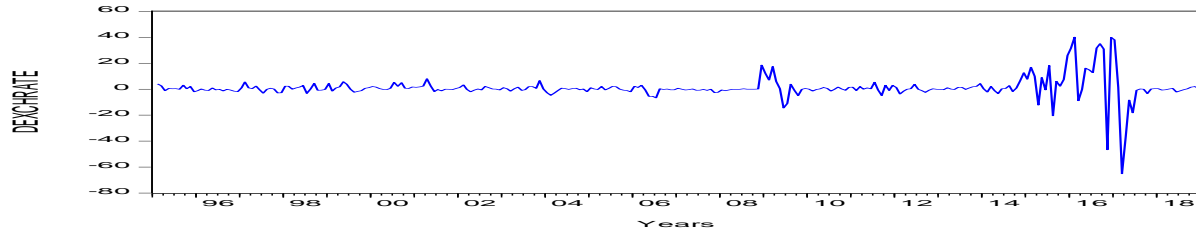**Figure 4.4:** **First Difference of Monthly Exchange Rate (Naira/ US Dollar) – From January, 1995 to December, 2018.**

Figure 4.5: **Graphical Representation of the Differenced Exchange Rate (Naira/ US Dollar) from January, 1995 to December, 2018.**
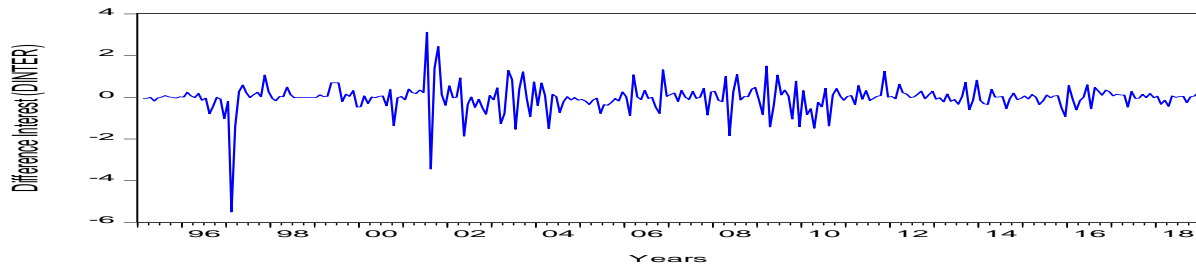

Figure 4.6: **Graphical Representation of the Differenced Interest Rate (Naira/ US Dollar) from January, 1995 to December, 2018.**

Table 4.1 below contains the summary descriptive test statistic of all the variable used in the study. This test was carried out to check the direction of the movement of the variable whether they are skewed to the left or right and also checked whether normally distributed or not

Table 4.1: Summary Descriptive Test Statistics

Variable	Mean	Median	Max	Min	Std	Kurtosis	Skewness	J-B	Prob.
Broad Money	8200	4439	2708	2545	8093.0	0.6936	2.0783	33.2847	0.0000
Exchange Rate	164.8687	140.4350	494.7000	77.1500	87.7792	1.8621	5.7459	256.9043	0.0000
Interest Rate	6.3020	5.5100	12.9800	1.2700	2.8809	0.7604	2.8276	28.1101	0.0000

4.2   Unit Root Test
Table 4.2 below is the result of the outcome of a group Augmented Dickey Fuller (ADF) test at level conducted to examine whether there is a unit root in all the variables under investigation. This is because the present of unit root will give us biased result that cannot be used for forecasting. Also, this was done to ascertain the stationary level of the series under consideration and unit root test was carried out using Augmented Dickey Fuller (ADF) test.
Table 4.2: Result of Unit Root Test for BRDM, INTR, and EXCHRATE

S/N0	Variables	Probability	Lag	Max Lag	Observation
1	BRMD	1.0000	4	4	283
2	INTERRATE	0.8534	4	4	283
3	EXCHRATE	0.0805	4	4	283

Source: Researcher's Computation using Eview software version ten

Table 4.3 below is the result of the outcome of a group Augmented Dickey Fuller (ADF) test at first difference conducted to examine whether unit root have been completely remove in all the variable under investigation. As shown in the result, all the variables are stationary at first difference.

