Original Research Article

A Vector Autoregression Analysis of the Efficacy of External Reserves Management on Exchange Rate Stability: Evidence from Nigeria

Abstract

This paper investigates the dynamic relationship between exchange rate variations and international reserves in Nigeria. The study aimed at ascertaining whether a lead-lag relationship exists between both phenomena using monthly time series data on the bureau de change exchange rate and international reserves extracted from the central bank of Nigeria's statistical publications covering 108 observations between January 2010 and December 2018. The econometric techniques utilized included Granger causality based on the vector error correction and the AR inverse root test for stability and reliability. The empirical result indicates the absence of causality between exchange rate volatility and international reserves fluctuation for Nigeria. Based on our empirical result, the study vehemently concluded that monetary authorities do not have to depend on external reserves management as an efficient strategy to stabilizing the value of the Nigerian currency. Thus, external reserves accumulation could be a face lifting parameter for credit ratings and attraction of needed capital to stimulate the much desired economic growth in Nigeria.

Keywords: ***Exchange Rate Stability, External Reserves Management, Granger causality, Vector Autoregression.***

1. Introduction

The accumulation of International Reserves and its prudent management is a core aspect of international finance and a macroeconomic indicator for inter-country economic analysis. Essentially, international reserves policies and strategies to drive reserve accumulation were earlier given adequate policy and research attentions in Asia during and after the 1991 balance of payment crisis that rocked the continent (Tiwari & Kyophilavong, 2017). However, in recent years, other countries have adopted external reserves accumulation and management strategies especially the oil-exporting nations with highly volatile economies attributed to the exogenous

crude oil price determination (Abdullateef & Waheed, 2010; Abdulazeez & Omade, 2013), in a view to attaining price and exchange rate stability.

Internal and external economic stability through international reserves management is coordinated by the Apex bank through intervention in the foreign exchange market, thus, preventing appreciation of the domestic currency, promoting competitiveness in the global market, stimulating economic growth and enhancing entrepreneurial development. To achieve the foregoing in Nigeria, the Central Bank monitors capital outflows and encourage capital inflows for external reserve accumulation (Folorunsho, Ajisafe, & Olofin, 2019).

Statistical evidence reveals significant volatility in Nigeria's external reserve; it jumped from US$ 4.98 billion in May 1999 to US$ 59.37 billion in March 2007, occasioned by economic reforms, rising crude oil price, and reduced debt repayment burden (Abdullateef & Waheed, 2010). The continual intervention to stabilize the Nigeria's exchange rate through external reserve strategies during the 2008/09 economic crisis costs the economy about 33 percent of her international reserve with a decline to US$ 44.53 billion in 2010, depleted further to US$ 39.10 billion in 2011, marginally recovered in 2012, 2013 and 2014 with respective external reserves value of US$ 45.71 billion, US$ 54.73 billion and US$ 44.66 billion as a result of the hike in crude oil price. Conversely, in the build-up to the 2016 economic recession, external reserves were traded off for exchange rate stability through the foreign exchange market. Thus, in 2015, 2016 and 2017, its values contracted tremendously to ₦35.77 billion, ₦ 31.24 billion and ₦ 38.67 respectively (CBN, 2018). In the face of the depletion to stabilize the exchange rate, how did the exchange rate respond?

Though the guided floating exchange rate system introduced by the CBN due to exchange market liberalization yielded stability in the exchange rate, however, the slump in international crude oil prices that culminated in dwindling foreign exchange earnings led to the widening of the margin between the interbank market and the rDAS windows. This created sharp practices amongst economic agents with rising pressure and grave consequences on the real sector of the economy.

Ironically, the exchange rate became more volatile, depreciating unpredictably and lost stability. For instance, considering the exchange rate market dynamics using the bureau de change (BDC)

rates, the average exchange rate in 2014 was ₦171.44: $1, but depreciated to ₦258.3 by December, 2015, worsen further to ₦320, ₦364, ₦431, ₦455 in April, June, September, and December in 2016 and by February, 2017 exchange rate boomeranged to ₦494 (CBN, 2018). The situation depicted a dilemma yearning for the empirical searchlight.

Thus, this study extends previous studies (Ajibola, et al., 2015; Nwachukwu et al., 2016) on a threshold cointegration analysis of exchange rate and external reserves, but departs significantly in the following four ways; one; the scope of this article covers the most recent volatility era –the post 2016 recession, two; monthly time series data against daily series with high frequency and volatility properties, three; this study used the changes/variations in exchange rate as against the exchange rate, this helps to capture the true dynamics in the foreign exchange market, four; standard VAR causality rather than threshold analysis. These points of depart from existing studies create a niche for this study in the economics literature.

