



EFFECT OF EXCHANGE RATE ON FOREIGN RESERVES IN NIGERIA: AN ARDL APPROACH

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Abstract: This study examines the effects of the exchange rate on foreign reserves in Nigeria, using time series data obtained from 1986 to 2021. The study employed the autoregressive distributed lag (ARDL) approach for its statistical analysis and concludes that the exchange rate has a positive and significant effect on foreign reserves in the short run while in the long run exchange rate has a negative and significant effect on foreign reserves. Thus, based on the inverse relationship between the exchange rate and foreign reserves in the long run, it is therefore recommended that policymakers should adopt a prudent policy to deal with the problem of exchange rate fluctuation to maintain stability in Nigeria's foreign reserves.

Keywords: Foreign reserve, exchange rate, Real GDP, Interest rate, Inflation rate, Broad money supply.

1. INTRODUCTION

The global economies have been drastically affected following the collapse of the Bretton Woods system of fixed exchange rates and the subsequent introduction of flexible exchange rates in the 1970s. These movements have generated debates on the adverse effects of exchange rates on the foreign reserve. The exchange rate refers to the price of one currency, usually the domestic currency in terms of another currency. The role exchange rate plays in international economic transactions cannot be overemphasized because no nation can be economically self-sufficient due to varying factor endowment. Besides the fluctuation in the exchange rate have undulating effects on macroeconomic variables such as foreign reserves, interest rate, inflation rate, and economic growth (Okoli, Mbah, & Agu, 2016). In this connection, foreign reserves are those external assets that are readily

available and controlled by a country's monetary authorities. It further comprises foreign currencies and gold reserves. Indeed, the assets held by the country's monetary authorities are in different currency reserves such as the British pound (GBP), U.S. dollar (USD), and the Euro (EUR) among others.

In this regard, many developing countries of the world like Nigeria were more conscious about the stability of their exchange rates since the adoption of flexible exchange rates. This is because their currencies are not convertible or serve as international currencies, they must necessarily earn foreign exchange through the export of goods and services or receipt of foreign loans or investments in order to import goods and services to promote growth and development and enhance the welfare of their citizens. In such countries, foreign exchange stability is very crucial to achieve macroeconomic stability and avoiding the external reserves problem (Soro & Aras, 2021).

As observed by International Monetary Funds (1993) external reserve accumulation serves as an economic insurance against financial crisis. It also safeguards the international value of their currencies. Indeed, Archer and Halliday (1998) identified the reasons why countries hold foreign reserves, and this includes; exchange rate targeting, exchange market stability, creditworthiness, and transaction buffer. Similarly, Aizenman and Lee (2005) argued that foreign reserve accumulation serves not only as a means for effective exchange rate management but also as a viable tool for maintaining low exchange rates which promote trade and international competitiveness. More so, adequate accumulations of foreign reserves help to boost investors' confidence and enhance investment and growth.

Specifically, the external reserves are held to support or back the local currency like the Naira. The foreign reserves can also be used to settle international trade especially when there is a deficit between exports and imports. Also, the foreign reserves assist the government to meet its external debt obligations; and maintaining a reserve for national disasters or other emergencies (Central Bank of Nigeria, 2021).

Taken altogether, the effects of the exchange rate on foreign reserves, the value of foreign reserves may decline if there is currency appreciation which could also lead to the loss of a country's wealth (Molapo, 2014). Nevertheless, foreign reserves are demanded as a tool for exchange rate and policy management. Adequate reserves not only ensure a realistic exchange rate but also help to maintain the competitiveness of export goods (Husain, 2002).

In this perspective, most of the previous empirical works that examine the nexus between exchange rates and foreign reserves in the Nigerian context have been very few and have concluded that exchange rates can either have a positive or negative impact on the foreign reserve. It is imperative that a study to identify

the effects between exchange rates and foreign reserves be carried out after the aftermath of Covid-19 induced economic recession.

Against the backdrop, this study examines the effects of the exchange rate on foreign reserves in Nigeria from 1986 to 2021. The paper is organized as follows. In Section two, the paper reviews the empirical literature on the exchange rate and foreign reserve in Nigeria, Section three, contains the research methodology and the results are discussed in Section four. Section five comprises the summary and conclusion drawn.

2.1. CONCEPTUAL LITERATURE

2.1.1. Concept of exchange rate

The exchange rate refers to the price of a country's currency expressed in terms of one unit of another country's currency which is influenced by interest rate, inflation, or the political condition of a country. In addition, the exchange rates are quoted in values against the United States dollar. Besides, exchange rates can be quoted against another nation's currency, which is known as Cross Currency, or Cross Rate (Andrew & Omoruyi, 2018).

