South Asian Journal of Social Studies and Economics

Volume 21, Issue 4, Page 119-129, 2024; Article no.SAJSSE.112132
ISSN: 2581-821X

Monetary Policy on Exchange Rate Volatility in Nigeria: Evidence from BARDL/ARCH and Garch Modellings

Muntari Darda'u Iliyasu [a], Saifullahi Sani Ibrahim [a] and Ibrahim Musa [a*]

[a] Department of Economics and Development Studies, Federal University Dutsin-Ma, Katsina State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/SAJSSE/2024/v21i4805

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/112132

Original Research Article

Received: 25/11/2023
Accepted: 31/01/2024
Published: 14/03/2024

ABSTRACT

While the impact of monetary policy on the exchange rate has been explored in the literature, the volatility of the exchange rate remains an important issue of concern. This study examines the impact of monetary policy on exchange rate volatility in Nigeria. The study uses annual time series data covering 1987 until 2023 which was analysed using Autoregressive Conditional Heteroscedasticity (ARCH), bootstrap bound test for cointegration and Granger causality test within the vector error correction model. The empirical finding of the ARCH reveals the presence of conditional volatility of the exchange rate. Moreover, findings from the bootstrap bound test establish a long-run relation among the variables. The study further found that the volatility of the exchange rate is accounted for by the changes in money supply and previous fluctuation of the exchange rate. The causality test indicates the existence of causality from exchange rate volatility to money supply, interest rate, saving and population in both in short and long run. The study concludes that the volatility of the exchange rate is driven by the variability of money supply,

**Corresponding author: Email: imusa2@fudutsinma.edu.ng;*

interest rate and savings. Therefore, controlling the shocks emanating from previous exchange rate volatility and money supply is key to addressing the exchange rate fluctuation in Nigeria. The study recommends a policy mix of utilizing key fiscal and monetary policy tools that could enable Nigeria to achieve exchange rate stability.

Keywords: ARCH / GARCH-bootstrap bound test; exchange rate volatility; monetary policy.

1. INTRODUCTION

"Monetary policy in Nigeria is anchored on the monetary targeting framework and price stability which represents the overall objective of economic stability. Monetary Policy refers to the specific actions taken by the Central Bank to regulate the value, supply and cost of money in the economy with a view of achieving predetermined macroeconomic objectives. For many countries, the objectives of monetary policy are explicitly stated in the laws establishing the Central Bank, while for others they are not. The objectives of monetary policy may vary from country to country but there are two main views. The first view calls for monetary policy to achieve price stability while the second view seeks to achieve exchange rate stability vis-a-vis other macroeconomic objectives. In due course, the Central Bank of Nigeria, has been increasingly pursuing policies aimed at achieving economic stability" [1].

"On the other hand, the exchange rate is defined as the rate at which one country's currency may be converted or exchanged into another. It may fluctuate daily with the changing market forces of supply and demand for currencies from one country to another. For these reasons when sending or receiving money internationally, it is important to understand what determines exchange rates. In this sense volatility in exchange rate denotes the risk associated with unexpected movements in the exchange rate. Economic fundamentals such as the inflation rate, interest rate and the balance of payments, which become more volatile in the 1980s and early 1990s, are by themselves, seen as the sources of exchange rate volatility" Ozuturk, [2] Hook and Boon [3] added that "increase cross-border flows that have been facilitated by the trend towards liberalization of the capital account, the advancement in technology, and currency speculation have also caused exchange rate fluctuation. The exchange rate is generally determined by supply and demand of foreign exchange in a free foreign exchange market that causes the exchange rate movements".

"Exchange rates can fluctuate by several percentage points even during a single day. Exchange rate volatility is commonly accepted to have a negative effect on the domestic economy passed through international trade and capital flows. The fluctuations are ignited directly through uncertainty and adjustment costs, and indirectly through its effect on the allocation of resources and government policies. There has been excessive volatility of the Naira against major exchange rates in Nigeria since the adoption of flexible exchange–rate regimes in 1986. Consequently, sustained exchange rate volatility was thought to have led to currency crises, distortion of production patterns as well as sharp fluctuations in external reserve" Adubi & Akunmadewa [4] Dahiru & Joseph 2013).