The remaining paper is organized as follows. Part two details our stylized facts on external reserve, exchange rate variation and all shares index in Nigeria. Empirical reviews are carried out in Part three, while Part four describes the methodology and data employed in the study. Part 5 contains the analysis of data and discussion of results. Part six summarizes the paper with conclusion and policy implications.

2. Stylized Facts

In this section, the study presents the trends in Nigeria's foreign reserves, exchange rate fluctuations and provides a basic analysis of facts on the responses of exchange rates to interventions through external reserve depletion from January 2010 to December 2018.

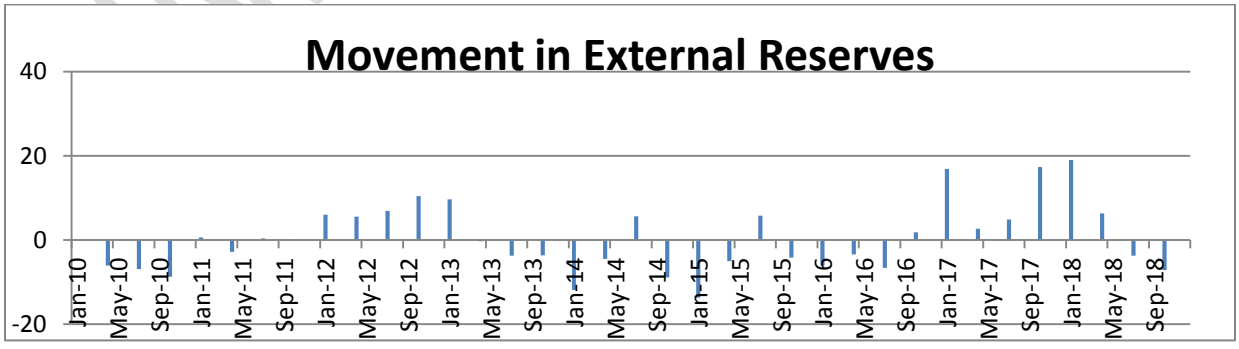


Figure 1. External Reserve Depletion and Accumulation Rates between 2010 and 2018.

In an attempt to salvage the value of Naira against other international currencies, the CBN depleted Nigeria's external reserves by 6.08 per cent between Q1 and Q2; 2010, that is, down from $12.41 billion to $11.66billion between January and June 2010. Further depletions were not uncommon, thus, from Figure 1 above, external reserve declined by 8.77 per cent between the third and fourth quarters of 2010. In 2013, the marginal depletion was recorded in similar periods as 2010 with 0.31 per cent and 3.66 per cent respectively in 2013. A thorough look at the chart reveals external reserves accumulation and recovery due to favourable crude oil price and relative peace that enhanced domestic output in oil exploration. However, as oil price sneezes, the shrinking in external reserves worsened as shown by an 11.83 per cent, 6.64 per cent, 3.70 per cent and 7.10 per cent between Q4-Q1, 2013, Q1-Q2, 2016, Q2-Q3, 2016, Q2-Q2, 2018 and Q3-Q4, 2018 respectively (CBN, 2018).

