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IMPACT OF MONEY SUPPLY ON EXCHANGE RATE VOLATILITY IN NIGERIA

By

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Abstract

The study examined how money supply can be used to cushion the effect of exchange rate volatility in Nigeria from 1981 to 2022, using autoregressive distributed lag model. From the result of the study, there exists a long run relationship among the variables. The results found that interest rate, inflation rate and trade openness had negative impact on exchange rate volatility in Nigeria in the long run, while money supply and output growth had positive impact. The short run result shows that output growth and money supply have positive impact, while interest rate, inflation and trade openness have negative impact. In the long run, none of the variables is statistically significant while in the short run, only money supply is statistically significant at 5%. The error correction term had the expected sign with the value of -1.09, which means that about 1.09% disequilibrium in the previous year was corrected for in the current year. In conclusion, money supply has significant impact on exchange rate volatility in Nigeria. The study therefore recommends, in line with the findings, that government should implement contractionary monetary policy measures so as to reduce the volume of money in circulation and thereby curb exchange rate volatility.

Keywords: Keywords: Exchange rate volatility, money supply, interest rate, Nigeria, ARDL

JEL Codes: C1, E31, E51, F31

1. Introduction

Exchange rate describes the relationship between two currencies and fluctuates on daily, weekly, monthly, quarterly and yearly basis. It is the cost of exchanging one currency for another. No country of the world desires a volatile exchange rate, hence the pursuit of exchange rate stability which is the fundamental feature of economic development. The cause of exchange rate risk is currency volatility, which also has an impact on the volume of international trade. Exchange rate volatility is the risk that is associated with unexpected movements in the exchange rate. Put differently, exchange rate volatility is the instability, unstableness, uncertainties and fluctuations associated with exchange rate. The exchange rate has been facing series of depreciation since the adoption of structural

adjustment programme (SAP) up until this day (Central Bank of Nigeria, 2022).

Globally, exchange rate volatility has different effects on the economies based on their macroeconomic policies. In the case of developing and emerging market economies, the oscillations have far-reaching negative overwhelming effects because they create economic uncertainty and raise business and investment risks (Oaikhenan & Aigheyisi, 2015). Exchange rate volatility can be measured as the absolute value of the monthly percentage change in the exchange rate and is determined by some factors such as inflation, interest rate, government debt, government interventions, speculations, balance of payment etc. There is a factual argument that market mechanisms alone are unable to carry out all economic functions in the absence of supporting policies, including monetary policy (Hassan et al., 2017). Theoretically, it has been established that an increase in money supply depreciates the currency while a decrease appreciates it. When currency appreciates, foreign goods become cheaper in the domestic market leading to increased demand for both the goods and foreign currency while prices of domestic goods in foreign market rise leading to low demand for both the goods and local currency. On the other hand, when a currency depreciates, foreign goods become costly in the domestic market leading to decreased demand for both the goods and foreign currency while domestic goods become cheaper in foreign countries leading to high demand for both the local currency and goods (International Monetary Fund, 2022).

Nigeria's economy is reliant on imported raw resources, technology, and other related goods from other nations. Consequently, there is frequency in the volatility of exchange rate as a result of the pressure on foreign exchange brought on by inadequate foreign earnings to fulfil demand (Ehikioya, 2019). Over a decade ago, exchange rate volatility has been a major source of worry to the government as well as the CBN which is the Nigerian economic manager. As a result, the Nigerian government has continued to make frantic efforts towards achieving exchange rate stability which is a major tool in achieving sustainable economic growth. These include actions such as restricting some items from assessing funds at the interbank foreign exchange market (CBN, 2021), unification of the official and parallel market rates. This implies that exchange rate will be determined by market forces of demand and supply as well as the removal of restrictions on inflows into domiciliary accounts (Aduloju, 2023). Other significant reforms have been implemented in the financial sector including suspension of binance operations, chasing speculators out of the forex market and resumption of sale of forex to BDCs.

Despite all these policy interventions, exchange rate has remained volatile making it difficult for investors and traders to thrive in the macro

economy. Since the first quarter of 2020, Nigeria has faced an exchange rate crisis triggered by foreign exchange supply shortfalls due to drop in oil prices and the mono-product structure of the economy which has now accelerated by the pandemic-induced global lockdown. Recently, there is a slide in the official exchange rate of the naira and dramatic widening of the parallel market premium which signals that the unease in the Nigerian foreign market has intensified. The current exchange rate crisis triggered by these shortfalls in foreign exchange supply or foreign exchange reserve relative to demand led to exchange rate volatility. There is excess demand for dollars against the naira for the payment of imported goods and foreign services. For some time now, the exchange rate has been over 1000/US$1 (Maureen et al., 2022). Experts even predict an exchange rate of ₦1200/US$1 by first quarter of 2024. Currently, there is massive depreciation of the exchange rate and consequently exchange rate volatility. Excess money supply has been adjudged to be a contributing factor to exchange rate volatility. With excess money supply, people tend to hoard dollar which is needed for importation of raw materials. This has led to exchange rate volatility which triggers inflation (Bello &Abdullahi, 2020).