Table 4.3: Result of Unit Root Test for DBRDM, DINTR, and DEXCHRATE

S/N0	Variables	Probability	Lag	Max Lag	Observation
1	DBRMD	0.0000	4	4	282
2	DINTERRATE	0.0000	4	4	282
3	DEXCHRATE	0.0000	4	4	282

Source: Researcher's Computation using Eview software version ten

4.3 ARDL Regression

Table 4.4 below show the outcome of an ARDL regression carried out to fit the data to the model and this was done to determine the short run relationship between the series with different order of lagged.

Source: Researcher's Computation using Eview software version ten

Table 4.4: Result of ARDL Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DBRDM(-1)	-0.093051	0.061723	-1.507557	0.1328
DEXCHRATE	8708.582	2567.411	3.391971	0.0008
DEXCHRATE(-1)	-7944.353	2697.655	-2.944910	0.0035
DEXCHRATE(-2)	2387.197	2602.375	0.917315	0.3598
DEXCHRATE(-3)	2908.447	2584.185	1.125480	0.2614
DEXCHRATE(-4)	-7286.706	2675.535	-2.723457	0.0069
DEXCHRATE(-5)	7874.267	2558.932	3.077170	0.0023
DINTER	4440.671	30502.59	0.145583	0.8844

C	96777.38	21716.59	4.456379	0.0000

F-statistic	3.146575	Durbin-Watson stat	1.882886
Prob(F-statistic)	0.002009		

Table 4.5 below was an outcome of the test for the presence of Heteroskadosticity. Heteroskadosticity is a condition that occurs when a linear model violates the concept of having constant variance and zero mean, and when once a model is victim of heteroskadosticity the model cannot be use for forecasting.

Table 4.5: Result of Heteroskadasticity Test

F-statistic	0.592553	Prob. F(5,271)	0.7057
Obs*R-squared	2.995613	Prob. Chi-Square(5)	0.7007

Table 4.6 below is the result of an outcome of the test for the presence of serial correlation. This is used to assess the validity of model assumption inherent in applying regression like model to observed data series or where error terms in a time series transfer from one period of another. A Situation in which the error in one time periods is correlated with the error in another subsequent time period.

4.4 ARDL Long Run Form and Bound Test

Table 4.7 below is the results of ARDL long form and bound test for the co-integrating

Table 4.6: Result of Breusch-Godfrey Serial Correlation LM Test

F-statistic	2.555848	Prob. F(5,268)	0.0279
Obs*R-squared	12.83480	Prob. Chi-Square(5)	0.0250

relationship between broad money (M_2) exchange rate (excharate) and interest rate (interrate).

Table 4.7: Result of ARDL Long Run Form and Bound Test

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	96777.38	21716.59	4.456379	0.0000

DBRDM(-1)*	-1.093051	0.061723	-17.70893	0.0000
DEXCHRATE(-1)	6647.435	4471.169	1.486733	0.1382
DINTER**	4440.671	30502.59	0.145583	0.8844
D(DEXCHRATE)	8708.582	2567.411	3.391971	0.0008
D(DEXCHRATE(-1))	-5883.205	4098.080	-1.435600	0.1523
D(DEXCHRATE(-2))	-3496.008	3547.595	-0.985459	0.3253
D(DEXCHRATE(-3))	-587.5614	3041.593	-0.193176	0.8470
D(DEXCHRATE(-4))	-7874.267	2558.932	-3.077170	0.0023

EC = DBRDM - (6081.5407*DEXCHRATE + 4062.6378*DINTER + 88538.7418)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	78.46919	10%	2.63	3.35
K	2	5%	3.1	3.87
		2.5%	3.55	4.38
		1%	4.13	5
		Finite Sample: n=80		
Actual Sample Size	282			
		10%	2.713	3.453
		5%	3.235	4.053
		1%	4.358	5.393

Source: Researcher's Computation using Eview software version ten

4.5   ARDL Error Correction Regression

Table 4.8, below are result of error correction model which was carried out to correct movement of disequilibrium within a period.

