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FOREIGN RESERVE EFFECTS OF INTEREST RATES IN NIGERIA

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Abstract

The steady depletion of Nigeria's foreign reserves has raised serious concerns for economic blueprints and policy interventions for economic prosperity. With the autoregressive distributed lag technique, we interrogated foreign reserves effects of different interest rates using time series data for the period 1990 to 2020. Results show that effects of monetary policy rate on foreign reserve were not significant though it was negative in the short run but turned positive in the long run. Bond rate effect on foreign reserve was positive but not significant in the short run and negative but significant in the long run. Treasury bill rate and US federal fund rate had positive but no significant effect on foreign reserves in both long run and short run. We found interest rate differential to have positive and significant effects on foreign reserves both in the long and short run. We recommend that Nigeria's monetary authority should ensure a significant interest rate differential among similar interest rates with considerations for monetary policy and treasury bill rates if the intention is to increase foreign reserves in the long run, while considerations should be for government bond rate if the intention is to increase foreign reserves in the short run.

Keywords: Interest rate, foreign (external) reserves, interest rate differential, monetary policy rate, treasury bill rate

INTRODUCTION

Adequate holding of foreign (otherwise external) reserves is very important to a country because it assists in withstanding unexpected monetary shocks. It provides cushions to pressing economic problems; it intervenes when exchange rate is volatile; and it boosts an economy's creditworthiness and access to international market. Adequate foreign reserve is a buffer when nations experience drops in revenue and would need to fall back on its savings as a lifeline and a means to meet timely international payment obligations. Payments for trade between countries are done with foreign currencies therefore, it is mandatory to ensure that adequate reserves are always available (CBN, 2007).

A core determinant of foreign reserves is the interest rate (CBN, 2007). Various types of interest rates include monetary policy rate, bond rate, treasury rate, and US federal fund rate and each of them plays significant roles in foreign reserve accumulation. For instance, Popov (2019) asserts that sales of government bonds through open market operations increases interest rates which in turn attracts capital inflow leading to greater accumulation of foreign reserves. The proceeds of foreign treasury securities could be used to augment our reserves or retire external debts. An increase in treasury bills rates attracts capital inflow which ultimately increases reserve accumulation (Nyawata, 2012). Monetary economics explains a negative relationship between domestic credit and foreign reserves in that when domestic credit increases, money supply also increases, resulting in a decrease in the interest rate, and consequently foreign exchange outflow resulting to reduction in foreign exchange reserves.

Foreign reserve accumulation pattern of Nigeria has been a boom and bust-like pattern for decades and has continually hindered macroeconomic stability and growth, particularly via the nominal anchor and price mechanism. Between 2000Q1 and 2006Q1, the average foreign reserves were US$12.64 billion with a per quarter interest rate spread of 3.05 per cent. This period was characterized by high levels of short-term debt to reserves ratio, the average foreign reserves were US$42.93 billion between the periods from 2006Q2 and 2007Q4, with a 1.54 per cent per quarter interest rate spread. This spread coincides with the period when the economy exited the Paris and London clubs debt obligations. The significant increase in reserves was also primarily linked to the steady increase in crude oil prices, during the period (CBN, 2019). The periods between 2008Q1 to 2010Q4 saw the peak of foreign reserves of US$62.08 billion in 2008Q3 to as low as US$33.00 billion in 2010Q4 with an average interest rate spread of 3.96 per cent. This was due to the onset of the global economic crisis, which also impacted the Nigerian economy, and triggered the Nigerian banking crisis. It led to the withdrawal of credit lines and capital flow reductions as foreign investors repatriated funds back to their home countries to shore up their balance sheets. As of the end of 2016, the foreign reserves

plummeted to USD 24 billion and returned to $38 billion in 2020, which is almost 50% less than the all-time high reserve recorded in 2008 (CBN, 2019).

