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Factors Determining Exchange Rate Volatility in Nigeria

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Abstract:

This study investigated the factors affecting the volatility of the Nigerian exchange rate between 1986 and 2020, and source from the Central Bank of Nigeria Statistical Bulletin, World Development Indicators, National Bureau of Statistics. Hence, several estimation techniques were employed ranging from the unit root testing for stationarity, descriptive analysis, regression analysis, covariance and correlation, ARCH model to Granger causality analysis. The study reported that $RESID(-1)^2$ which is also known as the ARCH effect has the coefficient value of 0.686699, with the p-value of 0.00551, representing that the exchange rate was volatile since the GARCH(-1) being the internal cause of the volatility of exchange rate has the coefficient value of 0.405101 with the p-value of 0.0499 representing that exchange rate during the period has GARCH affect. It was concluded that GDP was positively insignificant to influence the exchange rate movement, the consumer price index was negatively insignificant to influence exchange rate variation, the money supply was positively significant to influence exchange rate variation, and monetary policy rate was positively significant to influence exchange rate variation during the study period.

Keywords: Volatility, Exchange Rate, Money Supply, and GDP

1. Introduction

The foreign currency rate, as well as its volatility, are important elements influencing economic activity. As a result, variations in the foreign currency market have long captured the imagination in literature. Foreign currency rates in Nigeria have been volatile during the previous two decades, creating instability in the country; as a result, potential foreign enterprises are inherently subjected to exchange risks if they invest in Nigeria. As a result, recognizing the economic dynamics influencing the country exchange policy is critical for international corporations and investors. Most economies throughout the globe have seen substantial foreign exchange rate volatility, which turns into a high level of uncertainty in achieving key macroeconomic objectives such as price stability and economic growth. Hence, in terms of its impact on economic growth and development, the exchange rate has attracted a great attention. As demonstrated by Rahmatsyah et al (2002), the detrimental effects of exchange rate fluctuations on different parts of the economy have now been well reported in various scientific studies (2002). Meanwhile, the Nigerian exchange mechanism had passed through numerous regimes. A fixed exchange rate regime was introduced in the 1960s, in which the currency was set at parallel with the British pound. When the British pound was devalued in 1967, the authorities consented to peg the currency to the US dollar and tight regulatory limits on foreign exchange and enforced import restrictions. Nigeria had to leave the dollar peg after the financial crisis though returned to the British pound and remained loyal to it until 1973, when the Nigerian naira was once again fixed to the US dollar. As a result of the worldwide economic slump in the early 1980s, the Nigerian economy began to experience crises with unfortunate implications on global commodities prices. The decline of oil prices caused structural imbalances, which had a negative impact on the nation's revenue. Hence, there was a significant budget deficit, a large external trade deficit, rising unemployment, and a high inflation rate despite diminishing domestic investment intake. In the recent time, Nigeria exchange rate has experienced a sporadic uprising movement due to several crises ranging from the financial crisis, economy recession to pandemic.

2. Empirical Review

In the study of Mokoma and Moroke (2015), they focused on exchange rate volatility in the South African economy using ARCH technique and reported that soon, exchange rate will not be highly volatile though they will experience depreciation in its currency. Adelowokan, Adesoye and Balogun (2015) studied the relationship between exchange rate volatility, investment, and growth in Nigeria from 1986-2014. They employed cointegration and VECM. They reported that exchange rate volatility negatively impacts on investment and growth though exhibited a positive impact on inflation and interest rate. Oyinpreye, and Moses (2015) wrote on the effect of exchange rate volatility and share price movement in the Nigerian economy. They used ARCH LM test and found that exchange rate volatility exhibited a negative influence on share price movement. Osigwe (2015) wrote on exchange rate and economic growth including oil price in Nigeria between 1960 and 2005 using OLS and two stage OLS analyses. The study reported that oil price and exchange rate have a positive impact on the Nigerian economic growth. Amassoma and Odeniyi (2016) conduct a study on the correlation between the variation of exchange rate and the growth of the economic in Nigeria. they used cointegration and ECM techniques and