Table 4.8: Result of ECM

ECM Regression

Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DEXCHRATE)	8708.582	2390.032	3.643710	0.0003

D(DEXCHRATE(-1))	-5883.205	2696.014	-2.182187	0.0299
D(DEXCHRATE(-2))	-3496.008	2741.145	-1.275382	0.2033
D(DEXCHRATE(-3))	-587.5614	2682.725	-0.219017	0.8268
D(DEXCHRATE(-4))	-7874.267	2375.952	-3.314152	0.0010
CointEq(-1)*	-1.093051	0.061360	-17.81365	0.0000

Source: Researcher's Computation using Eview software version te

4.6 Wald Test

Table 4.9 below is the results of wald test to validate the result obtained from the ARDL long run form bound test.

Table 4.9: Result of Wald Test

| Test Statistic	Value	df	Probability
F-statistic	7.762649	(2, 273)	0.0005
Chi-square	15.52530	2	0.0004

VAR Stability Conditional Test

Table 4.10 below are the result of VAR stability conditional check for the position of the inverse roof of the AR.

Table 4.10: Result of VAR Stability Conditional Check

Root	Modulus
1.006024	1.006024
0.976193	0.976193
0.930625	0.930625
-0.292009 - 0.497981i	0.577282
-0.292009 + 0.497981i	0.577282
0.519428	0.519428
-0.008570 - 0.401663i	0.401754
-0.008570 + 0.401663i	0.401754
0.389096	0.389096
-0.133304 - 0.246892i	0.280581
-0.133304 + 0.246892i	0.280581
0.040334	0.040334

Warning: At least one root outside the unit circle.

VAR does not satisfy the stability condition.

The diagram below is the diagrammatic presentation of the dynamic stability of the inverse root of the AR of VAR stability condition check. For the point to fall in the unit circle it is simply means that the model is dynamical stable and it can be used for policy formulation.

Inverse Roots of AR Characteristic Polynomial
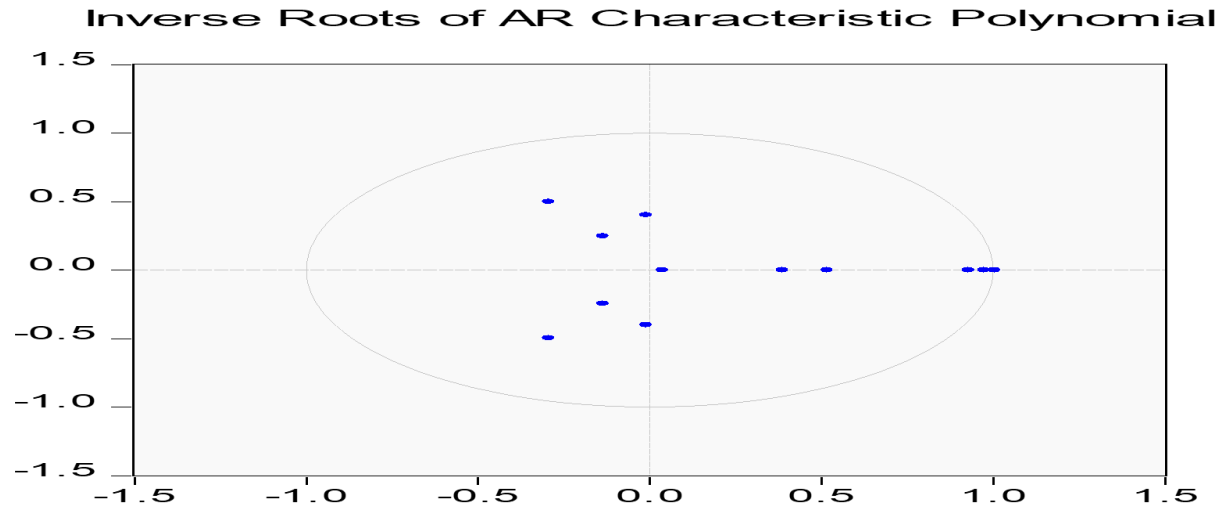
5.1 Discussion of Results