Therefore, as identified by CBN [1] the Bank controls the monetary affairs of the economy specifically exchange rate volatility as in this regard largely through money supply (broad and narrow) and the interest rate. Other variables that influence exchange rate volatility include among others, inflation rate, performance of the internal economy and balance of payment as well as gross savings Ozturk, [2] Morina et.al, 2020). An increase in money supply informed of expansionary monetary policy will result in a state of more cash in the economy thereby leading to an increase in production level and gross domestic product which leads to an excess of export over import and by extension the exchange rate for the country appreciates over the other foreign currency and vice versa. Similarly, changes in interest rates and inflation rates affect the exchange volatility positively and negatively depending on whether it is increased or decreased. High interest and inflation rates affect the exchange rate negatively and vice versa. Variables such as Inflation rate, gross savings and Gross Domestic Product (GDP) per capita are among the ones that determine the exchange rate volatility of a country. This is because, high and sustained GDP per capita and gross savings, improve the exchange rate and stabilize exchange rate volatility and vice versa. As established earlier, it is among the core objectives of macroeconomic policy to have a

stable exchange rate which if achieved would guarantee full employment, economic stability and a good international economic image. However, the exchange rate is not always stable especially in developing countries like Nigeria due to flexible monetary policies such as poor broad money supply plan, interest rate, inflation rate, poor reserve status of the economy as well as lack of sustained economic growth.

This study is structured into five parts including the introduction. Section two presents a review of the literature, Section three discusses the methodology, Section four presents results and discussion and the last Section concludes.

2. LITERATURE REVIEW

2.1 Theoretical Settings

In examining the interaction between monetary policy tools and exchange rate volatility most studies have adopted the Markov-switching model developed by Hamilton [5] in explaining the possibility of switching between the regimes of high and low volatility of exchange rates. This involves the shift between "crisis" and "tranquil" incorporating the features of multiple equilibria. Goldfajn and Gupta [6] discover, using a large panel data set, that high-interest rates support the currency, but only when the banking system is strong.

The equation of exchange has been stated by Cambridge economists, Marshall and Pigou, in a form different from Irving Fisher's. Cambridge economists explained the determination of the value of money in line with the determination of value in general. The value of a commodity is determined by the demand for and supply of it and likewise, according to them, the value of money is determined by the demand for and supply of money. As studied in the cash-balance approach to the demand for money Cambridge economists laid stress on the store of value function of money in sharp contrast to the medium of exchange function of money emphasized by Fisher's transactions approach to demand for money. According to the cash balance approach, the public likes to hold a proportion of nominal income in the form of money (i.e., cash balances).

2.2 Empirical Literature

Yunusa [7] revealed that “the effect of exchange rate volatility on Nigerian crude oil exports to its trading partners (UK, USA, Italy, France, Spain, Canada and Brazil) was examined using monthly data from the first month of 2006 (M01) to the last month of 2019. (M12). The exchange rate volatility was estimated using GARCH and the effect of exchange rate volatility on crude oil exports was estimated using ARDL. The result of the GARCH shows that the exchange rates of the trading partners are volatile. The result of the ARDL shows that the exchange rate volatility of Nigeria's trading partners is statistically significant for all trading partners but of varying magnitudes, which means the volatility of Nigeria's trading partners The real exchange rate of the trading partners is statistically significant for all trading partners, while the revenue of Nigeria's trading partners is statistically significant for 4 out of 7 countries. As a result, the volatility of the exchange rate has a significant impact on the export of crude oil to Nigeria”.

In addition, Ikechi and Anthony [8] investigated “the impact of exchange rate volatility on international trade in Nigeria. The study used secondary data from 1996 to 2018. Vector Auto-Regressive (VAR), Variance decomposition analysis, impulse response analysis ARCH and GARCH were used to determine the relationship. The estimations of the VAR model indicate an inverse relationship between export, import and Real Effective Exchange Rate (REER) during the current period. The analysis of variance decomposition suggests that shocks partly explain fluctuations in the RRSP as well as exports and imports. The Impulse Response Analysis shows a negative association between exports and the actual effective exchange rate while it has been largely positive for imports over the ten-year period. The causal effect is that imports cause exports, but exports do not cause more imports. The ARCH modelling approach suggests the existence of a first-order arch effect and a significant GARCH term. Although the GARCH Coefficient in the mean term is negative, it has produced a singular covariance that is not unique in itself. The results show evidence of the volatility of clustering in import and export trading activities in Nigeria”.

Paul, Uma and Obidike [9] investigate “the efficiency of monetary policy in ensuring stability on the exchange rate in Nigeria. Data covering from 1981 to 2014 were obtained from secondary sources particularly the Central Bank of Nigeria (CBN) statistical Bulletin and National Bureau of Statistics of various issues. Analysis was carried

out using multiple regression method, Augmented Dicky-Fuller unit root test, Johansen co-integration test and Error Correction Mechanism (ECM). The results revealed that all variables were not stationary at their level form but rather stationary after first differencing hence they are integrated of order one I(1). The results also showed that a long-run relationship exists among the variables as well as the presence of one co-integrating vector in the model. The results also showed that the impact of monetary policy on the exchange rate was significant while the Error correction Mechanism (ECM) showed the extent of reverting to stability when deviated from a stable path".