found that there is a positive and insignificant correlation between exchange rate and the growth of the Nigerian economy. Jelilov, Jibrin and Isik (2016) did a survey on exchange rate and the growth of the economy in Nigeria between 1990 and 2014 using vector autoregressive model and granger causality test. They discovered that a unidirectional relationship exists between GDP and inflation though a bidirectional connection was found between exchange rate and inflation. Ismaila (2016) wrote on the correlation between exchange rate depreciation and the Nigerian economy performance, a post-SAP study from 1986 to 2012. The study employed cointegration test and ECM techniques and reported that exchange rate exhibits an insignificant effect on economic growth. Okorontah (2016) carried out a study on exchange rate effects on economic growth in Nigeria between 1986 and 2012. The study used cointegration and ECM. It was resulted that a weak connection exist exists between economic growth and exchange rate fluctuation. Guzman, Ocampo, and Stiglitz (2016) investigated on the policies of exchange rate (real) on economic development in Columbia. The empirical survey reported that stable and competitive exchange rate strategies are helpful for economic development. Diala, Kalu, and Igwe-Kalu (2016) wrote on the exchange rate volatility effects on the returns of commercial property in Nigeria between 2000 and 2010. EGARCH was employed and discovered that the volatility of exchange rate has a positive connection with the returns of the commercial property. Sulaiman, Lawal, and Migirow (2017) discussed the connection between the shocks from monetary policy and exchange rate behavior in Nigeria and SA from 1985 to 2015. They employed VAR analysis and found that foreign interest rate influences SA exchange rate while world oil price influences the Nigerian exchange rate sudden movement.

The study of Gidigbi, Babarinde, and Lawan (2018) on the connection between inflation and exchange rate volatility in Nigeria between 1981 and 2015, using VECM and found that inflation and exchange rate volatility revealed a short-run relationship. Kilicarslan (2018) wrote on the determinants of exchange rate volatility in Turkey using GARCH and FMOLS. The study found that there exists a long-run association-ship between the variables. Simtowe and Yi (2018) did a study between 1980 and 2014 on real exchange effects on the Malawian economy using OLS and VECM as the estimation techniques. It was found that exchange rate was negatively significant on economic growth during the study period. Nwafor (2018) did a survey on Naira impact on the growth of the Nigerian economy from 2006 to 2016 using OLS and presented that there is no significant of Naira on economic growth of Nigeria during the study period. Idris, Ashemi and Musa (2019) used autoregressive distributed lag to examine the correlation between exchange rate and GDP in Nigeria between 1981 and 2017. They reported that a long-run correlation exists between GDP and exchange rate. Adjei (2019) examined the connection between the volatility of exchange rate and the growth of the Ghanaian economy between 1983 and 2010. ARCH and GARCH were used as the estimation techniques and found that the volatility of exchange exhibits a significant negative influence on economic growth. Uzoma-Nwosu and Orekoya (2019) discussed on the connection between the volatility of exchange rate and FDI in the Nigerian perspective from 1980 to 2017. They used VECM, descriptive analysis, cointegration and granger causality analysis. It was reported that no significant connection between FDI and exchange rate volatility during the study period.

Ikechi and Nwadiubu (2020) focused on the connection between exchange rate volatility and international trade using Nigeria as a case study. They used vector autoregressive, ARCH, and GARCH methods and found that a unit increase in export and import leads to decrease of about 0.9% and 0.4% respectively in real exchange rate. Karahan (2020) investigated exchange rate influence on economic growth in Turkey using a quarterly data from 2002 to 2019. Innovation accounting techniques, cointegration and granger causality were used and reported that exchange rate exhibited a negative causal influence on economic growth. Morina, Hysa, Ergiin, Panait, and Voica (2020). Discussed on the exchange rate volatility effects on the growth of the CEE nations' growth between 2002 and 2018. They used panel data analysis of effect effects and reported that economic growth is affected negatively by exchange rate volatility. Abdi, Muturi and Olweeny (2020) discussed the factors influencing the volatility exchange rate in Kenya between 2004 and 2019 using descriptive analysis, charts, correlation, and covariance analyses. It was reported that interest and inflation have significant influence on the volatility of exchange rate. Nor, Masron, and Alabdullah (2020) examined the relationship between the macroeconomic indicators and the volatility of exchange rate in Somalia. EGARCH was used and found that macroeconomic indicators influence exchange rate volatility and its own shocks. Anifowose (2021) investigated the connection between the growth of the Nigerian economy and the dynamics of exchange rate between 1981 and 2020. The study used non-linear autoregressive distributed lag analysis and reported that economic growth exhibits an influence on exchange rate in long-run.