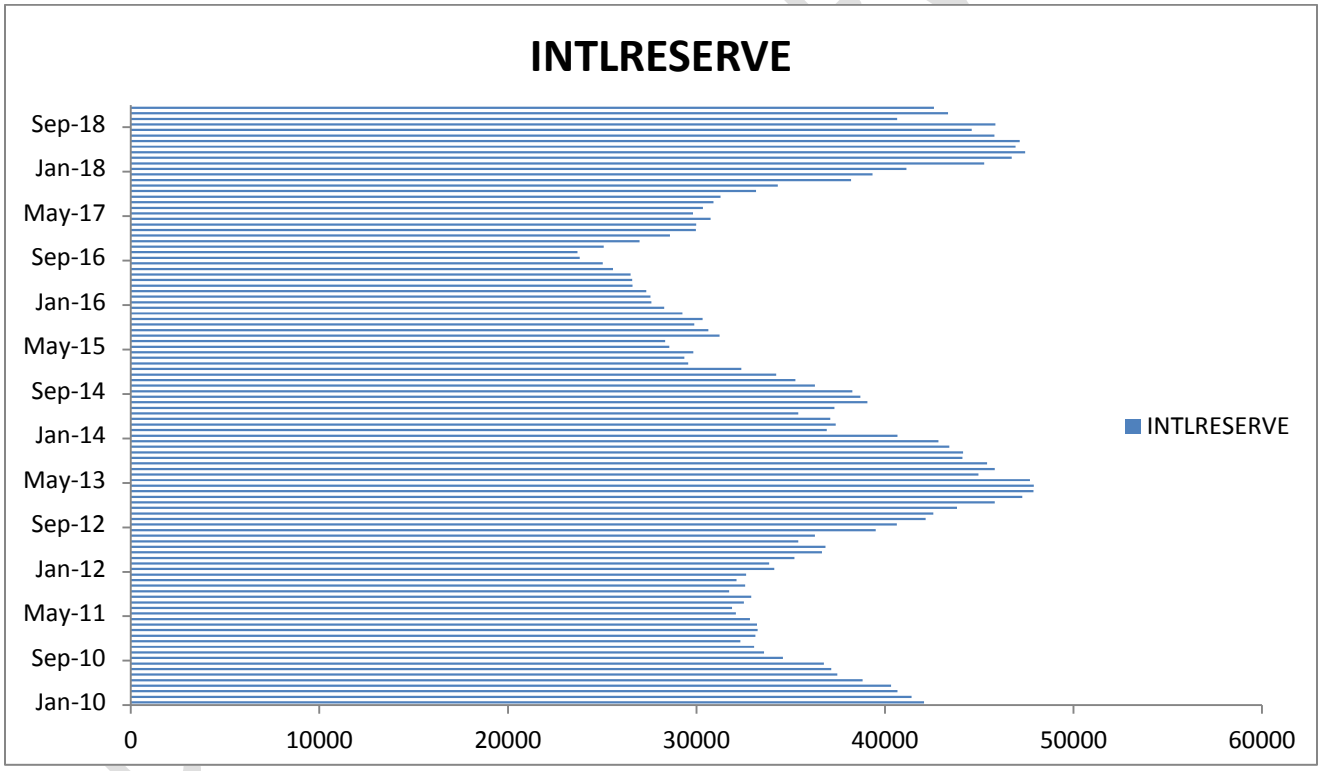


Figure 2: Nigeria's International Reserves (Jan. 2010 to Dec. 2018)

The CBN Act of 1958, an amendment in 1999 and 2007 CBN empowers CBN to safeguard the value of the national currency through the management of external reserves. In a bid to carry out these responsibilities saddled on the CBN by law, various exchange rate management policies have been adopted with mixed results in the past.

In this vein, the Inter-bank Foreign Exchange Market (IFEM) was introduced in January 1989 in an attempt to cushion the excess demand pressure that greeted the introduction of an Autonomous Foreign Exchange Market (AFEM) in 1988. Under IFEM, authorized dealers were saddled with funding responsibility under the watch and intervention of the CBN when the need arises. This was aimed at developing the depth of the Nigerian Foreign Exchange Market (FEM) through augmentation of the market supply base. However, the objective was largely unrealised to the extent of CBN non-active participation as the major supplier of foreign exchange as cited in (Ajibola, et al., 2015). The IFEM period was characterised by market pressure due to excessive demand, bubbling parallel market resulting from the widening of the arbitrage premium between the official and parallel rates.

To develop a functional foreign exchange market that will establish a realistic and stable value for the Naira, the Dutch Auction System and a fully deregulated system were emerged in 1990 and 1992, respectively. The inability of these policies to resolve the crises in the FEM necessitated a drastic policy reversal. The policy shift was undertaken in 1994 when the naira exchange rate was pegged to about N21.9/US$. The key target was the exchange rate stability. In sum, during the interbank foreign exchange market (IFEM) introduced in January 1989, exchange rate stood at ₦12.9377/US$, in 1994 the fixed exchange rate system pegged it at ₦21.8861/US$, the Autonomous Foreign Exchange Market (AFEM) in 1995 retained the rate at 1994, the reintroduction of IFEM in October 1999 saw exchange rate devalued to ₦108.0000/ US$.