The depletion in foreign reserves witnessed in Nigeria in recent times could elevate risk concerns among foreign investors. This could have serious implications for the risk premium, portfolio flows, short-term external debt position, which could plummet reserve adequacy below import and short term loan benchmark, leading to unfavourable balance of payment and poor economic growth. The dwindling fiscal buffers tend to increase the country's reliance on foreign portfolio flows which are known to be volatile and constitute a major risk to exchange rate stability, especially with uncertainties around capital flows and oil price. A country's ability to manage its short-term obligations to the outside world, maintain a disciplined fiscal regime and attract long-term capital is crucial in the determination of its risk premium (Moses, Egbuna, Sagbamah, Abdusalam, Ogundele, Oduyemi & Oladunni, 2015). Some of the efforts by the government to ensure an adequate level of the external reserve include the adoption of a regulated but flexible interest rate regime, and the introduction of the Secondary Market Intervention Sales (SMIS) window to deepen the foreign exchange market among others. Yet, Nigeria's foreign reserves deplete steadily with an unstable interest rate, which has raised serious concerns among policymakers and investors.

Most studies on the effects of interest rates on foreign reserve are either panel studies or have used one type of interest rate to represent all other types of interest rates. For instance, a cross-sectional analysis by Pina (2017) used one type of interest rate which did not provide specific evidence for Nigeria since generalization is made for all countries studied based on the average effect obtained. Other studies such as Irefin and Yaaba (2012), Umoru and Oseme (2013), Eke, Eke and Odim (2015), Banakole and Shuaibu (2013), Okoye, Nwakoby and Modebe (2015) and Nwachukwu, Ali, Abdullahi, Mohammed, Zirra, Falade, & Alenyi (2016) used domestic interest rate to represent all types of interest rate to examine the interest rate effect on one of the core macroeconomic variables influencing the behaviour, management and performance of foreign reserve in Nigeria. These studies did not consider the effects of different interest rate and interest rate differential on foreign reserves. The approach adopted by these previous studies did not reveal valuable information about the effect of different categories of interest rates on Nigeria's foreign reserve. An alternative path is an approach that can focus on specific forms of interest rate. It is, therefore, important to analyse these different interest rates for Nigeria and establish how each of them affects Nigeria's foreign reserves so that appropriate and affirmative policy options can be considered.

The specific objectives of our study is to examine the effect of various types of interest rate (monetary policy rate, bond rate, treasury rate, US federal fund rate) on foreign reserves,

and to ascertain the effect of interest rate differential (opportunity cost) on Nigeria's external reserves. Our paper reduces the overgeneralization of findings from one type of interest rate and therefore, a veritable policy tool for external reserve managers; risk and information management tool for investors; and research information for the academia.

Having introduced the paper, the next section is on review of related literature. Section three is on the method adopted for the study. Section four contains the interpretations of results while section five concludes the paper.

REVIEW OF RELATED LITERATURE

Conceptual Literature

Foreign (otherwise external) reserves are cash and other reserve assets such as gold held by a central bank or other monetary authority of a country that are used to back liabilities and influence monetary policy (CBN, 2007). These assets according to Heller (1966) possess two important qualities: they should be acceptable at all times to foreign economic entities for payment of financial commitments; and their value, expressed in foreign units of account, should be known with sureness. Using these criteria, four assets qualify as reserves: official holdings of gold, special drawing rights (SDRs), convertible foreign exchange, and unconditional drawing rights with the IMF (Flood & Marion, 2002). Foreign reserves are external assets held by a nation and these include currency, securities, deposits, special drawing rights, monetary gold, etc (Molapo, 2016). They are assets held on reserve by a central bank in foreign currencies. Although there are many definitions of external reserves, the International Monetary Fund (IMF, 2012) definition is adopted for this study. On this basis, we define foreign reserves as official public sector foreign assets that are readily available to and controlled by monetary authorities for direct financing of payment imbalances, through intervention in the exchange rate market to affect the currency or assets of central banks or other monetary authorities held in different reserves countries' currency such as the United States dollars, British pound sterling, European Euro, Japanese Yen and so on.

Interest rate is a return to fund-owners or the cost of borrowing. It is usually expressed as a per cent per annum of the amount of money invested, lent or borrowed (Reserve Bank of Australia, 2012). There are various types of interest rates based on policy, deposit and lending rates (CBN, 2016). The deposit rates are paid on savings and time deposits of different maturities such as a one-month and fixed deposit in financial institutions; and lending rates are charged by money lenders for meeting the short and medium-term financing needs of borrowers. The monetary policy rate (MPR) is the rate at which CBN lends to deposit money banks (DMBs) in performing their duties as lenders of last resort. It is usually set at a level that

is consistent with the macroeconomic objectives. The MPR is expected to manifest the position of monetary policy and functions as a roadmap for all other market interest rates. The MPR has been used to explain the cardinal point of a standing facility meant to steer market interest rates.