Amir and Amir [10] investigated "the impact of monetary policies on the exchange rate of selected developing countries. Dynamic panel data based on the Generalized Moment Method (GMM) were used to estimate the model. Their findings indicate that the exchange rate lag has a positive and significant effect on the exchange rate. These results reflect the exchange rate dynamics over time. In addition, this paper shows that the liquidity coefficient as an indicator of monetary policy is positive and significant. Furthermore, GDP, inflation, and exports of goods and services Moreover, GDP, inflation and exports of goods and services have negative, positive and negative effects on the exchange rate, all of which are statistically significant".

Babatunde and Olufemi [11] analysed "the effects of monetary policy shocks on exchange-rate volatility in Nigeria through changes in various monetary policy instruments. It specifically looked at the relationship between exchange rate volatility and monetary policy shocks in Nigeria. The paper uses the classic ordinary least square to examine the short-term monetary policy determinants of exchange rate volatility in Nigeria. The error correction mechanism model was also estimated after establishing a long-term interaction between the set of incorporated variables using the Engle-Granger approach. The results of the paper show that the real and nominal exchange rates in Nigeria were unstable during the period under review. In short, the variation in the monetary policy variable explains the movement/behaviour of the exchange rate through a self-correction mechanism process with little or no intervention by the monetary authority (CBN). In addition, the results of the causality tests between exchange rate volatility and monetary policy variables have shown that there is a causal link between past value of monetary policy variables and the exchange rate".

Umar [12] argued that "monetary policy is a fundamental basis for sustainable exchange-rate stability in Nigeria. This is because it increases national savings and private investment, improves exports and maintains a competitive balance of payments. Exchange rate stability guarantees economic growth to a large extent. To this end, several factors have been identified as potential determinants of exchange rate stability. These include diversification of exports to discourage over-dependence on oil; improved trade relations and increased inflows of foreign direct investment. Using time series data for the period 1980-2011 and adopting the Granger causality test and error correction mechanism (ECM), the results showed that money supply had a positive and significant impact on the exchange rate, while monetary policy rate and liquidity ratio had a negative impact on the exchange rate".

Zafar and Sabo [13] examine "the effects of monetary policy variables on exchange rates in Nigeria. Using multiple regression analysis and time series data for the period 1980-2010, quantitative evidence shows that money supply, Treasury bill rate and cash reserve ratio have a negative and significant impact on the exchange rate. Empirical results also suggest that monetary policy rates are negatively linked to exchange rates, suggesting that timely and effective implementation of monetary policy decisions is the best alternative to managing exchange rates".

3. MATERIALS AND METHODOLOGY

3.1 Sources of Data

The type of data used in this paper is secondary data. The data of the variables (broad money supply, interest rate, gross savings and population) were all sourced from the World Development Indicators database from 1987 to 2023 for all variables.

3.2 Model Specification

Depending on the situation, the Nigerian experience revealed that the monetary authority uses either quantitative or qualitative steps to stabilise macroeconomic activities. Previous experiences prompted the monetary authority to raise the stock of money reserves in order to

minimise exchange rate volatility and closely track the overall economy's productivity performance. As argued by Chen [14] exchange volatility is either a crisis or a tranquil regime which is dependent on the appropriate selected monetary variables (especially interest rate) employed as stabilization instruments. Following from this, however, the research intends to extend the argument of Chen [14] by adopting the theoretical framework of the Markov model at the multiple equilibria process expressed as:

$$et = \alpha \Pi st + \mu \quad (1)$$

Furthermore, adopting the variables used in the research work of Amir and Amir [10] with a slight modification of adding population because of its major role in the structure of both the banking and real sectors of the economy. on the preceding statement, the empirical model for analysing the impact of monetary policy shocks on exchange rate volatility in Nigeria by taking into account the most commonly used monetary of broad money supply, interest rate, gross savings and population) is the based model and expanded into functional relationship as follows:

$$EXRV = F(BMS, INTR, LGSAV, LPOP) \ldots \ldots (2)$$

In the model specification exchange rate Volatility (EXRV) is used as the dependent variable while the independent variables are broad money supply (BMS), and Interest rate(INTR), whereas log of gross savings(LGSAV) and the log of population(LPOP) are control variables. The model is then redefined into mathematical form:

$$EXRV = BMS + INTR + LGSAV + LOGPOP \quad (3)$$

The mathematical model equation (3) is therefore modified into econometric model by incorporating the error term below:

$$EXRV = \alpha_0 + \beta_1 BMS + \beta_2 INTR_t + \beta_2 LGSAV_t + \beta_2 LPOP_t + \mu_t \quad (4)$$

In order to investigate the Exchange rate volatility clustering ARCH/GARCH modelling was employed, for the long run and the dynamic relationship among the variables, the Bootstrap ARDL technique established by Paseran et al. 15] and MacNown [16] was used. The ARCH/GARCH modelling was formulated, followed by the ARDL modelling approach as follows:

The (ARCH/GARCH) models were proposed by Engel [17] and Bollerslev [18] respectively.