Data from CBN also reveals that money supply has a sharp oscillation as compared to interest rate which could be as a result of its application in cushioning some shocks. However, interest rate has been fluctuating around 20% and above since 2022. While the exchange rate has experienced a continuous depreciation, the growth in money supply and the interest rate has been grossly unstable overtime (CBN, 2022). It is against this backdrop that this study examined the impact of money supply on exchange rate volatility in Nigeria.

2. Literature Review

2.1. Conceptual Review

According to Frazier (2017), exchange rates express the value of one country's currency in relation to the value of another country's currency. The rates play an important part in economics, affecting the balance of trade between nations and influencing investment strategies. CFI team (2022) defines exchange rate as the rate at which one currency can be exchanged for another between nations or economic zones. It is used to determine the value of various currencies in relation to each other and it is important in determining trade and capital flow dynamics. Micheal and Jay (2012) opine that exchange rate is sometimes called the most important price in a highly globalized world. According to them, the dollar-euro exchange rate, being the world most important price is determined by market forces and changes day to day and even minute to minute.

The money supply is defined by the central bank in two ways: narrow money and broad money. Money in circulation plus deposits made into current accounts at commercial banks are considered to be narrow money (M1). Broad money, which includes savings and time deposits with banks, including deposits denominated in foreign currencies, is a measure of the entire amount of money in circulation in the economy. A surplus of money exists when the total amount of money in circulation surpasses the level of the economy's overall output. The price system becomes unstable and leads to inflation or higher prices for goods when the money supply rises beyond what the economy can absorb efficiently. A decrease in the money supply has an impact on banks' capacity to generate new money through lending to their customers. In this way, the central bank could be said to be pursuing a contractionary monetary policy. When investors cannot get new loans to expand their investments, it reduces the level of total output in the economy. A reduction in output affects the level of employment and prices as less money is available for purchasing goods. In this way, prices remain stable or fall. The central bank can also pursue an expansionary monetary policy when it reduces the cash reserve ratio and buy securities from the open market (CBN, 2021).

2.2. Theoretical Framework

The framework for this study is based on the Markov-switching model developed by Hamilton (1989) which explains the possibility of switching between the regimes of high and low volatility of exchange rate. This means a shift between “crisis” and “tranquil” incorporating the characteristics of multiple equilibria. This argues that a variety of suitable monetary policy measures, including interest rates, must be used to achieve balance between the switching periods as represented as:

$$\epsilon_t = \alpha\pi_{st} + \mu_t \qquad (2.1)$$

$$\mu_t \sim N(0, \sigma_{st}^2)$$

Where, ϵ_t is The exchange rate volatility in both crisis and calm regimes is regulated by a set of appropriated, chosen monetary policy instruments (π) and an observed, normally distributed state variable (μ_t). Chen (2006) explains the macroeconomic theory of exchange rate determination by assuming that *st* follows a two-state Markov process, with a time-varying transition probability matrix as follows: the “tranquil” state when σ_st^2 is low (state L) and the “crisis” state when σ_st^2 is high (state H).

$$P_t = \begin{bmatrix} P_t^{11}(i_t) & 1 - P_t^{22}(i_t) \\ 1 - P_t^{11}(i_t) & P_t^{22}(i_t) \end{bmatrix}$$

(2.2)

In equation (2.2), $P_t^{kj}(i_t) = P(s_t = j/s_{t-1} = k, i_t)$, and i_t is the nominal interest rate taken as one of the monetary instruments. Thus, it follows that equation (2.2)'s time-varying transition probability matrix controls how the two distinct regimes change over time. With the proper selection of monetary policy instruments, it is envisaged that the likelihood of transitioning between periods of either high or low volatility will change in order to maintain stability. Most research has examined the connection between monetary policy instruments and exchange rate volatility using Hamilton's (1989) Markov-switching model. By combining the characteristics of multiple equilibria, this model describes the possibility of alternating between the regimes of high and low exchange rate volatility, or the shift between "crisis" and "tranquil." Although there are alternative models, the Markov-switching model is the best appropriate for this research because Nigeria currently has a floating exchange rate system in place.