When investors buy bonds, they are loaning money to the issuer in exchange for interest (bond rate) and the return of principal at maturity. Because bonds traditionally pay the investor a fixed interest rate periodically, they are also known as fixed-income securities. Fixed income securities provide periodic income payments at an interest rate known in advance by the holder. The most common fixed-income securities include treasury bonds, corporate bonds, preferred stock and certificates of deposit (CDs). Holders of treasury bonds and CDs receive a fixed interest rate based on a par value over a specific period.

Foreign reserves are part of the total assets of a country. As such, they could be used alternatively to finance productive investment projects, to repay (external) government debt or to buy other assets according to optimal portfolio considerations. The difference between the return of these alternative investment options and the yield on liquid international reserves is the appropriate concept of opportunity cost hence the interest rate differential. This plays an important role in the determination of foreign reserves.

Measuring the opportunity cost of holding reserves is debatable. Different scholars have used different financial variables (i.e. interest rate and lending rate) as a proxy for the opportunity cost. Suvojit (2008) used monthly yield on cut off price of 91 days treasury bills. Edwards (1985) suggests that opportunity cost, termed as penalty rate by Frenkel and Jovanovic (1981), corresponds to the difference between a country's marginal product of capital and interest rate on reserve. However, noting that marginal productivity of capital is difficult to measure due to data unavailability, Edwards (1985) proposes measuring the opportunity cost of holding reserves by the spread between the interest rate on external debt and return on reserves (LIBOR rate). This approach was also adopted by authors such as Rodriguez and Funk (2012), therefore forming the base of our study.

Empirical Literature

Literature search has revealed that a number of foreign empirical studies have been conducted on the effect of interest rate on foreign reserve but these studies are fewer for the Nigerian economy. For instance, Bird and Rajan (2003), studied the effectiveness of interest rate on the adequacy of internal reserve in the aftermath of the crisis of Europe and Australia using buffer stock model. The study found that interest rate, among other variables, had a significant influence on the level of foreign reserves though only the domestic interest rate was investigated.

Pina (2017) examined the relationship between international reserves and global interest rate using a simple open economy model. The study used quarterly data for 75 countries between the periods from 2000 and 2013. The result showed that change in global interest rate was positively related to the target level of external reserves.

Azar & Wael (2017) did a panel study on the accumulation of foreign exchange reserves and the development of the macro-economy in the Gulf and Cooperation Council (GCC) countries including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates from 1996 to 2015 using the ARDL model. The empirical results showed that the stockpile of foreign exchange reserves in the GCC countries was not significant to interest rates on the US dollar, neither to nominal effective exchange rates nor to the ratio of imports to GDP.

Anwar, Djamala and Undai (2019) studied the effects of foreign loans, interest rate, and export on the foreign exchange reserves in Indonesia from 2002-2016 using the ordinary least squares (OLS) method. It was found that while the interest rate could not affect the foreign exchange reserves in Indonesia during the sample period, foreign loans and export positively affected foreign exchange reserves.

In the Nigerian literature, Oputa (2006) examined the determinants of the currency composition of external reserve in Nigeria using the multiple regression models, including exchange rate, domestic interest rate, trade flows, currencies of creditor's nation (external indebtedness), and political consideration dummy representing the determinant of currency composition in Nigeria. The exchange rate and domestic interest rate were significant in the findings though only one interest rate was investigated.

Oligbi and Iyoha (2020) estimated the demand for international reserves function in Nigeria using the vector auto-regressive model and annual time-series data for 1980-2017. The result indicated that there is a stable, long-run relationship between international reserves and domestic interest rate among other variables though other types of interest rates were not investigated.

Oyeniran and Alamu (2020) determined the optimal levels of foreign reserves in Nigeria. The study adopted the buffer stock model as advanced by Frenkel and Jovanovic (1981) using the autoregressive distributed lag approach (ARDL). The results showed that Nigeria's optimal reserves level responded positively to opportunity cost of reserves holding, adjustment cost of holding reserves, and exchange rate volatility though the various types of interest rates were not investigated.