The ARCH model

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-1}^2 \quad (5)$$

Where: α_0 is the mean, α_1 is the conditional volatility and ε_{t-1} is the white noise representing the residuals of the time series, However, to overcome the weaknesses found in applying the ARCH models in connection to volatility clustering, Bollerslev [18] modifies the version of ARCH models, which refers to symmetric relationship as Generalized Auto Regressive Conditional Heteroskedasticity (GARCH). The Model synchronized both the lagged squared residuals and the lagged Variances, the GARCH (p,q) model is presented in the following equation as follows:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-j+}^2 \sum_{i=1}^{p} \beta_i \sigma_{t-j}^2 \quad (6)$$

where, i= 0,1,2,23,…p, conditional volatility, $\omega, \alpha_j \beta_i$ are non-negative constant with $\alpha_j + \beta_i < 1$, it must be near to unity for correct model, $\sigma_{t-\,are}^2$ GARCH components.

The ARDL bound test to cointegration by adding the lagged independent variables to augment the existing F-and the t-test for cointegration Proposed by Paseran et al. [19] as follows. The ARDL testing approach is formulated as follows:

$$\Delta lnexr = C_0 + \delta_1 lnerv_{t-1} + \delta_2 Intrs_{t-1} + \delta_4 lgsav_{t-1} + \delta_4 lgpop_{t-1} + \sum_{i=1}^{p} \pi_1 \Delta lnervt_{t-i} + \sum_{i=0}^{q} \vartheta_j \Delta Intrs_{t-j} + \sum_{i=0}^{q} \rho_m \Delta lgsav_{t-m} + \sum_{i=0}^{q} \theta_z \Delta lpop_{t-z} - \lambda ECT_{t-1} + \mu_{t-1} \quad (7)$$

Where: i) the coefficients π i, ϑ j, ρ_m and θ_z represent short-run dynamics of the model; ii) the coefficients δi represent the long-run multipliers corresponding to long-run relationships; iii) C_0 is the drift; iv) ECT_{t-1} is the long run parameter equation and vi) μ t is the white noise error term.

4. ANALYSIS AND RESULTS

4.1 Unit Root Test

In order to examine the order of integration of the variables of interest, the Augmented Dickey-Fuller (ADF) test and Phillips-Perron test were employed for the purpose of determining the stationarity of the series.

Table 1 presents the unit root result for stationary testing of the ADF and the PP Test with trend and intercept. According to the result of the ADF

and the PP test, EXRV, BMS, LGSAV and LPOP are found to be stationary at first difference while INTR is found to be stationary at level, indicating mixed order integration and this qualifies the use of bootstrap ARDL.

Testing the presence of the ARCH effect is done by using the ordinary least squares (OLS) regression of the series by adopting the Autoregressive (AR) process with the aim of best fitting the data. However, autoregressive order one AR (1) and AR (2) were selected as the best regression that fits the series and therefore used as the conditional mean equation. The result of the ARCH AR (1) and AR (2) is presented in Table 2.

Table 2 presents the results of the heteroskedasticity test for ARCH effect, moreover, it exhibits evidence of heteroskedasticity in the series at a 1% level of significance, thus rejecting the null hypothesis of the absence of ARCH effect in the model. Thus, the estimation is as follows in Table 3.

According to the Table 3. The result exhibits the existence of a volatility effect in the model, the ARCH term AR (1) is significant at 1%, implying rejection of the null hypotheses of no ARCH effect, therefore, EXRV has an ARCH effect in Nigeria. Furthermore, as the EXRV exhibit an ARCH effect, the study is consistent with various studies conducted earlier, such as; Gokan [20] and Frances and Van Dijik [21]. However, the Nigerian exchange rate volatility is persisting**,** implying rejection of the null hypothesis of its non-existence.

4.2 Bootstrap ARDL Bounds Test to Cointegration

To ascertain the long-run relationship between EXRV and the other variables, the traditional ARDL bound test to Cointegration as proposed by Pesaran et.al. [22] was run as a baseline model then Bootstrap ARDL MacNown [16] of augmented ARDL technique was employed.

Findings of the bootstrap ARDL and traditional bound testing to cointegration as provided in Table 4 indicate the F-bootstrap value exceeded the critical values at a 5% level of significance, implying the existence of long-run Cointegration between EXRV, BMS, INTR, LGSAV and the LPOP.

4.3 Long and Short Run Estimate of the ARDL

Impact of monetary policy on exchange rate volatility, to test the impact of monetary policy on exchange rate volatility, the estimated ARDL result is presented in Table 5 a & b.