2.3. Empirical Literature

Insah and Chiaraah (2013) carried out empirical research on the variables influencing real exchange rate volatility in Ghana from 1980 to 2012. Government spending, money supply, domestic debt, and foreign debt were chosen as explanatory variables of exchange rate volatility. The autoregressive distributed lag (ARDL) model was used by the authors to investigate if these variables are determinants of exchange rate volatility. Their research showed a positive impact between government spending and exchange rate volatility, but money supply, domestic debt, and external debt showed a negative impact on exchange rate volatility. Adeoye and Saibu (2014) examined the influence which monetary policy instruments exert on exchange rate volatility in Nigeria. Using the standard deviation approach to generate exchange rate volatility, they anchored the model using the Markov's switching model as it is capable of showing the probability of transition between regimes. The classical linear regression model within the error correction model was employed in the model. The three monetary policy variables used in the model are money supply, interest rate and inflation. The result showed that money supply and interest rate showed evidence to positively increase exchange rate volatility in Nigeria.

Between 1980 and 2008, Babatunde and Olufemi (2014) looked into the connection between monetary policy shocks and exchange rate

volatility in Nigeria. The short-term factors influencing exchange rate volatility that are related to monetary policy were investigated using classical OLS. Additionally, after utilising the Engle-Granger approach to determine the long-run interaction among the set of included variables, the error correcting mechanism model was estimated. The result demonstrates that during the study's period, Nigeria's real and nominal exchange rates were both unstable. Furthermore, there is a causal relationship between the exchange rate and the historical values of monetary policy variables. They came to the conclusion that the money supply, reserves, interest rate, and inflation rate all depreciate and contribute to nominal exchange rate volatility. A study on the effects of money supply on foreign exchange rates in Nigeria by Yakubu (2016) covered the sample size of fifteen years (2000 to 2014). Using the vector error correction model (VECM), Yakubu found evidence for a positive and significant relationship between money supply and the exchange rate. The study noted that simple monetary policy instruments is capable of stabilizing the exchange rate and the central bank should be committed to ensuring its stability and at the same time, not having to exacerbate the level of inflation in the economy.

Furthermore, from 1989Q1 to 2015Q4, Hassan, Abubakar, and Dantama (2017) looked at the causes of exchange rate volatility in Nigeria. The ARCH model, which is the autoregressive conditional heteroskedasticity, was used to produce exchange rate volatility series. To model the full study, however, the drivers of exchange rate volatility in Nigeria were achieved using the ARDL model. The results showed that interest rate, among other factors had a positive and considerable influence on exchange rate volatility. While Odoom (2019) used monthly data covering the years 1990 to 2017 to assess the factors influencing Ghana's exchange rate volatility. Interest rates, inflation rates, current account balances, and money supply are some of the factors taken into account. Since the quantile regression model proved to be more reliable than the traditional least squares regression model, it was employed in the study. The findings showed that the money supply, current account balance, and interest rate all significantly and negatively affect Ghana's exchange rate volatility. On the other hand, it was discovered that inflation positively affected Ghana's exchange rate volatility.

Bello and Abdullahi (2020) studied the effect of monetary policy dynamics on exchange volatility in Nigeria. The study employed the asymmetric GARCH model. Exchange rate volatility for the period 2009 and 2018 was found to be persistence when direct monetary instruments

adjust. The study also discovered that the direct or indirect instruments' contraction of monetary policy is a factor in the foreign exchange market's volatility. Findings further revealed that cash reserve ratio dampens volatility while interest rate and money supply were found to further generate same instability/volatility. The control of capital accounts was further generated. In the same vain, Arikekpar (2020) investigated the relationship between monetary policy shocks and exchange rate volatility in Nigeria from 1981 to 2018. The, VECM was utilized to address the objective of this study. From the results of this work, it was discovered that credit reserve requirement has a negative relationship with exchange rate. However, broad money supply, interest rate and inflation rate have a positive relationship with exchange rate in the country. Eze and Okotori (2022) investigated the influence of innovations in monetary policy on the rate of exchange rate volatility in Nigeria. The study utilized VECM alongside the impulse response function and forecast error decomposition function in the estimation. Their study found that all monetary policy variables in the long run show a significant relationship with exchange rate volatility. While in the short run, only money supply and exchange rate volatility appeared to have a significant relationship.

A study using an open economy, Kolasa, Ravgotra, and Zabczyk (2022) investigated the relationship between monetary policy and exchange rate dynamics. Using the New Keynesian model the study showed evidence of more monetary spillovers and increase in the persistence of real exchange rate. Also, using time series data from 1981 to 2021, Maureen et al. (2022) examined the impact of monetary policy measures on price and exchange rate stability in Nigeria by employing the error correction technique. According to the study, money supply (MS2) had a statistically significant positive relationship with both the exchange rate and the consumer price index. While, Iliyasu, Ibrahim and Musa (2024) examined the impact of monetary policy on exchange rate volatility in Nigeria from 1987 to 2023. The data was analysed using autoregressive conditional heteroscedasticity (ARCH) model and Granger causality test and found the presence of conditional volatility of the exchange rate. Moreover, findings from the bootstrap bound test established 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 showed the existence of causality from exchange rate volatility to money supply, interest rate, savings and population in both in short and long run. The study concluded that the volatility

of exchange rate is driven by the variability of money supply, interest rate and savings.