Studies like Pina (2017) stated that interest rate had a negative impact on external reserve without specifying which form of interest rate. The conclusion by Pina (2017) is similar to most other studies such as Oligbi and Iyoha (2020), Oputa (2006) and Bird and Rajan (2003),

who also concluded that interest rate, had a positive impact on external reserve in Nigeria. Different from these existing studies, our study encompassed different categories of interest rates thereby increasing the precision of the information in the Nigeria's economic blueprint and providing policy makers with more robust information for the best understanding of national financial statements and notes for strategic policymaking.

RESEARCH METHOD

Theoretical Framework

The monetary approach to the balance of payment (MABP) theory is adopted as the theoretical framework of the study. The model explains that monetary authorities are more concerned with reserves movements and their influence on demand and supply of money. The advantages and applicability of the MABP over other related external reserves theories are that its adaptability to various conditions, like flexible exchange rate, open economy, international payment, and domestic interest is seen as a proxy for global interest rate. The MABP approach was developed by Mundel (1968), Johnson (1972), and Zecher (1974), and was tested by the reserve-flow equation. The reserve-flow equation is an equation in which the dependent variable is either the level of the country's foreign reserves, changes in foreign reserves, or the rate of change in foreign reserves (Chaudhary & Shabbir, 2004). The explanatory variables of the equation are the basic determinants of the demand for money; domestic interest rate, domestic price level, and domestic income, along with other key explanatory variables of the equation which represents the domestic monetary and fiscal policy.

It should be mentioned here that different forms of equations were adopted by different empirical studies to test for the predictions of the monetary approach to the balance of payments. Following Howard and Maningi (2002), the standard and most common form of the monetary approach are:

$M_d = P.L(Y, r)$ *(1)*

$M_s = m.H$ *(2)*

$M_s = m\ (R+D)$ *(3)*

$M_d = M_s$ *(4)*

$P.L(Y, r) = m\ (R+D)$ *(5)*

Where, *P* is the price level; *Y* is the domestic income; *r* is the domestic interest rate; *m* is the money multiplier, *R* stands for foreign reserves; *D* is the domestic credit; *Ms* is the money supply, *H* is the monetary base which equals (D+R), and *Md* is the money demand. Differentiation of Equation (1) concerning *R* gives**:**

$$\frac{R}{R+D}\dot{R} = a_1\dot{P} + a_2\dot{Y} + a_3\dot{r} + a_4\dot{m} + a_5\frac{R}{R+D}\dot{D} + U \qquad (6)$$

Equation (6) is the "reserve-flow" equation and it represents the standard form to test for the predictions of the monetary approach theory. This form was adopted in several empirical studies such as Zecher (1974); Shamia (1989); Dabbagh and Al-Ngdawi (1994); Hamdan (1997); and Howard and Mamingi (2002).

Variables, Data and Data Sources

The data for our study except US Federal Fund Rate were drawn from Nigeria's time series data covering the period 1990 to 2020. The choice of this period is based on changes in Nigeria's macroeconomic outlook. For instance, the country's external reserve was an all-time high of $53.6b in 2008, coupled with the historical all-time high oil crude oil price of $147.27 in July 2008 while it recorded its all-time high interest rate of 34.7% in 1993. This period is also relevant for the study as Nigeria witnessed historic debt cancellations from its two prominent lending institutions as well as maintained high external debt profile.

The variables used in our study include foreign reserve, opportunity cost (measured by the interest rate on external debt minus Libor rate), external debt, oil revenue (% of GDP), USA federal fund rate, nominal exchange rate, bond rate, monetary policy rate, and foreign direct investment (FDI). The data on foreign reserves, nominal exchange rate, monetary policy rate, oil revenue, and FDI were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin of various issues. The data on external debt and the federal bond rate was obtained from Nigeria's Debt Management Office 2020 online, while USA Federal Fund Rate and the opportunity cost were obtained from the Federal Reserve online.