Table 1. Unit root test result

Variables	Order of Integ.	ADF	Critical values (5%)	PP	Critical values (5%)
EXRV	I(1)	-4.995	-3.558	-4.984	-3556
BMS	I(1)	-8.677	-3.558	-14.393	-3.558
INTR	1(0)	-4.632	-3.558	4.583	-3.553
LGSAV	I(1)	-5.544	-3.558	-6.312	-5.558
LPOP	I(1)	-5.444	-3.558	-6.312	-3.558

Note: The statistical significance is at a 5% level of significance.

Table 2. Result of heteroscedasticity test (ARCH-LM test for residuals)

ARCH-LM Test Statistics	102.399
Probability Chi-square (1)	0.000

Source; Authors' computation using Eviews (2023)

Table 3. ARCH result

ARCH	Coefficients	Prob.
C	60.521	0.000
AR(1)	1.202	0.001
AR (2)	-0.079	0.856

Source; Authors' computation using eviews (2023)

Table 4. Findings of the bootstrap ARDL estimates

ARDL (1, 2, 0, 0, 0,)	$F_{Pesaran}$	$F_{Bootstrap}$
(EXRV, BMS, INTR, LGSAV, LPOP)	3.745**	9.415**
CV 5%	3.87[a]	4.863[b]

Source: Author's computation using Gretel Econometrics software (2023)
Note: [a and b] indicate 5% based on Narayan [23]and McNown et al, [16] respectively.

Table 5a & b. Long and Short-run estimates of the ARDL

Panel A. Long-run Estimates		
Variables	**Coeff.**	**P-Values**
BMS	-0.270 (-1.076)	0.294
INTR	-0.051 (-0.784)	0.441
LGSAV	-0.017 (-0.051)	0.960
LPOP	52.699 (1.168)	0-256
Panel B. Short-run estimates		
Variables	**Coeff/t-Stat.**	**P-values**
ΔBMS	-0.091 (-1.080)	0.758
ΔINTR	-0.017 (-0.842)	0.409
ΔLGSAV	-0.006 (-0.051)	0.960
ΔLPOP	17.821 (1.054)	0.304
ECM (-1))	-0.338 (-5.007)	0.000

Source: Authors computation using eviews (2023)
Note: Figures in parenthesis are the t-statistics values

Table 5 presents the results of the estimated long-run ARDL coefficients depicted in the upper segment of Table panel A. The long-run association arranged the variables according to the results reveals that BMS, INTR LGSAV exhibit negative coefficients indicating decreased response to EXR, in addition, LPOP exhibit a positive relation to EXR. Accordingly, all response variables (BMS, INTR, LGSAV and LPOP) are not statistically significant going by their respective p- p-values.

The BMS coefficient which is -0.270 with p-values (of 0.294) indicates that EXR responds negatively by 27% to a unit increase in Broad money supply in Nigeria in the long run, meaning that, a percentage increase in Broad money supply in the long run, will make EXR more volatile (uncertain) by about 2.7unit change in Nigeria. In addition, the long-run findings on the relative influence of BMS on Nigeria's foreign exchange market contradict the findings of Umaru (2013), Inlu and Paul [9] Timothy et. Al. [24] Amir & Amir [10] but the research findings are in line with content findings of Zafar and Sabo [13].

The coefficients and respective p-values of INTR, LGSAV and LPOP are; -0.017 (0.441), -0.017 (0.960) and 52.699 (0.255) respectively, for the INTR and LGSAV, a 1% increase in these variables will lead to -0.017 and 1.7 per cent decrease in exchange rate volatility though not significant in the long run, while maintaining positive increase in EXRV by 52% increase in population, even though it is also not statistically relevance to Nigeria's exchange rate volatility in the long run. Results conform with the findings of Onwuteaka, Cecelia, Okoye, Molokun and Miran [25] Amir and Amir [10] and Umeh (2013).

According to the result of the short-run dynamic equation, the output of ECM is negative and valid which conforms to Granger's (1982) theorem. Furthermore, according to the short-run estimates, the estimated result of the dynamic short-run equation indicates that short-run - long-run deviation will be corrected annually by -0.338 per cent in the short run. The coefficients of BMS reveal non-statistical influence in the previous period at 5%, the coefficient statistical values show that a unit percentage change in BMS exhibits an increase in EXRV by 1.9 % in the short run. In the current period, the BMS (-1)) exhibits statistical significance at a 5% level of significance, a unit increase in BMS in period (1)) will lead to an increase in EXRV by 11.6% in the short run. The t-statistics values 3.188 with their corresponding p-values (0.004) confirm the statistical influence of the BMS in the past period on EXRV than the other way round [26].