3. Methodology

The study used a descriptive research design. Meanwhile, study using a descriptive design is only concerned in explaining the circumstance under investigation. It's a theory-based design process that involves collecting, interpreting, and presenting data. Hence, this study employed a secondary form of data collection which was sourced from the Central Bank Nigeria Statistical Bulletin, National Bureau of Statistics and World Development Indicators. This study employed several estimation techniques ranging from the descriptive analysis, regression analysis, ARCH-M model to granger causality. Some of the techniques used were explained below

This study used a singleton functional equation modeling where some of the macroeconomic variables were used to regress the volatility of the exchange during 1986 to 2020. The functional model was further expressed in mathematical equation model, econometric equation model and time series form. The models are presented as:

$$EXRV = f(MPR, M2, GDP, CPI) \dots \dots \dots \text{eq1}$$

Where

EXR – Exchange Rate Volatility

MPR – Monetary Policy Rate

M2 – Money Supply
 GDP – Gross Domestic Product
 CPI – Consumer Price Index

The above model was presented mathematically as:

$$EXRV = \vartheta_0 + \vartheta_1 MPR + \vartheta_2 M2 + \vartheta_3 GDP + \vartheta_4 CPI \dots\dots\dots eq2$$

Where

ϑ_0 = Constant

$\vartheta_1 - \vartheta_4$ = the coefficient

Econometric form of the model is presented as

$$EXRV = \vartheta_0 + \vartheta_1 MPR + \vartheta_2 M2 + \vartheta_3 GDP + \vartheta_4 CPI + \varepsilon_t \dots\dots\dots eq3$$

Where

ε_t = Error Term

While the time series form is presented as

$$EXRV_t = \vartheta_0 + \vartheta_1 MPR_t + \vartheta_2 M2_t + \vartheta_3 GDP_t + \vartheta_4 CPI_t + \varepsilon_t \dots\dots\dots eq4$$

3.1. A priori Expectation

Variables	Description	Expected Sign
MPR → EXRV	MPR is expected not to affect exchange rate positively	-
M2 → EXRV	M2 is projected to be positive or negative to exchange rate volatility	+/-
GDP → EXRV	GDP is expected to be positive or negative to exchange rate volatility	+/-
CPI → EXRV	The increase in CPI is expected to be positive to exchange rate volatility	+

Table 1: Expected Sign
 Source: Writer's Compilation

4. Analysis Discussion

4.1. Unit Root Testing

Variables	ADF Test		Remark	Philip Peron Test		Remark
	T-stat	Crit. Val		T-stat	Crit. Val	
MPR	-3.2527	-2.951125	Stationary	-3.3129	-2.951125	Stationary
M2	-1.9654	-2.954021	-	-2.4006	-2.951125	-
GDP	-0.1762	-2.951125	-	-0.2463	-2.951125	-
EXR	1.72283	-2.951125	-	1.91971	-2.951125	-
CPI	-4.5071	-2.976263	Stationary	-2.8655	-2.951125	-

Table 2: Unit @ Level
 Source: Writer's Compilation

This table reveals the unit root report of ADF test and PP test of the variables. The report shows that monetary policy rate (MPR) has absolute t-stat value of 3.2527 with the critical absolute value of 2.951125, signifying in the remark that MPR was stationary at level. Money supply (M2) has the absolute ADT t-stat value of 1.9654 and the critical value in absolute term was 2.954021, indicating that M2 was not stationary at level. Gross domestic product (GDP) has the ADF t-stat absolute value of 0.1762 and the critical value of 2.951125, connoting that GDP was not stationary at level. Exchange rate shows that ADF t-stat value of 1.72283 with the critical absolute value of 2.951125, indicating that EXR was not stationary at level. While consumer price index (CPI) has the absolute ADF value of 4.5071 and the absolute critical value of 2.976263, implying that CPI was stationary at level.