Empirical Model Specification

In determining the effect of various types of interest rates (MPR, bond rate, treasury bill rate, US federal fund rate) and interest rate differential (opportunity cost) on foreign reserves, the model by Al-Basheer and Ahmad (2016) is adopted with modifications. Al-Basheer and Ahmad (2016) based on the MABP approach specified the following functional form:

$$FRESERV = f(GDP, DNIR, M2) \qquad (7)$$

Where, *FRESERV* is foreign reserves held by the CBN; *GDP* is GDP growth (annual %) – a measure for economic growth; *DNIR* is weighted average interest rate on savings deposits – a proxy for domestic nominal interest rate; and *M2* is broad money supply.

For this study, and the robustness of findings, we augment monetary policy rate *MPR*, federal government bond rate *BRATE*, treasury bill rate *TBILRATE*, US federal fund rate

USFRATE, interest rate differential (opportunity cost) *INRDIFF*, exchange rate *EXCHR* and oil export revenue *OILREV* on foreign reserve *INRDIFF* into Equation (7) above and re-specify the functional form as:

$$FRESERV = f(GDP, DNIR, M2, MPR, BRATE, TBILRATE, USFRATE, INRDIFF, OILREV, EXCHR) \quad (8)$$

The various types of interest rates in Equation (8) – for example, MPR, bond rate, treasury rate, US federal fund rate, among others are mostly short-run policy variables. Therefore, it will be appropriate to capture the short-run effects of the variables on foreign reserves. Thus, we take the log of the variables and specify Equation (8) in an ARDL form as:

$$lnFRESERV_t = \alpha_0 + \alpha_1 lnFRESERV_{t-1} + \alpha_2 EXCHR + \alpha_3 lnGDP + \alpha_4 DNIR + \alpha_5 lnM2 + \alpha_6 MPR + \alpha_7 BRATE + \alpha_8 TBILRATE + \alpha_9 USFRATE + \alpha_{10} INRDIFF + \alpha_{11} lnOILREV + \sum_{j=1}^{p} \beta_1 lnFRESERV_{t-j} + \sum_{k=0}^{q} \beta_2 EXCHR_{t-k} + \sum_{s=0}^{q} \beta_3 lnGDP_{t-s} + \sum_{m=0}^{q} \beta_4 DNIR_{t-m} + \sum_{z=0}^{q} \beta_5 lnM2_{t-z} + \sum_{z=0}^{q} \beta_6 MPR_{t-z} + \sum_{s=0}^{q} \beta_7 BRATE_{t-s} + \sum_{s=0}^{q} \beta_8 TBILRATE_{t-s} + \sum_{s=0}^{q} \beta_9 USFRATE_{t-s} + \sum_{s=0}^{q} \beta_{10} INRDIFF_{t-s} + \sum_{s=0}^{q} \beta_{11} lnOILREV_{t-s} + \mu_{1t} \quad (9)$$

In Equation (9), the lag terms show the long-run process, while the differenced terms in the equation represent the short-run variables. μ_{1t} is the error term while a_i (i = 1,2,3, …10) and β_i (i = 1,2,3, …10) are the long and short-run parameters of the respective variables. Variables with ln are logged variables. Variables in rate are not logged. The optimal lag length is to be determined using Akaike information selection criteria. The inclusion of the interest rate differential (opportunity cost) on external reserve (INRDIFF) enable us to capture objective two.

The ARDL model is applicable irrespective of whether the underlying regressors are stationary at I(0) or I(1) or a mixture of both. An advantage of this model is that it has a small sample property and provides an unbiased estimate of the long-run model as well as reliable t-statistics even when most of the regressors are endogenous. In the presence of cointegration, an error correction model will be estimated that will show the adjustment of the cointegrated variables towards equilibrium. The error correction model is specified as:

$$\Delta lnFRESERV = \beta_0 + \sum_{j=1}^{p} \beta_1 lnFRESERV_{t-j} + \sum_{k=0}^{q} \beta_2 EXCHR_{t-k} + \sum_{s=0}^{q} \beta_3 GDP_{t-s} + \sum_{m=0}^{q} \beta_4 DNIR_{t-m} + \sum_{z=0}^{q} \beta_5 lnM2_{t-z} + \sum_{z=0}^{q} \beta_6 MPR_{t-z} + \sum_{s=0}^{q} \beta_7 BRATE_{t-s} + \sum_{s=0}^{q} \beta_8 TBILRATE_{t-s} + \sum_{s=0}^{q} \beta_9 USFRATE_{t-s} + \sum_{s=0}^{q} \beta_{10} INRDIFF_{t-s} + \sum_{s=0}^{q} \beta_{11} lnOILREV_{t-s} + ECM1_{t-1} + \mu_{2t} \quad (10)$$

Where, $ECM1_{t-1}$ is the error correction term.