3. Data and Methodology

3.1. Model Specification

This study examined the impact of money supply on exchange rate volatility in Nigeria between 1981 and 2022. From the theoretical framework, the study modifies the Markov model to incorporate other control variables. Therefore, to model the impact of money supply on exchange rate volatility, we have the functional form as:

$$EXRV = f(M2, IR, INF, TO, YG, FD, OIL) \quad (3.1)$$

Transforming equation (3.1) to its econometric form, we have:

$$EXRV_t = \beta_0 + \beta_1 M2_t + \beta_2 IR_t + \beta_3 INF_t + \beta_4 TO_t + \beta_5 YG_t + \mu_t \quad (3.2)$$

where: $EXRV$is exchange rate volatility; $M2$ is money supply; IR is interest rat; $INF$is inflation rate; TO is trade openness; and YG is output growth. Equation (3.2) is specified using ARDL model:

$$\Delta\log(EXRV_t) = \beta_0 + \beta_1\log(EXRV_{t-j}) + \beta_2\log(M2_{t-i}) + \beta_3\log(IR_{t-i}) + \beta_4\log(INF_{t-i}) + \beta_5 log(TO_{t-i}) + \beta_6\log(YG_{t-i}) + \beta_7\log(FD_{t-i}) + \sum_{j=1}^{p}\alpha_{1j}\Delta\log(EXRV_{t-j}) + \sum_{i=0}^{q1}\alpha_{2i}\Delta\log(M2_{t-i}) + \sum_{i=0}^{q2}\alpha_{3i}\Delta\log(IR_{t-i}) + \sum_{i=0}^{q3}\alpha_{4i}\Delta\log(INF_{t-i}) + \sum_{i=0}^{q4}\alpha_{5i}\Delta\log(TO_{t-i}) + \sum_{i=0}^{q5}\alpha_{6i}\Delta\log(YG_{t-i}) + \mu_t \quad (3.3)$$

where $\beta_i$and α_i are parameter estimates, Δ is the lag operator, μ_t is the error term at time t, (p, q) are the lag length of the dependent and independent variable.

3.2. Estimation Techniques and Procedures

In order to check that the mean equation is adequately specified and not to run a spurious regression, it becomes necessary to run a unit root test on the data using the Augmented Dickey-Fuller (ADF) unit root test. This test is selected because it helps to correct for serial correlation in the residuals. To check for possibilities for cointegration, the ARDL bounds testing cointegration method was adopted. This is to check for long run relationship among the variables. This cointegration approach is unique and different from other approach in that it does not require that all the variables be integrated of the same order. After ascertaining the long run relationship, the ARDL was employed. ARDL approach has been proven to be robust in small sample, estimating and testing hypothesis of long run coefficients of underlying variables irrespective of whether they are all integrated at level, I(0), at first difference, I(1) or mixed (Pesaran, 1997). Thereafter, some diagnostic tests

such as serial correlation test (using the Durbin-Watson statistics), heteroskedasticity test and normality test are carried out. Finally, the CUSUM test used to test how stable the model is.

Definition of Variables and Data Sources

Exchange rate volatility (EXRV) is the nominal exchange being subjected into the generalized autoregressive conditional heteroscedasticity (GARCH) model. Two more variants of exchange rate volatility is the standard deviation of the nominal exchange rate and the absolute value of the change in annual nominal exchange rate, money supply is the volume of money in circulation at a specific time which is denoted as M2 from source, interest rate (IR) shows the proportion of loan that is charged as interest to the borrower, inflation (INF) measures the persistence and continuous rise in the general price level, Trade openness (TO) is the rate by which a country is prone to external shocks while Output growth (YG) is measured as the percentage change in the level of output. Data for EXRV, M2, IR, TO and YG were sourced from CBN statistical bulletin (2022) while that of INF was sourced from WDI (2022).

4. Data Presentation and Discussion of Findings

4.1.1. Descriptive Statistics Test

Table4.1: Summary of Descriptive Statistics

	IR	M2	INF	TO	YG
Mean	1.128534	3.149808	1.126433	0.205990	0.533929
Median	1.130334	3.234249	1.070511	0.175577	0.643004
Maximum	1.311754	4.685402	1.736476	0.475632	1.184691
Minimum	0.795880	1.348305	0.757396	0.000978	-1.000000
Std. Dev.	0.102973	1.128943	0.263097	0.163048	0.460327
Skewness	-0.888304	-0.228529	0.932895	0.182498	-1.577798

Kurtosis	4.951731	1.683360	3.035206	1.583645	5.685414
Jarque-Bera	8.706985	2.428056	4.353014	2.674104	21.46155
Probability	0.012862	0.296999	0.113437	0.262619	0.000022
Sum	33.85603	94.49423	33.79300	6.179688	16.01786
Sum Sq. Dev.	0.307502	36.96088	2.007385	0.770955	6.145140
Observations	30	30	30	30	30

Source: Researchers' compilation 2024 Using Eviews 10 Output.