The Philip Peron test was further used as a retest estimation technique to measure the root unit testing of the variables. It was reported that MPR has the absolute t-stat value of 3.3129 and the critical value of 2.951125, indicating that MPR was stationary at level. This result is similar to the report of the ADF unit root testing. The money supply showed that PP unit root indicates an absolute value of 2.4006 and the absolute critical value of 2.95119, indicating that M2 was not stationary, which the same as prediction of ADF unit root was. PP unit root showed that GDP has the absolute t-stat value of 0.2463 and the critical value of 2.95119, indicating that GDP was not stationary. More so, EXR has the t-stat value of 1.91971 with the absolute critical value of 2.951125, connoting that EXR was not stationary. While CPI has the absolute value of 2.8655 and the absolute critical value of 2.95119, signifying that CPI was not stationary at level. The two-unit root testing reports are similar with a little different in CPI, ADF unit testing predicted CPI was stationary at level while PP

testing predict CPI was not stationary at level. Since the some of the variables are not stationary at level, first differencing was implemented to measure if they will become stationary.

Variables	ADF Test		Remark	Philip Peron Test		Remark
	T-stat	Crit. Val		T-stat	Crit. Val	
M2	-3.2015	-2.954021	Stationary	-3.0445	-2.954021	Stationary
GDP	-4.627	-2.954021	Stationary	-4.6233	-2.954021	Stationary
EXR	-3.944	-2.954021	Stationary	-3.8911	-2.954021	Stationary
CPI				-7.0407	-2.954021	Stationary

Table 3: Unit @ First Difference

Source: Writer's Compilation

The unit root of the first difference of ADF shows that money supply (M2) has the t-stat value in the absolute term of 3.2015 and the critical value of 2.954921, remarking that M2 was stationary after first difference. GDP reveals the t-stat value 4.627 and the critical value of 2.954021, connoting that GDP became stationary after first difference. While exchange rate (EXR) has the absolute value of 3.944 with the critical value of 2.954021, remarking that EXR also became stationary after first difference. The PP testing equally shows that M2 has the t-stat value of 3.0445 with critical value of 2.954021, revealing that M2 was stationary after first difference. GDP shows the t-stat value of 4.6233 and the critical value of 2.954021, indicating stationary after converting to first difference. Exchange rate also shows the t-stat value of 3.8911 with critical value of 2.954021, connoting stationarity after first difference. CPI which was stationary at level in ADF testing became stationary at first difference in PP unit root testing since the t-stat value was 7.0407 with critical value of 2954021.

4.2. Covariance and Correlation Tests

Covariance Correlation t-Statistic					
Probability	EXR	GDP	CPI	M2	MPR
EXR	9672.294				
	1.000000				
GDP	35.60153	0.185185			
	0.841204	1.000000			
	8.936923	-----			
	0.0000	-----			
CPI	-688.5225	-4.020637	307.9661		
	-0.398935	-0.532403	1.000000		
	-2.499191	-3.613064	-----		
	0.0176	0.0010	-----		
M2	89.58070	0.406245	-7.816049	1.039273	
	0.893480	0.926020	-0.436889	1.000000	
	11.42867	14.09259	-2.790096	-----	
	0.0000	0.0000	0.0087	-----	
MPR	-88.77154	-0.870202	24.62736	-1.485356	13.87673
	-0.242307	-0.542843	0.376724	-0.391131	1.000000
	-1.434700	-3.713105	2.336232	-2.441367	-----
	0.1608	0.0008	0.0257	0.0202	-----