Table 6. The short run and long run Causality test result

	Short run					Long run
(Y/X)	ΔEXR	ΔBMS	ΔINTRS	ΔLGSAV	ΔLPOP	ECT_{t-1}
ΔEXRV	-	10.626**	6.058**	0.016	4.576	-0.395[-1.979]**
ΔBMS	1.733	-	2.123	0.789	0.238	-0.004[-2.314]**
ΔINTRS	2.086	7.180**	-	1.775	1.613	0.016[4.774]**
ΔLGSAV	0.008	6.342**	7.264**	-	0.285	-0.000[-0.658]
ΔLPOP	2.153	0.744	0.688	0.766	-	-9.36E-08[-0.767]

*NOTE: ** indicates 5% level of significance*
Note: the block bracket is the t -statics values

4.4 Diagnostic Tests on the ARDL

The joint Diagnostic test of the research was established to ensure the robustness of the model, and to avoid falling into the trap of spurious regression dilemma, the serial or autocorrelation, Jaque-Bera Normality test and the Heteroscedasticity test statistics are the basic post-estimation test required for the purpose, the results of the tests are presented in the te 6.

Table 6 is the result of the serial correlation using the Breusch Godfrey serial correlation LM test, the outcome indicates that the series is not serially correlated (normally distributed), because the p-value 0.621 is greater than the 5% level of significance, this is evidence supporting the acceptance of null hypotheses of no serial correlation. Therefore, the residuals are uncorrelated at a 5% level of significance.

The result of the granger causality test was presented in Table 7, Wald test coefficient restriction was employed in testing the causality effect based on null hypotheses, that a particular variable granger cause the other variable depending the nature of the permutation patterns of the hypotheses, this emanated from the valid intuitive discovery of the possibility of endogeneity problem that could exist among the variables, the theory provide a precise explanation of the direction of the causality among the variables under consideration. The decision rule establishes rejection of the null hypotheses of no causality effect or relationship among the variables if the p-values are less than the 5% level of significance.

When EXR is the dependent variable, causality effect runs from BMS and INTRS to EXR at 5% level of significance in the short run periods, meaning that; BMS and INTR are influencing the EXR in the short run at 5% Level of significance, this implies that, BMS and INTR have relevant effect in affecting the EXR system in Nigeria, this is because, implementation of the policy response that has positive linkage to these variables invariably leads to affect the EXR in the short run periods. Furthermore, when the BMS and LPOP are the dependent variables, other variables exhibit no any significance inference in response to the other variables, this indicates absence of no causal effect running from independent variables to the dependent variable in the short run.

In addition, when INTR and LGSAV are the dependent variables, there exist causal relationship running from them to other regressors in question in the short run at 5% level of significance, this indicates that the causal effect is relevant to INTR and LGSAV while maintaining no causal effect running from BMS, LGSAV, INTR and EXRV to LPOP when its dependent variable in the short run, For the long run ECM equation, there exists long run causal relationship running from BMS, INTR, LGSAV and LPOP to EXR. This mean that BMS, INTR, LGSAV and have relevance inference to EXRV in the long run periods at 5% level of significance.

Table 6. Diagnostic tests of the ARDL

Test	Test Statistics	*P*- Values
Serial correlation LM Test	0.0296	0.971
Jaque- Bera Normality Test	0.744	0.689
Heteroscedasticity Test	0.906	0.529
Ramsey Reset	0.021	0.885

Source: Authors computation using eviews (2023)