Table 4.1 shows that money supply (M2) has the highest mean value of 3.1498 while trade openness has the lowest mean value of 0.2060. The standard deviation for all the variables shows low values, meaning that there is low variability. It simply suggests that all the variables are as close to their true values and as such, our estimates would be reliable for prediction. The skewness values indicate that interest rate (IR), money supply (M2), and output growth (YG) are negatively skewed with long left tail, while inflation (INF), and trade openness (TO) are positively skewed. The kurtosis further shows that M2, YG, INF and TO are platykurtic, that is, their values fall below threshold of 3, while IR falls above the threshold of 3. The distribution also shows that the series do not deviate from normal distribution as the Jarque-Bera probability values for M2, INF and TO are greater than the critical value at 5 percent. This asserts that the variables are normally distributed. Therefore, the null hypothesis that the variables are normally distributed cannot be rejected. On the other hand, the Jarque-Bera probability value for IR and YG are lower than 0.05, which suggests that variables are not normally distributed.

4.1.2. Augmented Dickey Fuller Unit Root Test

Table 4.2: Summary of the ADF Unit Root Test

Variables	ADF Stat	Critical Value (5%)	Order of Integration	P Values	Remarks
EXRV	-5.4398	-2.9369	I(1)	0.0001	Stationary
IR	-5.9977	-2.936	(1)	0.0000	Stationary

M2	-4.1857	-2.9369	I(1)	0.0021	Stationary
TO	-4.7554	-2.9389	I(1)	0.0004	Stationary
INF	-3.4198	-2.9350	I(0)	0.0159	Stationary
YG	-4.0292	-2.9389	I(0)	0.0033	Stationary

Source: Researchers' Computation Using Eviews 10.

The summary of the unit root test results for this investigation is shown in Table 4.2. The findings indicate that while output growth (YG) and inflation rate (INF) are stationary at level, or integrated of order zero I(0), exchange rate volatility (EXRV), interest rate (IR), money supply (M2) and trade openness (TOP) are stationary at first difference, or integrated of order one (I(1)). The null hypothesis that there is no stationarity is thus rejected in light of the conclusion that all the variables are stationary. Owing to this mixed integration order, the ARDL Bounds test is necessary.

4.1.3. Lag Length Selection Criteria

Table 4.3: VAR Lag Selection Criteria

Included observations: 25

Lag	LogL	LR	FPE	AIC	SC	HQ
0	98.97836	NA	9.54e-14	-7.278269	-6.888228	-7.170088
1	275.2608	225.6415*	1.57e-17*	-16.26087*	-12.75050*	-15.28724*

* indicates lag order selected by the criterion

Source: Researchers' Computation Using Eviews 10.

Table 4.3 presents the lag length criteria used to select the optimum lag length for the model of this study. From the result, lag one is chosen as the appropriate lag length, Akaike criterion is used based on the decision rule which states that the criterion with the lowest value should be chosen.

4.1.4. ARDL Bounds Test for Cointegration

Table 4.4: Summary of ARDL Bounds Test

Test Statistic	Value	K
F-statistic	4.017641	5
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26
Null Hypothesis: No long-run relationships exist		

Source: Researchers' Computation Using Eviews 10.

The summary of the ARDL Bounds test for cointegration, which establishes a long-term link between the variables, is shown in Table 4.4. Nonetheless, given that the F-statistics value of 4.0176 is higher than both the upper and lower bound at the five percent critical threshold, the result demonstrates cointegration among the variables. As a result, the null hypothesis which holds that there is no long-term link between the variables is rejected. As a result, it can be said that the variables have a long-term relationship.

4.1.5. Autoregressive Distributed Lag Result

Table 4.5: Long run ARDL Estimates

Dependent Variable: EXRV

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.569929	0.422325	1.349503	0.1923
EXRV(-1)	0.562236	0.141474	3.974128	0.0007
IR(-1)	-0.101206	0.256719	-0.394228	0.6976
M2(-1)	0.955509	0.516205	1.851025	0.0790
INF(-1)	-0.083369	0.079783	-1.044939	0.3085
TO(-1)	-0.235327	0.444356	-0.529591	0.6022
YG(-1)	0.007612	0.047387	0.160632	0.8740

Table 4.6: Short Run ARDL Estimate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.050760	0.057840	0.877596	0.3950
D(EXRV(-1))	0.529806	0.201826	2.625056	0.0200
D(IR(-1))	-0.128528	0.255096	-0.503843	0.6222
D(M2(-1))	1.265849	0.580900	2.379117	0.0369
D(INF(-1))	-0.015736	0.090426	-0.174015	0.8643
D(TO(-1))	-0.393805	0.569268	-0.691775	0.5004
D(YG(-1))	0.006789	0.037272	0.182135	0.8581
ECT(-1)	-1.089429	0.322394	-3.379188	0.0045
R-squared	0.728498	Mean dependent var		0.090423

Adjusted R-squared	0.553960	S.D. dependent var	0.145425
S.E. of regression	0.097124	Akaike info criterion	-1.531323
Sum squared resid	0.132063	Schwarz criterion	-1.040467
Log likelihood	28.37587	Hannan-Quinn criter.	-1.401098
F-statistic	4.173879	Durbin-Watson stat	2.409141
Prob(F-statistic)	0.008602		

Source: Researchers' Computation Using Eviews 10.