Table 4: Covariance Analysis: Ordinary

Source: Writer's Compilation

The above analysis shows the covariance and correlation including t-statistics and probabilities between the variables. Exchange rate and gross domestic product has the covariance value of 35.60153 with the correlation value of 0.841204, t-stat value of 8.93923 with the prob value of 0.0000, implying that positive connection exist between exchange rate and gross domestic product significantly. The connection between exchange rate and consumer price index reveals the covariance value of -688.5225, correlation value of -0.398935, t-statistic value of -2.499191 and the probability value of 0.0176, indicating that negative connection exists between EXR and CPI significantly. Exchange rate and money supply has the covariance value of 89.58070, correlation value of 0.893480, t-statistic value of 11.42867 and the probability of 0.0000, meaning that exchange rate and money supply has strong connection. While the connection between exchange rate and monetary policy rate shows the covariance value of -88.77154, correlation value of -0.242307, t-statistic value of -1.434700 with the probability of 0.1608, implying that exchange rate and MPR are negatively connected.

4.3. ARCH Analysis

Dependent Variable: EXR				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	131.1507	5.448947	24.06901	0.0000
Variance Equation				
C	423.3903	15463.02	0.027381	0.9782
RESID(-1)^2	0.686699	0.385844	1.779731	0.0551
GARCH(-1)	0.405101	0.206577	1.961019	0.0499
GDP	-11.79861	1206.958	-0.009775	0.9922
M2	-5.196718	24.67553	-0.210602	0.8332
CPI	-2.286019	81.74221	-0.027966	0.9777
MPR	-18.78499	107.1214	-0.175362	0.8608

Table 5: Arch Report

Source: Writer's Compilation

$$\text{GARCH} = C(2) + C(3)*\text{RESID}(-1)^2 + C(4)*\text{GARCH}(-1) + C(5)*\text{GDP} + C(6)*\text{M2} + C(7)*\text{CPI} + C(8)*\text{MPR}$$

The report shows that RESID(-1)² which is also known as the ARCH effect has the coefficient value of 0.686699, std error value of 0.385844, t-statistic value of 1.779731 with the p-value of 0.00551, representing that the exchange rate has ARCH effect that is exchange rate is volatile since the p-value is less than 5% significant level. The GARCH(-1) being internal cause of the volatility of exchange rate has the coefficient value of 0.405101 with the p-value of 0.0499, representing that exchange rate during the period has GARCH affect. Meanwhile, the external variables employed that could cause volatility on exchange rate reveal that GDP has the coefficient value of -11.79861, t-stat value of -0.009775 with 0.9922, representing that GDP was insignificantly negative to cause the volatility in exchange rate. Money supply shows the value of the coefficient of -5.196718, t-stat value of -0.210602 with p-value of 0.8332, indicating that money supply does not cause the volatility of exchange rate. The consumer price index has the value of -2.286019, t-stat value of -0.027966 with p-value of 0.9777, representing that consumer price index does not cause the volatility of the exchange rate. Monetary policy rate revealed the value of -18.78499, with t-stat value of -0.175362 and p-value of 0.8608, representing the MPR was insignificantly negative to influence the volatility of the exchange rate during the study period.

5. Conclusion

This study examined the factors affecting the volatility of the Nigerian exchange rate between 1986 and 2020. Several estimation techniques were employed ranging from the unit root testing for stationarity, descriptive analysis, regression analysis, covariance and correlation, ARCH model to granger causality analysis. It was concluded that exchange rate volatility was caused by the internal factors and not the external factors. Meanwhile, the external variables employed that could cause volatility on exchange rate reveal that GDP was insignificantly negative to cause the volatility in exchange rate, money supply does not cause the volatility of exchange rate, consumer price index does not cause the volatility of the exchange rate, and monetary policy rate was insignificantly negative to influence the volatility of the exchange rate during the study period.

6. Recommendations

This is recommended that the policy makers and the regulators should be proactive to the sensitive movement of exchange rate and employed appropriate regime to curb its volatility. Since the volatility of exchange rate is mostly caused by the internal factors, the regulatory authorities should implement policy that will suppress the internal factors. The external factors in one way or the other could affect exchange rate volatility, particularly the macroeconomic factors should be kept under watch and introduce measures will cushion the volatility of exchange rate.

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