2.1.2. Concept of foreign reserves

Foreign reserves consist of the official public sector foreign assets that are readily available and controlled by the monetary authorities, for direct financing of payment imbalances, and directly regulating the magnitude of such imbalances, through intervention in the exchange markets to affect the currency exchange rate or for other economic purposes (International Monetary Fund, 1993). More so, foreign reserves represent the number of external assets held by a nation. These assets include currency, securities, deposits, special drawing rights, and monetary gold among others

2.2. EMPIRICAL LITERATURE REVIEW

In the global context, Tariq et al (2014) examined the relationship between the exchange rate and foreign reserves in Pakistan, using the mercantilist approach from 1973–2008. The results obtained show that the depreciation of the exchange rate has a positive and significant effect on the foreign reserves accumulation in Pakistan's economy.

On the other hand, Ernest and Isaac (2017) examined the effect of the exchange rate on international reserves in Nigeria using annual time series data started from 1980 to 2014. The study uses the Autoregressive Distributed Lag (ARDL) model to determine the long-run equilibrium relationship among the variables. The results show that the official exchange rate has a negative impact on the Nigerian international reserves during the study periods.

In the same vein, Nanwul and Bolaji (2018) examined the effect of selected macroeconomic variables on Nigeria's foreign reserve from 1986 to 2016. The study employed the ARDL method for data analysis. The findings show that the depreciation of exchange rates had a negative effect on Nigeria's foreign reserves.

Another study by Andrew and Omoruyi (2018) examined the impact of exchange rate instability on Nigerian foreign reserves. Data were obtained from the Central Bank of Nigeria Statistical Bulletin from 1993 to 2016. The model was estimated using the Johansen co-integration test. The study found that exchange rate instability has a positive influence on Nigerian foreign reserves.

Similarly, Soro and Aras (2021) examined the impact of exchange rate variation on the external reserves in Nigeria, using annual data from 1980 to 2019. The study employed the Autoregressive Distributed Lag model and the result of the study shows that the exchange rate has a positive and asymmetric impact on foreign reserves in Nigeria.

The review of empirical literature indicates that there is a dearth of research work on the nexus between exchange rates and foreign reserves within the Nigerian economy. The preview study review shows that there is a lack of consensus concerning the effects of the exchange rate on external reserves. Studies by Soro and Aras (2021), Andrew and Omoruyi (2018), and Tariq et al (2014) found that the exchange rate has a positive and significant effect on foreign reserves while studies by Nanwul and Bolaji (2018) and Ernest and Isaac (2017) established that exchange rate has a negative and significant effect on foreign reserve. This implies that the relationships between the variables are inconclusive. This present study contributes to the existing literature by employing the Autoregressive distributed lag (ARDL) approach proposed by Pesaran and Shin (1999) and Pesaran et al. (2001) to examine the effects of exchange rate on foreign reserve in Nigeria.

2.3. THEORETICAL FRAMEWORK

2.3.1 Financial instability hypothesis

The theoretical framework for the effects of the exchange rate on foreign reserves in Nigeria is the financial instability hypothesis. This theory was developed by Minsky (1986) after the Second World War. Minsky hypothesis is an explicit model which considered an economy with stable financing regimes and unstable financing regimes. Minsky stipulates that an economy could move from stability to instability when there is a rising exchange rate instability which tends to have a deteriorating effect on foreign reserves. In the hypothesis, the depreciation of the exchange rate could have a dampening effect on productivity and investment. The overall impact reduces output. A reduction in output means the low

productive capacity of the economy. The low productive capacity of the economy implies lower foreign exchange earnings.

3. METHODOLOGY

3.1. Source of Data

The time series data for this study were drawn from both the Central Bank of Nigeria (2021) and the World development indicator (2021). Indeed, data on foreign reserves, exchange rates, inflation rates, and money supply are sourced from the World Bank indicator (2021). While interest rate and real GDP are drawn from Nigeria's central bank report (2021)

3.2. Model Specification and Estimation

The econometric model for this study is specified as follows:

$$FR_t = \beta_0 + \beta_1 EXR_t + \beta_2 RGDP_t + \beta_3 ITR_t + \beta_4 IFR_t + \beta_5 BMS + \mu_t \quad (1)$$

Where:

FR= Foreign reserves.