From tables 4.5 and 4.6, it is observed that the regression lines for long run and short run estimates have positive intercepts of 0.5699 and 0.0508 respectively as presented by the constant (c). This means that if all the variables are held constant or fixed (zero), exchange rate volatility (EXVR) will be valued at 0.57 in the long run and 0.05 in the short run. Thus, the a-priori expectation is that the intercept could be positive or negative, so it conforms to the theoretical expectation.

Furthermore, the coefficients of the lagged values of EXRV show positive values of 0.5622 in the long run and 0.5298 in the short run. This suggests that a 1% increase in exchange rate in the previous year, will lead to an increase in EXRV by 0.56 in the long run and 0.53 in the short run. The variable is however statistically insignificant at 5% both in the long and short run. The coefficient of the lagged value of money supply (M2) is positive both in the long and short run with the values of 0.9555 and 1.2658 respectively. It implies that if M2 is increased by 1%, EXRV will increase by 0.96% in the long run and by 1.27% in the short run. The finding is consistent with reality since Nigeria is an import dependent nation, and if there is too much money in circulation, people will result into purchasing more foreign goods. This will then lead to pressure on exchange rate. The finding is in tandem with the finding of Yakubu (2016). The coefficient value of interest rate (IR) is -0.1012 in the long run and -0.1258 in the short run. It has negative relationship with exchange rate volatility, and it implies that a 1% increase in IR will decrease EXRV by 0.10% in the long run and 0.13% in the short run. The negative impact of interest rate simply means that any attempt to increase IR will decrease the level of exchange rate volatility. This is because IR determines the rate at which banks would give out loans to investors, and when the rate is high, funds become inaccessible to investors. This will however help the foreign exchange users to

reduce import and as such exchange rate volatility will be controlled. The findings are not consistent with the findings of Eze and Okotori (2021).

In a similar vein, inflation rate is negatively related to exchange rate volatility with a value of -0.0834 in the long run and value of-0.0157 in the short run. The negative relationship suggests that on average, if inflation rate is increased by 1%, exchange rate volatility will decrease by 0.016% in the short run and by 0.08 percent in the long run. The negative impact of inflation rate on exchange rate volatility both in the long and short run indicates that any attempt to increase the prices of goods and services, exchange rate volatility will be reduced. This is because when the prices of imported goods and services are increased, people will prefer locally made goods and the pressure on exchange rate will be reduced. The coefficient value of output growth suggests a positive relationship with exchange rate volatility both in the long and short run. It shows that if on average, YG is increased by 1%, EXRV will increase by 0.008% in the long run and 0.007 percent in the short run. When output grows, it simply means that producers produce more domestic goods, and the level of exchange rate volatility will be reduced. But in the case where a country depends on importation of raw materials for production, output growth will cause excessive volatility in exchange rate. In the case of Nigeria, output growth has been revealed to increase exchange rate volatility because Nigeria is an import dependent nation.

Similarly, trade openness has negative impact on EXRV both in the long and short run. This indicates that both in the long run and short run, a 1% increase in TO will lead to a decline of 0.24% and 0.39%, respectively. This is because when a nation is opened to cross country trade, the use of foreign currency will be involved. Thus, trade openness which causes interaction between countries has caused exchange rate to be more volatile since people demand for foreign currency to purchase foreign goods and services.

The error correcting term, which is captured by ECT shows a value of -1.0894, indicating that about 1.09% deviations from the long run equilibrium will be corrected for in the current year. This speed of adjustment is very high and statistically significant at 5% significant level. The R^2 which is a measure of goodness of fit has a value of 0.7285. This suggests that about 73% variations in the exchange rate volatility are explained by the explanatory variables of this model. This value is quite high and it is concluded that the model can be used for future economic predictions. The F-statistic shown in this result tests the overall significance of the

variables. From the result the F-statistic value is 4.1738 and it suggests that the variables are jointly statistically significant at 5% level of significance.