The first step is to determine the lag order of the ARDL. Thereafter, the model can be estimated using the ordinary least square (OLS) technique. The use of OLS is justified by the

fact that it is the best, linear and unbiased estimator (BLUE) in the class of all available estimators. Estimation of the ARDL model in this study shall begin with the test for the appropriate lag order using Akaike information model selection criteria. Also, since most levels from the time series are usually non-stationary, the variables will be tested for unit root using the Augmented Dickey-Fuller (ADF) and Philips Peron (PP) unit root tests. After the unit root tests, a test for cointegration (the long-run relationship among the variables) would be carried out using the bounds test with the assumption of order 1 and order 0 – I(1) and I(0) variables.

RESULTS AND DISCUSSIONS

Augmented Dickey-Fuller and Philips Perron Unit Root Test

The Augmented Dickey-Fuller and Philips Perron unit root test was used to test the stationarity of the variables with the use of Stata 16 econometrics package. The test results are presented on Table 1.

Table 1: Augmented Dickey-Fuller and Philips–Perron Unit Root Test Results

Variable	Augmented Dickey-Fuller Result		Philips–Perron Result		Lag Order	~I(d)
	Level	1st Difference	Level	1st Difference		
FRESERV	-2.247	-6.712*	-2.991	-7.338*	1	I(1)
DNIR	-1.013	-5.083*	-1.896	-6.874*	1	I(1)
lnM2	-0.480	-4.352*	-0.138	-3.673*	1	I(1)
GDP	3.441	-4.019*	-2.838	-4.362*	1	I(1)
MPR	-2.443	-5.333*	-3.476	-7.876*	1	I(1)
BRATE	-2.357	-3.826*	-2.594	-4.354*	1	I(1)
TBILRATE	-3.418	-5.724*	-3.242	-7.608*	1	I(1)
USFRATE	-3.660	-4.369*	-2.918	-4.450*	1	I(1)
lnOILREV	-0.789	-4.202*	-0.827	-4.509*	1	I(1)
INRDIFF	-3.230	-6.024*	-3.444	-5.127*	1	I(1)
EXCHR	-1.193	-3.773*	-1.018	-4.102*	1	I(1)

*denotes significance at 5% and the rejection of the null hypothesis of the presence of unit root. The optimal lag lengths were chosen according to Akaike's Final Prediction Error (FPE), and Akaike's information criteria. The ADF 5% critical values at the level and 1st difference are -3.584 and -3.588. The Philip-Perron 5% critical values, on the other hand, at the level and 1st difference are -3.580 and -3.584. The trend is included in both the Augmented Dickey-Fuller and Philips–Perron unit root test models estimated.

The Augmented Dickey-Fuller and the Philips–Perron tests showed that the variables respectively have an insignificant test statistic at the level form. For this reason, the null hypothesis of the presence of unit root is accepted at the 5 per cent level. The acceptance of the null hypothesis justifies our decision to take the 1st difference of the variables respectively. We repeated the test at 1st difference and, the result showed significant test statistics for all the variables respectively. Therefore, the null hypothesis is rejected at 1st difference.

The Effects of MPR, Bond Rate, Treasury Bill Rate, US Federal Fund Rate and Interest Rate Differential (Opportunity Cost) on Foreign Reserves

The ARDL error correction model was estimated. In this section, the estimation results are presented and discussed. We begin with the bounds test result, reported in Table 2.

Table 2: Bound Test Result

	10%		5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F-statistic	1.83	2.94	2.06	3.24	2.28	3.50
t-statistic	-2.57	-4.69	-2.86	-5.03	-3.13	-5.34
F = 4.037						
t = -1.675						
H0: No levels relationship						

Since t < critical value for the I(1) regressors, we also reject the null hypothesis using the t-value. Thus, in both tests, cointegration is found. Therefore, the error correction equation was estimated and the result is presented in Table 3.