EXR= Exchange rate

RGDP= Real gross domestic product

ITR= Interest rate

IFR=Inflation rate

BMS= Broad money supply

e =Error Term, t = Time Series, β_0 = Constant

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are parameters of the variables to be estimated in the model

3.2.1. Estimation procedure

This study adopts Autoregressive Distributed Lag (ARDL) approach developed by Pesaran and Shin (1999) and Pesaran et al. (2001), the dynamic short-run and long-run ARDL model is specified as;

$$\begin{aligned} \Delta[(\ln LFR_t)] &= \beta_0 + \beta_1 \ln(LFR_{t-1}) + \beta_2 \ln(LEXR_{t-1}) + \beta_3 (LRGDP_{t-1}) + \beta_4 (LITR_{t-1}) \\ &+ \beta_5 (LIFR_{t-1}) + \beta_6 (LBMS_{t-1}) + \sum_{i=1}^p \alpha_1 \Delta \ln(LFR_{t-1}) + \sum_{i=1}^m \alpha_2 \Delta \ln(LEXR_{t-1}) \\ &+ \sum_{i=1}^n \alpha_3 \Delta LRGDP_{t-1} + \sum_{i=1}^0 \alpha_4 \Delta LITR_{t-1} + \sum_{i=1}^0 \alpha_5 \Delta LIFR_{t-1} + \sum_{i=1}^0 \alpha_6 \Delta LBMS_{t-1} + \varepsilon_t \dots \dots (2) \end{aligned}$$

Similarly, the error correction model is specified as:

$$\Delta[(\ln LFR_t)] = \beta_0 + \sum_{i=1}^p \alpha_1 \Delta \ln(LFR_{t-1}) + \sum_{i=1}^m \alpha_2 \Delta \ln(LEXR_{t-1}) + \sum_{i=1}^n \alpha_3 \Delta LRGDP_{t-1} + \sum_{i=1}^0 \alpha_4 \Delta LITR_{t-1} + \sum_{i=1}^0 \alpha_5 \Delta LIFR_{t-1} + \sum_{i=1}^0 \alpha_6 \Delta BMS_{t-1} ecm_{t-1} \dots \dots (3)$$

Where Δ is the first difference operator, $\ln(LFR)$ is the natural log of the foreign reserves, $\ln(LEXR)$ is the natural log of the exchange rate, $\ln(LRGDP)$ is the natural log of real GDP, $\ln(LITR)$ is the natural log of interest rate, $\ln(LIFR)$ is the natural log of inflation rate, $\ln(LBMS)$ is the natural log of broad money supply, the p denote the lag Length, the $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4$, and $\alpha_5, \beta_0, \beta_1, \beta_2, \beta_3, \beta_4$, are parameters to be estimated in the model while the e_t stand for white-noise error term respectively.

4. RESULTS AND DISCUSSION

4.1. Pre-estimation Test

In this study, two types of unit root tests are employed such as the Augmented Dickey-Fuller (1982) and the Phillips-Perron (1988) to take quality control of the heterogeneity problem as well as avoid the spurious regression problem. The results of the unit root tests are presented in Table 1.

Table 1: Results of Unit Root Tests

Variables	Unit root tests			
	Augmented Dickey-Fuller (ADF)		Phillips Perron (PP)	
	Constant Without Trend	Constant With Trend	Constant Without Trend	Constant With Trend
	Level			
LFR	-2.9818	-2.1032	-2.0343	-2.3403
LEXR	-2.5163	-2.6740	-2.7819	-2.6752
LRGDP	-0.7251	-1.7892	-0.0753	-1.6826
LITR	-2.4646	-2.4582	-2.5117	-2.4588
LIFR	-3.8450***	-3.6329***	3.3119***	3.6425***
LBMS	-4.3361**	-4.1760**	-4.5409**	-4.5598**
First Difference				
LFR	-10.4516*	-10.2821*	-13.9182*	-13.6482*
LEXR	-6.0278*	-6.1479*	-6.0270*	-6.1880*
LRGD[-3.0310**	-3.9160**	-3.0310**	-3.9140**
LITR	-7.0906*	-6.9985*	-7.2995*	-7.4548*
LIFR	-1.2153	-1.6686	-1.8395	-1.6407
LBMS	-1.5013	-2.2065	-0.9666	-2.3077

Note: *, ** and *** denotes significance at 1%, 5%, and 10% significance level, respectively.

Source: Authors' computation from E-views 9 software (World Bank 2021)

The unit root test in Table 1 shows that the inflation rate and broad money supply are stationary at levels 1(0) while foreign reserves, exchange rate, real GDP, and interest rate were stationary at their first differences 1(1). Therefore the mixture of 1(0) and 1(1) order of integration met the condition for adopting the Autoregressive Distributed Lag (ARDL) bound test developed by Pesaran, Shin, and Smith (2001), which contains the test for co-integration and error correction model.