Figure 4.1, 4.2, and 4.3 represents time series plot of the data used in the study. In the graphical representation, figure 4.1 reveals a progressive movement in the trend of the data in an upward projection from the year, 1995 to December, 2018. Similarly, figure 4.5 representing the time plot for the variable exchange rate and from visual examination the trend in the movement does show evidence of an upward projection except within the year 2014 – 2018 that there was increase in the movement. The result obtained could be synonymous to Da–Waribiko and Essi(2019) findings in their investigation on the determinants of exchange rate in Nigeria (1991 – 2017) using am ARDR/ Long –run form of bound test Methodology. Also, in Da – Warribiko and Essi (2019), it was found that the shift in the trend and movement of the graph from the year 2014 – 2018 was attribute to policy shift as well as the amendment of Central Bank of Nigeria (CBN) act in 1992 during the Ibrahim Babangida's regime of reckless spending. In like manner, figure 4.3 was time series plot of monthly data on interest rate from January 1995 December, 2018 form the visual observation of the trend in the movement of the line graph, it was revealed that there was a sharp fall interest between 1996 – 1998 and sharp projection between 2000 – 2004. All these rise and fall shows evidence of the characteristic or financial data series. Also, Figure 4.4, 4.5 and 4.6 are all time plot for the difference series and they appear to be stationary. This was done to confirm that the series has been de-trend. Also table 4.1 contain the summary descriptive test statistics and the result shows that the variables are positive skewed to sight, the Jargue-Bera test are all greater than three (3) and their calculated probability values are less than 0.05 which means that the hypotheses of normality should be rejected. This simply means that they are not normal distributed and the result obtained is in agreement with the basics characteristics of financial data.

Table 4.2 contain the result obtained after running a unit root test on the non- stationary series (BRMD, INTERRATE and EXCHANGE) and on the first difference at level. Similarly table 4.3 contain the result obtained after running a unit root test on the first difference series (DBRMD, DINTERRATE and DEXCHANGE) which shows that it is stationary. Also the result obtained here confirmed the assertion of Pesaran*et al* (2001). In Pesaran*et al*(2001), it was revealed that for a time series data to be filled to an auto-distributed lagged model the variables must be stationary at 1(0), or 1(1) or a mixed of I(0) and I(1) or I(1)and I(i) (Jarnta, 2006).

In another development, the model under investigation established a relationship between the dependent (monthly broad money (BMY)) and independent variables (Monthly data on exchange rate (Exchange and interest rate) form January, 1995 to December, 2018 respectively. The study used the method three (3) unrestricted constant and no trend in pesaran*et al*., (2001) specification. The auto regressive distributed lagged structure of the model obtained was ARDL (1,5,0) and this was selected using the least Akaike Information Criterian (AIC) model selection technique.

The Auto Regressive Distributed Lagged (ARDR) models are typically estimated using an ordinary Least Squire technique but in the case of this study, the model obtained an ARDL (1, 5, 0) using built in equation object specialized for an ARDL model estimation. The estimated probability (F- statistic) was (3.146575) whereas the calculated probability of the overall model was (0.002009) which was less than the standard probability value of 0.05 and this revealed that the model is good. The model was further verified   using heteroskedasticity and serial correlation test to check for the presence of ARCH effect and serial correlation in the residual of the error term. Table 4.5 shows the result for heteroskedasticity test and from the results obtained there is evidence of absence of heteroskedasticity as the probability value of the F- statistic and X^2 (a) were greater than 0.05.

To estimate the co-integrating relationship of the time series variables using the ARDL Long run and bound test as revealed in table 4.7 and this was done by testing the null hypothesis (H_0) stating that there is no equilibrating relationship against the alternative hypothesis (H_1), there is equilibrating relationship. The result, F-statistic is 78.46919, evidently this is above the integral critical bounds value of I(1) indicating that there is co-integrating relationship between the variables, therefore the null hypothesis was rejected. The results obtained here conformed to Chude and Chude (2016) findings in their investigation about the impact of Broad Money Supply on Nigerian Economic Growth. In Chude and Chude (2016), it was found that there exist a positive and significant relationship between Broad Money Supply and economic growth in Nigeria.

This implies that Broad Money Supply has dominant influence on output and prices. Similarly, the result obtained under this investigation also agree with Fatukasi, *et al* (2015) estimation about the dynamic interrelation among the macroeconomic variables viz., real output, money supply, government expenditure, inflation, exchange rate, interest rate, trade openness and financial deepening using annual data for Nigeria covering the period from 1970- 2013 following ARDL bounds approach to cointegration.