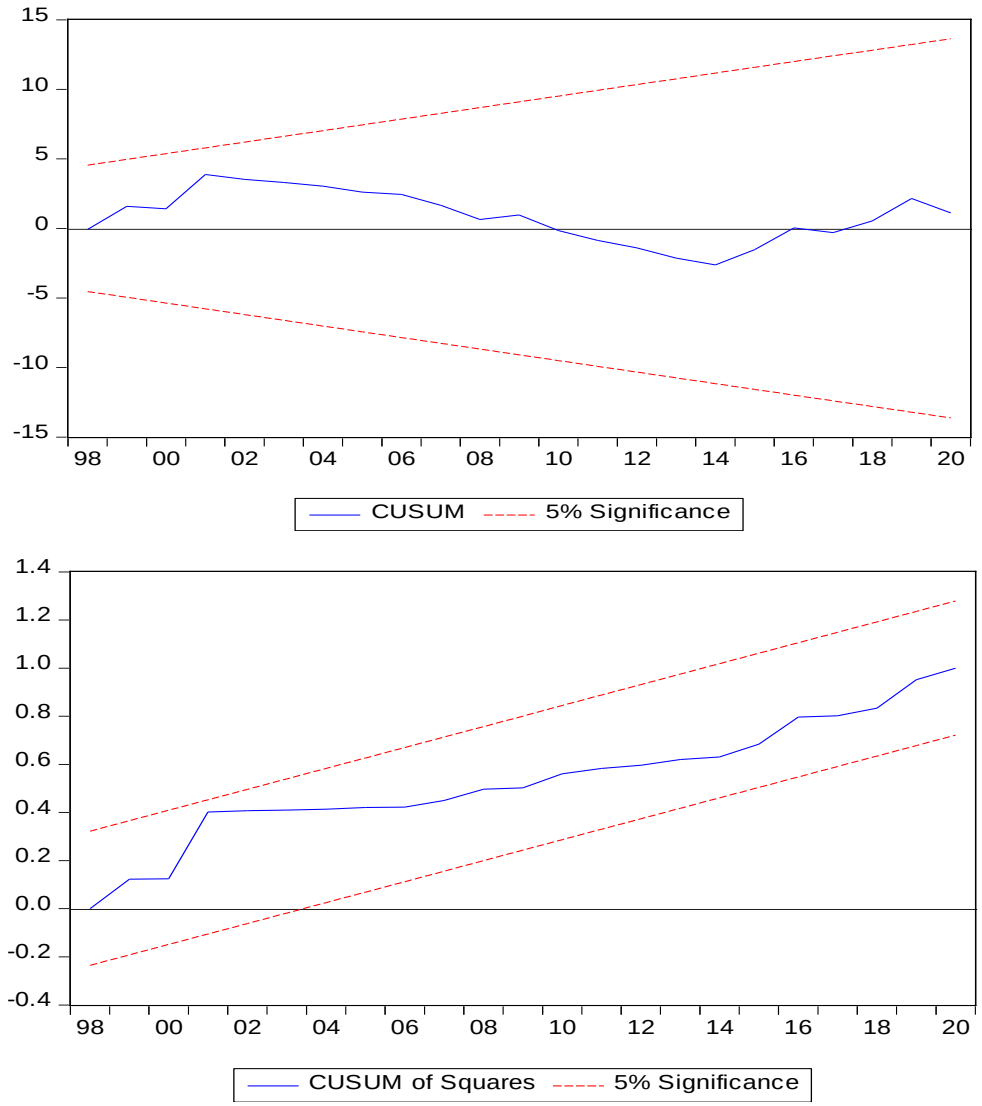

Fig. 1. The CUSUM and CUSUM of squares test

The Test for normality test of the time series of the residuals was also presented in Table 6 according to the result, the probability value of the JaqueBera statistics (0.744) along with its respective p-value (0.689) reveals the normality of the distribution, the decision rule establishes that, for the series to be normally distributed, the p-values and the F- statistics of the residuals must be greater than 5% level of significance, as such, the result exhibits normality of the data set, meaning that, the residuals of the series are normally distributed. For the test for heteroskedasticity, the test statistics is 0.906 and the p-values are 0.529, this indicates that the residuals are not heteroskedasticity they are homoskedastic. For the Ramsey reset test, testing for a noncorrect functional specification if any, reveals that the model is correctly specified, this surface from the p-values statistics that is greater than a 5% level of significance, therefore, the null hypothesis is here by rejected and accept the alternative which states that; the null is not true. Therefore, the model is robust.

According to the outcome of the figure CUSUM test, the model is stable because the CUSUM line lies within the band of 95% confidence interval that is at a 5% level of significance. The result therefore confirmed the stability of the short-run parameters estimated in the model.

5. CONCLUSION

Conclusively, the finding of the study shows that the exchange rate in Nigeria is highly Volatile

exporting with the expansion of Money supply, Interest rate, and Savings. The long-run coefficients of Broad money supply, interest rate, savings and Population are consistent with the short-run coefficients of the Variables understudy. The exchange rate of Nigeria decreases by 27% from a percentage increase in money supply in the long run. This infers that BMS is among the key determinants of exchange rate stability as well as exchange rate volatility in the country. Similarly, the exchange rate of the country decreases by 0.51%, 0.02 and 52.7% from a percentage increase in interest rate, gross savings and population. This indicated that interest rate and gross savings could be key determinants of the exchange rate if were used appropriately in Nigeria. On the contrary, the exchange rate increase sharply by 57.7% with a percentage increase in population. Therefore, we can deduce from the findings that, the exchange rate for Nigeria is highly volatile because BMS, INTR and LGSAV decrease the exchange rate but population resulted in an increase in the exchange rate and this is a great weakness as three variables are stabilizing while the major one is destabilizing.

6. RECOMMENDATION

Based on the findings of the study, the following policy recommendations are offered so as to help address the problem of exchange rate volatility in Nigeria.

With reference to the coefficients of BMS, LGSAV and INTR, the Central Bank of Nigeria, ministry of finance as well as the Monetary policy working committee should pay more attention to the afore mentioned variable through consistent monetary policies available in need of priority target objective that will adhere to establish stability in the exchange rate system, these could be achieved through expansionary monetary policy during a crises or contractionary monetary policy when the economy is faced with excess money in circulation. By addressing the prime objective of achieving stability in the exchange rate system, Volatility issue will be reduced to best bearest minimum level.