Table 3: Error Correction Estimates of the ARDL Model

The dependent variable is foreign reserves held by the CBN (FRESERV)				
UNEMP	coefficients	Standard Errors	t-Statistics	P-value
Adjustment	-0.4196	0.1568	-2.67	0.032
Long-Run				
EXCHR	2.4817	1.2165	2.04	0.038
GDP	2.9877	1.0786	2.77	0.000
DNIR	3.5468	29.5568	0.12	0.909
lnM2	-7.5599	20.9997	-0.36	0.730
MPR	2.6689	2.9655	0.90	0.393

BRATE	-4.1244	1.8331	-2.25	0.034
TBILRATE	1.9857	2.7201	0.73	0.485
USFRATE	10.1573	7.6949	1.32	0.224
INRDIFF	40.2302	15.4139	2.61	0.002
lnOILREV	51.9949	18.7032	2.78	0.000
Short-Run				
EXCHR	70.5301	83.08221	2.05	0.044
GDP	41.9706	123.8568	0.34	0.743
DNIR	1.3139	1.4129	0.93	0.381
lnM2	-29.1407	13.4289	-2.17	0.037
MPR	-17.4855	538.5663	-0.03	0.975
BRATE	2.1559	8.8645	0.24	0.817
TBILRATE	4.6643	5.2408	0.89	0.398
USFRATE	1.0314	1.3055	0.79	0.454
INRDIFF	13.8386	6.0696	2.28	0.032
lnOILREV	14.6279	6.1983	2.36	0.026
Constant	-22.9515	8.3460	-2.75	0.000
R2		0.8963		
Adjusted R-Squared		0.6241		
F-statistics		41.46 (p = 0.0002)		
Durbin-Watson d-statistic (22, 30)		2.0773		
Breusch-Godfrey LM Chi-square Statistics		0.278 (p = 0.5979)		

Table 3…

Table 3 show the error correction adjustment coefficient of -0.4196 with a significant t-value of -2.67. The significant negative value of -0.4196 means that when there is disequilibrium in the short run, the variables in the model adjust back to equilibrium in the long run at a significant speed of 41.96 per cent per annum.

We found that in the long run, an increase in the domestic nominal interest rate led to a 3.55 per cent increase in foreign reserves. A similar result showed up in the short run though domestic nominal rate had no significant effect on foreign reserves in both periods. An increase in broad money supply brought about a 7.56 per cent insignificant decrease in foreign reserves. In the short run, a one percent increase in broad money supply brought about a significant 29.14 percent decrease in foreign reserves. The monetary policy rate had a positive but statistically insignificant effect on foreign reserves in the long run. A percentage increase in monetary policy rate resulted in about a 2.67 per cent increase in foreign reserves. In the short run, the monetary policy rate had a negative and statistically insignificant effect on foreign

reserves because a percentage increase in monetary policy rate led to a 17.49 per cent decrease in foreign reserves.

In the long run, an increase in the federal government bond rate led to a 4.12 per cent significant decrease in foreign reserves. However, in the short run, the federal government bond rate had no significant effect on foreign reserves even though a percentage increase in the federal government bond rate led to a 2.16 per cent increase in foreign reserves. An increase in the treasury bill rate brought about 1.99 per cent and 4.66 per cent increases in foreign reserve in the long and short run periods respectively even though the sizes of the coefficients were not statistically significant.

Concerning the US federal fund rate, a positive and insignificant effect on foreign reserves was found. It shows that a percentage increase in the US federal fund rate results in a 10.16 per cent insignificant increase in foreign reserves in the long run. Also in the short run, the US federal fund rate showed a positive and statistically insignificant coefficient. Thus, both in the long run and short-run US federal fund rates have a positive and statistically insignificant effect on foreign reserves. We found a positive and statistically significant effect of interest rate differential on foreign reserves in the long run. In specific terms, the percentage increase in interest rate differential led to a 40.23 per cent significant increase in foreign reserves. In the short run, interest rate differential also had a positive and statistically significant effect on foreign reserves as a percentage growth in interest rate differential led to a 13.84 per cent significant increase in foreign reserves.