4.2. Cointegration Test

The cointegration test was based on the Autoregressive Distributed Lag (ARDL) bound test and the results are presented as follows.

Table 2: Results of ARDL Bounds Test

<i>Test Statistic</i>	<i>Value</i>	<i>k</i>
F-statistic	8.450038	5
Critical Value Bounds		
<i>Significance</i>	<i>I0 Bound</i>	<i>I1 Bound</i>
10%	2.26	3.35
5%	2.62	3.79
1%	3.41	4.68

Source: Authors' computation from E-views 9 software (World Bank 2021)

The results of the cointegration test in Table 2 reveal that the F-statistic value of 8.4500 exceeds the upper bound and lower bound values at a 1% level of significance. The null hypothesis of no cointegration is rejected. As supported by the results of the ARDL bound tests there is evidence that the exchange rate has a long run relationship with the foreign reserve in Nigeria during the study period.

4.3. Estimation

In Table 3 the results of the short run coefficients tend to show that the exchange rate has a positive and significant effect on foreign reserve at a 5% level of significance. Also, indicate that an increase in exchange rate by 1% would increase foreign reserves by roughly 0.06% while real GDP has a positive and significant impact on foreign reserve at a 1% level of significance. This shows that an increase in real GDP by 1% would increase foreign reserves by roughly 0.01% respectively. The inflation rate has a positive and significant impact on foreign reserve at a 5% level of significance. It indicates that an increase in inflation rate by 1% would increase foreign reserve by roughly 0.16% Money supply has a negative and

Table 3: Results of ARDL short run Coefficients- Dependent Variable is LFR

<i>Cointegrating Form</i>				
<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Prob.</i>
D(EXR)	0.0587	0.0268	2.1915	0.0411
D(RGDP)	0.0100	0.0100	7.0289	0.0000
D(ITR)	-0.1209	0.1251	-0.9657	0.3463
D(IFR)	0.1645	0.0320	5.1378	0.0001
D(MS)	-0.7644	0.2128	-3.5927	0.0019
CointEq(-1)	-0.3344	0.1565	-8.5336	0.0000

Source: Authors' computation from E-views 9 software (World Bank 2021)

significant effect on foreign reserve at a 5% level of significance. Also, indicate that an increase in money supply by 1% would reduce foreign reserve by roughly 0.76. Again, the short-run error correction term for the model ECM (-1), has a coefficient value (-0.3345) with a negative sign, less than one, and is statistically significant at a 1% level of significance. Therefore, the speed of adjustment for correcting disequilibrium from the previous year to equilibrium in the current year is 0.33% respectively.

Table 4: Results of ARDL long run Coefficients -Dependent Variable is LFR

<i>Long Run Coefficients</i>				
<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Prob.</i>
LEXR	-0.0506	0.0182	-2.7805	0.0119
LRGDP	0.0100	0.0100	3.5859	0.0020
LITR	-0.0520	0.1485	-0.3502	0.7300
LIFR	0.1020	0.0642	1.5887	0.1286
LMS	-0.5502	0.2042	-2.6939	0.0144
C	0.8703	4.2854	0.2031	0.8412

Source: Authors' computation from E-views 9 software (World Bank 2021)

Similarly, Table 4 displays the results of the long run coefficients which imply that the exchange rate has a negative and significant effect on foreign reserves at a 5% level of significance. Also, indicate that an increase in exchange rate by 1% would reduce foreign reserves by roughly 0.05% while real GDP has a positive and significant impact on foreign reserves at a 5% level of significance. This shows that an increase in real GDP by 1% would increase foreign reserves by roughly 0.01% respectively. Money supply has a negative and significant effect on foreign reserves at a 5% level of significance. Also, indicate that an increase in money

supply by 1% would reduce foreign reserve by roughly 0.55% in Nigeria during the study period.