4.2. Post Estimation Tests

Table 4.7: Summary of Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.404446	Prob. F(2,12)	0.2831
Obs*R-squared	4.552224	Prob. Chi-Square(2)	0.1027

Source: Researchers' Computation using Eviews 10 Output

The result of the serial correlation test conducted is presented in Table 4.7. Based on the decision rule that the null hypothesis should be accepted if the probability value of F-statistic is greater than the critical value at 5 percent, the study therefore concludes that there is no serial correlation in the model since the probability value of F-statistic which stands at 0.2831 is greater than 5 percent level of significance. Thus, the null hypothesis of no serial correlation is accepted.

Table 4.8: Summary of Heteroscedasticity Result

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.965314	Prob. F(9,14)	0.1241
Obs*R-squared	13.39656	Prob. Chi-Square(9)	0.1455
Scaled explained SS	9.067349	Prob. Chi-Square(9)	0.4311

Source: Researchers' Computation using Eviews 10 Output

From the result, the probability(F-stat) is equals to 0.1241. This means that the probability F statistic is greater than 0.05 level of significance. Therefore, the study accepted the null hypothesis that the model has no

heteroscedasticity in the residuals and therefore, the data is reliable for prediction.

4.2.3. Test for Normality

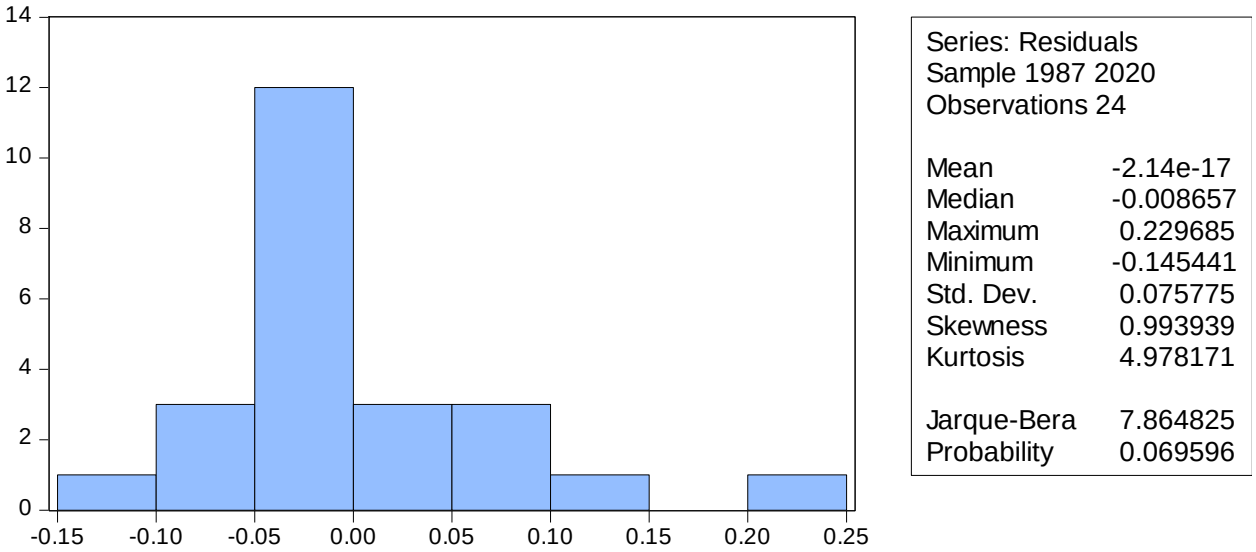


Figure 4.1: Histogram Normality Test
Source: Eviews 10 Output

The result of the histogram normality test in Figure 4.1 shows a Jarque-Bera probability value of 0.0696. This is above the critical value at 5% level and it suggests that the model is normally distributed. The decision rule for the acceptance or rejection of the null hypothesis is that the null hypothesis which states that the model is normally distributed should be accepted if the probability value of Jarque-Bera is greater than 0.05.