Concerning the exchange rate, a positive and significant effect on foreign reserves is found. It shows that a percentage increase in exchange rate resulted in a 2.48 per cent significant increase in foreign reserves in the long run. Also in the short run, it shows that a percentage increase in the exchange rate led to a 70.53 per cent significant increase in foreign reserves. Thus, both in the long run and short-run exchange rates had positive and statistically significant effects on foreign reserves. GDP growth (annual %) has a positive and statistically significant effect on foreign reserves in the long run. In specific terms, percentage growth in GDP (annual %) brought about a 2.99 per cent significant increase in foreign reserves in the long run. In the short run, GDP growth (annual %) had a positive and statistically insignificant effect on foreign reserves. In the long run, an increase in the oil export revenue led to a 51.99 per cent significant increase in foreign reserves. A similar result showed up in the short run. Oil export revenue had a significant effect on foreign reserves. Specifically, a percentage increase in oil export revenue led to a 14.63 per cent increase in foreign reserve.

Our model has a good fit since the adjusted R^2 coefficient of 0.6241 means that the explanatory variables jointly explain about 62.41 per cent change in foreign reserves in Nigeria. The remaining percentage change in foreign reserves is due to other variables that are not included in the model. The F-value is 41.46 with a p-value of 0.0002. The p-value is significant since it is less than 0.05. Therefore, the null hypothesis of no joint effect of the explanatory variables on the dependent variable is rejected. Thus, the independent variables have a joint significant effect on foreign reserves. The Durbin-Watson d-statistic is approximately 2. Therefore, the null hypothesis of no autocorrelation is accepted. Also, the insignificant Breusch-Godfrey LM Chi-square Statistics of 0.278 ($p = 0.5979$) means that the independent variables are not serially correlated.

Policy Implications of the Findings

The findings that monetary policy rate had a positive but insignificant effect on foreign reserves in the long run, and a negative but insignificant effect on foreign reserves in the short run implies that an increase in the interest rate that the monetary authority (CBN) set to control the main monetary variables in the economy such as consumer prices or credit expansion insignificantly increases foreign reserves in the long run, but in the short run, an increase in it reduces foreign reserves insignificantly. The findings that in the long run, the federal government bond rate had a negative and significant effect on foreign reserves, but, in the short run, federal government bond rate had a positive and insignificant effect on foreign reserves imply that in the long run an increase in the government debt security (issued by the government to finance its spending) significantly reduces foreign reserves, while in the short run, an increase in it insignificantly increases foreign reserves. Also, the Treasury bill rate and US federal fund rate were found to have positive and insignificant effects on foreign reserves both in the long and short run. This implies that an increase in short-term investment securities issued by the government to finance national borrowing requirements have a positive and insignificant effect on foreign reserves both in the long and short run. Similarly, an increase in the interest rates at which the US central bank lends reserve balances (Federal Reserve) to other depository institutions overnight without collateral leads to an insignificant increase in foreign reserves held by CBN in the long and short run. The finding that both in the long and short run, interest rate differential had a positive and significant effect on foreign reserves implies that an increase in the difference between two interest rates (the contrast in interest rate between two similar interest-bearing assets) significantly increases foreign reserves held by the CBN both in the long and short run.

CONCLUSION AND RECOMMENDATIONS

This study examined the effect of interest rates on external reserves in Nigeria and based on the findings, we conclude that monetary policy rate, bond rate, treasury rate, and US federal fund rate are insignificant in determining the foreign reserves held by the CBN in the long run while in the short run, federal government bond rate significantly determines foreign reserves. Both in the long and short run, interest rate differential had a positive and significant effect on foreign reserves.

We therefore recommend that Nigeria's monetary authority should ensure a significant interest rate differential among similar interest rates as a way of increasing the country's foreign reserve. We also recommend that if the intention is to increase foreign reserves in the long run, then, monetary policy rate and treasury bill rate instruments should be considered. One the other hand, if the intention is to increase foreign reserves in the short run, then, federal government bond rate should be considered. We further recommend that future studies should be conducted to ascertain the relevance or otherwise of foreign reserve effects of interest rate mix with a view to enriching the policy space.

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