4.4. Post-estimation test

The results of the post-estimation tests carried out to determine whether the residuals are distributed normally in the model are presented as follows;

Table 5: Results of ARDL Diagnostic Tests

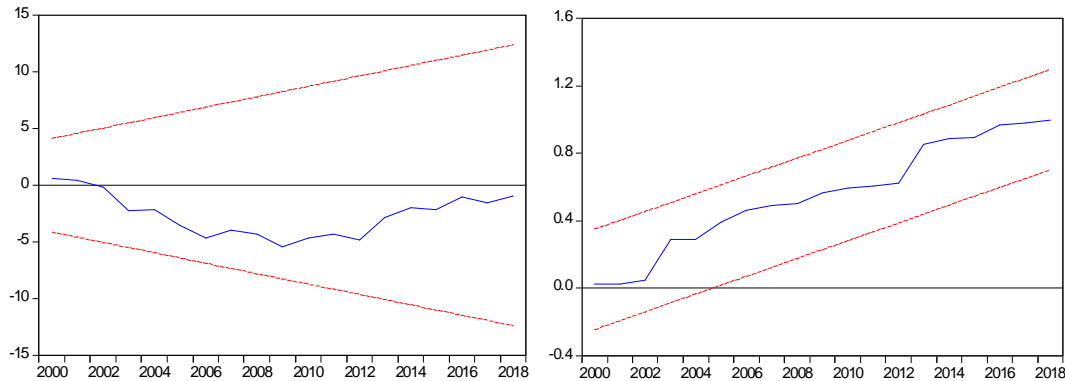
<i>Tests</i>	<i>F-statistics</i>	<i>Prob. Value</i>
Normality (Jarque -Bera Test Statistics)	1.2623	0.5319
Serial Correlation (Breusch-Godfrey LM Test)	2.3469	0.1139
Heteroscedasticity Test: Breusch-Pagan-Godfrey	0.6641	0.7628
Specification Error (Ramsey RESET Test)	0.0685	0.7967

Source: Authors' computation from E-views 9 software (World Bank 2021)

The results of the different post estimation tests in Table 5 show that the *Jarque-bera* probability value (0.5319) is not significant at any significances level. This implies that the conditions for normality are all met and the data is normally distributed. The Breusch-Godfrey serial correlation LM test result shows the p-value statistics of 0.1139 is not significant at any level. Therefore, the study concludes that the model is free from the autocorrelation problems. Similarly, the result of tests for Breusch-Pagan-Godfrey Heteroskedasticity carried out reveals that the p-value 0.7628 is not statistically significant at any level this implies the absence of a Heteroskedasticity problems in the model. The results of the Ramsey Reset test of Misspecification indicate the p-value is (0.7967) which is not significant at any level. As the study expects this entire test result is considered meaningful and subsequently, the model is stable and can be considered for decision-making, predictions, and other economic inferences.

4.5. Stability Test

The study employed the Cumulative Sum of recursive residuals (CUSUM) developed by Brown, Dublin, and Evans (1975) to test the stability of the model within a 5% level of significance. The results of the CUSUM and CUSUM Square test with the foreign reserve as the dependent variable and the explanatory variables such as exchange rate, real GDP, interest rate, inflation rate, and money supply are presented in Figures 1 and 2.



Source: Authors' computation from E-views 9 software (World Bank 2021)

4.6. Causality Test

In this study, the Toda and Yamamoto (1995) causality test was carried out to determine the direction of causal relationship among the variables from 1986 to 2021.

Table 6. Results of Toda and Yamamoto Causality Test

Causality	Chi-sq	df	Prob.
LMS does not Granger cause LFR	4.9961	2	0.0822***
LEXR does not Granger cause LRGDP 4.7730 2	0.0919***		
LRGDP does not Granger cause LIFR 6.8121 2	0.0332**		
LMS does not Granger cause LIFR	6.0384	2	0.0444**
LRGDP does not Granger cause LMS	8.4818	2	0.0144**

Note: that ** and *** represent 5% and 10% level of significance.

Source: Authors' computation from E-views 9 software (World Bank 2021)

The results of the causality tests presented in Table 6 reveal that there is a unidirectional causality between money supply and foreign reserves, exchange rate and real GDP, real GDP and inflation rate, money supply and inflation rate, real GDP and money supply over the study period.

5. SUMMARY AND CONCLUSION

This study examines the effects of the exchange rate on foreign reserve in Nigeria, using foreign reserve as a dependent variable while exchange rate, real GDP, interest rate, inflation rate and broad money supply were used as explanatory variables. The time series data from 1986 to 2021 were gotten from both the Central Bank of Nigeria and the World Bank indicators. The data was analyzed

using the Autoregressive Distributed Lag (ARDL) framework. The study concludes that the exchange rate has a positive and significant effect on foreign reserves in the short run while in the long run exchange rate has a negative and significant effect on foreign reserves in Nigeria. The study recommends that the monetary authorities should enact policies that would help to stabilize exchange rate fluctuation in order to improve the foreign reserve accumulation in Nigeria

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