Subsequently, the long-run coefficient of population of 52.7%, Nigerian government should in collaboration with the ministry of health, ministry of information, culture and tourism and national orientation agency put more effort in controlling population explosion rate in Nigeria.Government should also take extra precaution in birth control policy that will not hamper the revenue and labour participation rate in the long run, this could be achieved through effective training, education, awareness, mobilization and empowerment during the policy control execution, which in turn will foster revenues and productive labour force when its properly checked, monitored and supervised. Consequently, contribution to GDP growth, employment and income generation and by extension exchange stability will prevail when this policy of population control is properly executed in the country.

AREA FOR FURTHER RESEARCH

The study also recommends, inclusion of other finance related variables such as net import, remittances, Gross fixed capital, GDP per capita, nominal interest rate and many more as the key determinants for further research on exchange rate volatility in Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. CBN. Monetary policy department: Monetary Policy Series; 2006. CBN/MPD/Series/01/2006.
2. Ozturk I. Exchange rate volatility and trade: A literature survey. International Journlal of Applied Econometrics and Quantitative Studies. 2006;3(1).
3. Boon TH, Hook LS. August). Financial volatility and stock prices: the malaysian experience before and during the asian currency crisis. In 1st International Conference on Banking and Finance, University Utara, Malaysia, August. 2000; 18-20.
4. Adubi AA, Okunmadewa F. Price, exchange rate volatility and Nigeria's agricultural trade flows in Kenya: A dynamic analysis, AERC Research paper. 1999;87.
5. Hamilton JD. A new approach to the economic analysis of non-stationary policies. Oxford Review of Economic Policy. 1989;15(2):59-76.
6. Goldfajn I, Gupta P. Does monetary policy stabilize the exchange rate following a currency crisis? IMF Staff Papers. 2003; 50(1):90–114.

7. Yunusa LA. Exchange rate volatility and Nigeria crude oil export market, Scientific African; 2020.
8. Ikechi KS, Anthony N. Global oil price shocks and effects on economic growth: An econometric Investigation of Nigeria. International Journal of Innovation and Economic Development. 2020; 6(4):7-26.
9. Paul N, kalu EU, Paul CO. Monetary policy and exchange rate stability in Nigeria: an empirical investigation Best: International Journal of Humanities, Arts, Medicine and Sciences. 2017 ;5 (04):15-26.
10. Amir KD, Amir MT. The impact of monetary policies on the exchange rate in Iran: A GMM Approach. Economic Review. 2015; 19(2):177-191.
11. Babatunde WA, Olufemi MS. Monetary policy shocks and exchange rate volatility in Nigeria. Asian Economic and Financial Review. 2014;4(4):544-562.
12. Umar SL. Monetary policy and exchange rate determination in Nigeria, Journal of Business Studies. 2013;3(4).
13. Zafar MS, Sabo S. The effects of monetary policy on exchange rate determination. Journal of Social Sciences. 2013;24(2):24-36.
14. Chen SS. Revisiting the interest rate-exchange rate nexus: A Markov switching approach; 2004.
15. Pesaran MH. General diagnostic tests for cross section dependence in panels; 2004.
Available at SSRN 572504.
16. McNown R, Sam CY, Goh SK. Bootstrapping the autoregressive distributed lag test for cointegration. Applied Economics. 2018;50 (13):1509-1521.
17. Engle R, Granger C. Co-integration and error correction: Representation, estimation, and testing. Econometrica. 1987;55(2):251-276.
18. Bollerslev T. Generalised autoreggresive conditional hetrosdascedasticity, Journal of Econometrics. 1986;31(30):307-327.
19. Pesaran MH. On the interpretation of panel unit root tests. Economics Letters. 2012; 116(3): 545-546.
20. Gokan Y. Alternative government financing and stochastic endogenous growth. Journal of Economic Dynamics and Control. 2002;26(4):681-706.
21. Franses PH, D. Van Dijk. Forecasting stock market volatility using (non-linear) GARCH models Journal of forecasting. 1996;15:229-235.
22. Pesaran MH, Shin Y, Smith RJ. Bounds testing approaches to the analysis of level relationships. Journal of applied econometrics. 2001;16(3):289-326.
23. Narayan P. Reformulating critical values for the bounds F-statistics approach to cointegration: an application to the tourism demand model for Fiji Australia: Monash University. 2004;2:04.
24. Timothy AA, Stephen AA, Henry OO, Michael AO. Impact of monetary policy on exchange rate in Nigeria: Bound test and ARDL approach. Act Universities Danubius. Economica. 2019;15(4).
25. Onwuteaka, Cecilia I, Okoye PVC, Molokwu, Mirian I. Effect of monetary policy on economic growth in Nigeria. International Journal of Trend in Scientific Research and Development. 2019;3(3).
26. Antdack J. The framework of monetary policy: An overview of issues, in proceedings: Conference on monetary policy frameworks in Africa. Reserve Bank of South Africa. Pretoria; 2001.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/112132