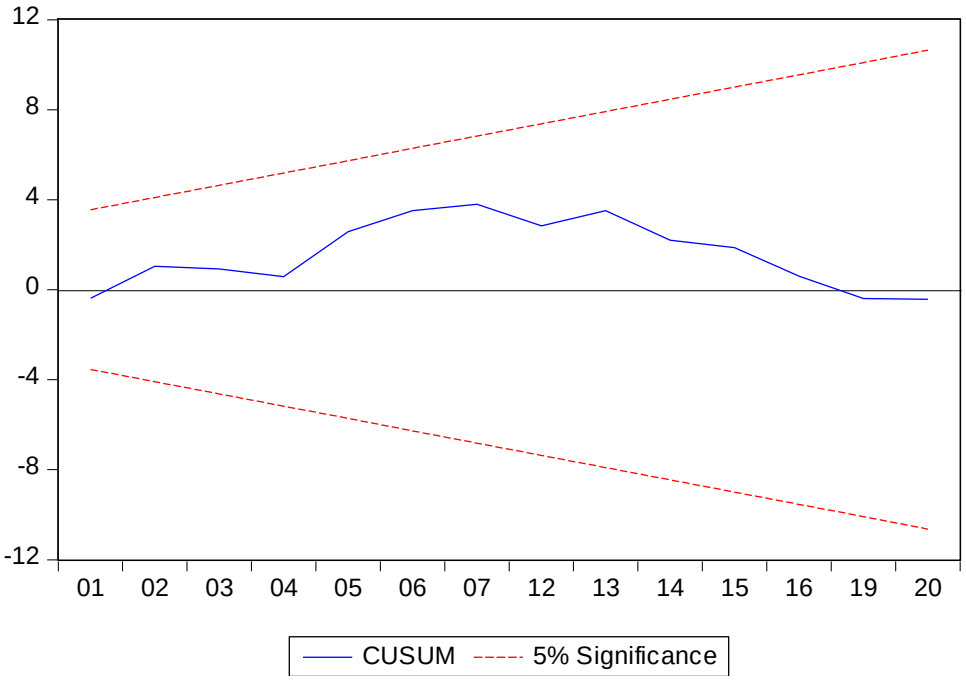


Figure 4.2: Cumulative SumTest
Source: Eviews 10 Output

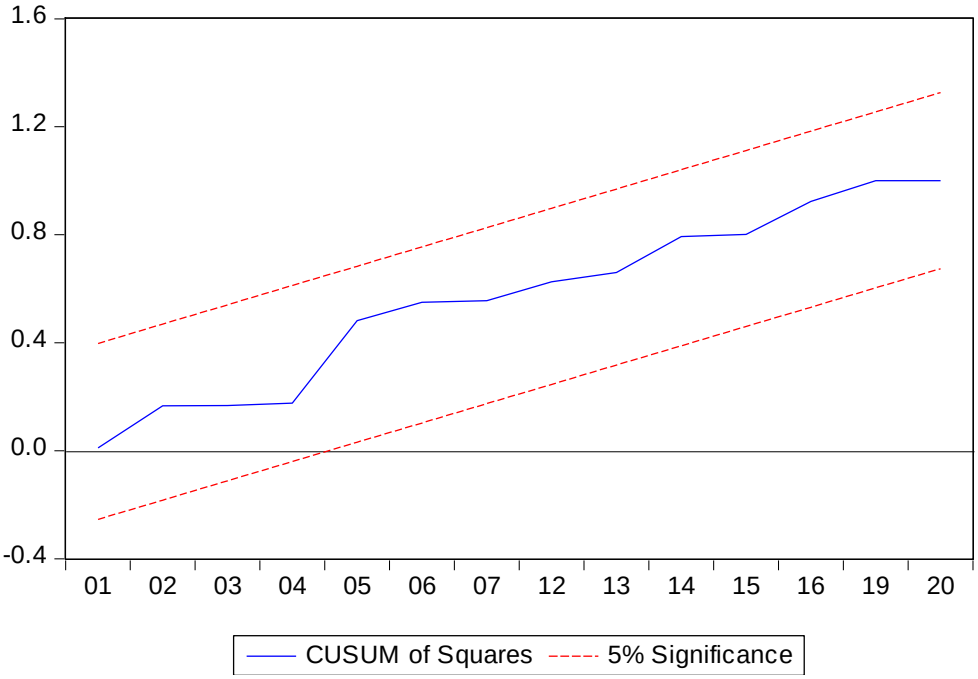


Figure 4.3: Cumulative Sum of Square Test Source: Eviews 10 Output

The CUSUM and CUSUM of Squares tests, carried out to ascertain the stability of the model, suggest that the model is stable. This is evident from the two tests as the critical lines fall within the 5% boundary level. Hence, the null hypothesis which states that the model is stable cannot be rejected.

5. Conclusion and Policy Recommendations

The study examined the impact of money supply on exchange rate volatility in Nigeria from 1981 to 2022, using autoregressive distributed lag. The findings show that interest rate, inflation and trade openness are negative both in the long and short run. Also, money supply and economic growth are positive both in the long and short run. The findings also show that the explanatory power of the variables is quite high, thus the model can be used for predictions. Money supply can be used by the Central Bank of Nigeria to tackle high inflation, unemployment and to stimulate economic growth. Thus, it is concluded that money supply determines the extent of exchange rate volatility in Nigeria. Based on the findings of this study, it is recommended that government should implement contractionary policy measures which includes decrease in money supply in order to reduce volatility in exchange rate. Money supply should be monitored through application of technology that will trace how money in circulation is being spent by citizens. This will reduce the incidences of using the money to hoard foreign currency by some speculators. The rate at which Nigeria is open to trade also causes exchange rate volatility during the period covered by this study. Since, international trade is essential for the growth of any nation, Nigeria government should ensure production of goods for export than import. This will reduce the pressure on exchange rate thereby curb exchange rate volatility.

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