In Fatukasi, *et al.,* (2015), it was found that there exists a long-run relation between real output, money supply, interest rate and exchange rate when the price and financial deepening variables were the dependent variables. The Error Correction Model regression also known as the EC term (z_{t-i}) was also investigated to confirmed the level of the speed of adjustment as shown in table 4.7 and the result shows that CointEq (-1)* has negative coefficient of -1.093051 which indicates that about 109.305% of any movements into disequilibrium between broad money and its determinants are corrected within one period (one month), additionally, with a t-statistic as high as (-17.81365). This confirmed the fact the coefficient is highly significant at 5% level of significance. This was synonymous to Duasa (2006) findings in determining Malaysian trade balance using ARDL bound testing approach. In Duasa (2006) study, it was found that there exist long-run relationship between trade balance and income and money supply variables but not between trade balance and real exchange rate. Therefore, the result recommended that Marshall-Lerner condition does not hold in long-run for Malaysia and for policy making reasons the Malaysian trade balance/balance of payments should be reviewed from absorption and monetary approaches.

A Wald Test was conducted as shown in table 4.8, the result revealed F-statistic is 7.762649, having (K+1) = 3 variables (BRDM EXCHRATE, and DINTR) in the model, and checking the critical values of the Bounds test table, we have K = 2. Furthermore, the Null Hypothesis here is H_0: C(9) = C(10) = (11) = 0 (meaning no co-integration) against H_1: A negation of H_0 (meaning continual lung run relationship). Since the f-statistic is less than the Chi-square =7.762649<15.52530 the null hypothesis (H_0) was rejected and we conclude that there is co-integration between the variables thus confirms that exchange rate and interest rate are determinants of broad money in Nigeria. To confirm the dynamic Stability of the Model, we investigated the position of the inverse roots, as reflected in figure 4.7 the roots are all inside the unit circle, thereby confirms that the model is dynamic stable.

6.1   Conclusion
This study aimed at developing a suitable Autoregressive Distributed Lagged (ADRL) modeling long-run relationship between Broad money, Interest rate and Inflation in Nigeria, specifically the objective of the study was to : establish a suitable Autoregressive Distributed Lagged(ADRL) model in modeling Broad Money and Economic growth in Nigeria, examine the long-run relationship between broad money with its determinants and compare the performances of ARDL model selected by using Akaike and Schwarz Information Criteria in modeling and determinants. Two researchquestions and hypotheses were set to guides this study.

After detailed review of related literature to this study, it was found that the possible determinants of Broad money and economic growth include; Interest rate and Inflation in Nigeria. However, to fit the variables, Broad money, Interest rate and Inflation to Autoregressive Distributed Lagged long-run model the study examine preliminary data analysis commenced by first confirming that no series under consideration were integrated of order 1 or above, this was achieved by running unit root test on the first difference using the Augment Dickey Fuller (ADF) test and the variables were stationary at all significant levels and this confirmed Persand*et a.,* (2001) assertion.

Following Pesaran, Shin and Smith(2001), bounds testing approaches to the analysis of level relationships using the unrestricted constant and no trend were considered in fitting the data, while the Akaike information Criterion (AIC) Model selection method was used to selecting model ARDL(1, 5, 0).

The test for the residuals of the ARDL regression shows that it was serially uncorrelated and was non heteroskedastic, the problem was tested using the HAC covariance matrix.

However, the findings of this study based on the empirical analysis notwithstanding, supported that aggregate Broad money supply is positively related to economic growth. Conversely, this in a way suggests that government should give more attention to ensuring that there is an appropriate policy mix for harmony and proper coordination of economic policies to cater for greater economic growth in Nigeria.

6.2 Recommendations

The following are recommended in this study;

i. Having established a suitable ARDL model in modeling Broad money and economic growth in Nigeria, therefore, it is imperative for economic policy makers to be using ARDL model in estimating determinant of Broad Money and economic growth in Nigeria. This will enhance monetary policy formulation beyond rhetoric of literally colloquialism to facts and figures with mathematical prove.

ii. Also, having determine the long-run interaction between broad money and economic growth determinants, it is necessary that economic policy makers and planners to planned the economy using ARDL model in such a way that will accommodate possible readjustment when the economy is stressed beyond its equilibrium point. This will create room for accurate determination of error correction or speed of adjustment.

ii. In comparing the performances of any ARDL model, it is recommended that Akaike and Schwarz Information Criteria should be considered as the best model selection models since it maximizes lost of degree of freedom.

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