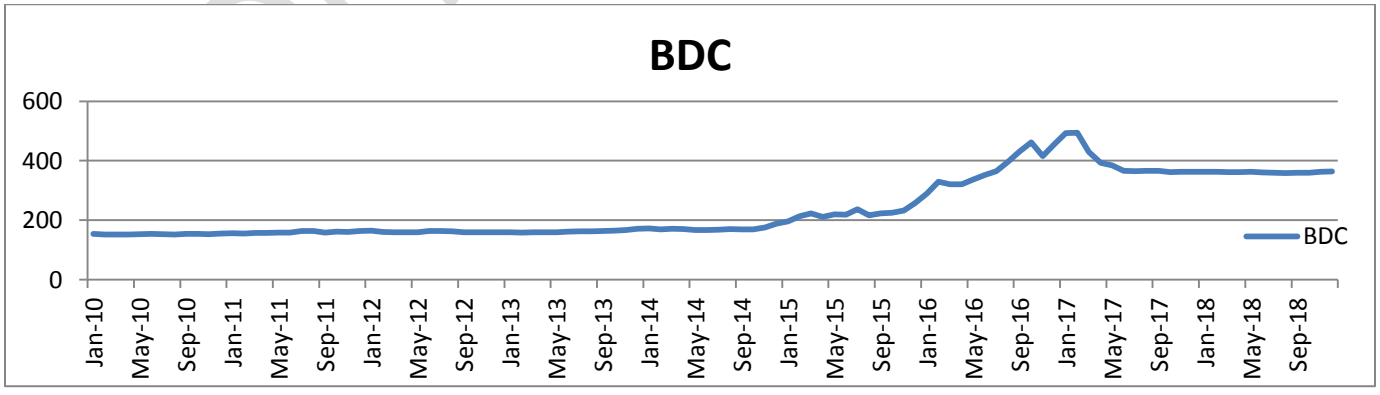


Figure 3: Trends in BDC Exchange Rate of the Naira from January 2010 to December 2018

However, in 2002, the Retail Dutch Auction System (rDAS) of foreign exchange management was introduced with exchange rate deteriorating to ₦130.8500/US$. Four years later, the Wholesale Dutch Auction System (wDAS) was introduced and exchange rate stood at ₦141.7600US$, and the Retail Dutch Auction System (rDAS) of foreign exchange management resurfaces on October 2, 2013, at the exchange rate of ₦157.4166 US$. The persistent decline in the external reserves, as well as increased foreign exchange demand, can be largely attributed to uncertainty over the impact of the falling crude oil prices on Nigeria's external reserves and the exchange rate of the naira.

3. Literature Review

The collapse of the Bretton Wood Agreement in the 1970s which emphasized on a fixed exchange rate system and the subsequent global financial crises arouse awareness on the need to manage and stabilize the value of national currencies discretionarily. One of the known ways is the use of external reserve management policies. Thus, the International Monetary Fund-IMF (1993) conceptualized international reserves as "official public sector foreign assets that are readily available to 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 and/or for other purposes".

A further perusal of international finance and economics literature shows that external reserves and exchange rate could be related in either of four distinct ways (Tiwari & Kyophilavong, 2017).

The first argument is that exchange rate volatility causes reserve, occasioned by the adopting of flexible exchange rate system which does not need high international reserve accumulation and economic crisis which causes perpetual domestic currency depreciation. Thus, exchange rate volatility underscores exchange rate management policies, and in turn affects external reserve accumulation (See Prabheesh, Malathy & Madhumathi, 2009; Ramachandran & Srinivasan, 2007; Srinivasan et al., 2009). This position is corroborated by the work of Choi & Baek (2004) that report smaller reserve holdings for economies with hard pegs than those under a flexible exchange rate system. In an earlier study by Romero (2005) for China and India, the ordinary least squares (OLS) regression results revealed that the exchange rate significantly determines external reserves in India but does not in China. In Nigeria studies by (Ahmad & Pentecost,

2009; Olayungba & Akinbobola; 2011) validated the argument that exchange rate causes external reserves. The study employed the structural break modelling technique and found that Nigeria's international reserves adjust faster to variations in the nominal exchange rate. Also, the study by Tariq et al. (2014) for Pakistan which employed the mercantilist methods to ascertain the relationship between the real exchange rate and foreign exchange reserves between 1973 and 2008, document that the reserves holdings in Pakistan are as a result of the export-led growth strategies through real exchange rate depreciation supports this position. Furthermore, Tiwari & Kyophilavong (2017) examine the relationship between real effective exchange rate (REER) and international reserve in India using bivariate and conditional bivariate Granger causality test in frequency domain framework. The study found that the International Reserves in India are significantly influenced by the exchange rate and as such Indian Reserve Bank should reckon with the exchange rate as an appropriate tool in managing the external reserve.

The second argument subsists on the position that reserve accumulation causes exchange rate. Tiwari & Kyophilavong (2017) document that the Asian crisis between 1997 and 1998, the Russian and Brazilian disaster of 1999 pointed to the fact that inadequate external reserves stimulate financial crisis. Since creating an effective intervention is a function of external reserve accumulation, international reserves, therefore, causes the exchange rate. In Nigeria, Abdullateef & Waheed (2010) employed dual techniques of OLS and Vector Error Correction (VEC) methods to examine the impact of change in external reserve positions of Nigeria on major macroeconomic variables including the exchange rate. The result of the study indicated that changes in external reserves in Nigeria have a significant effect on exchange rates. This gets credence from Chinaemerem (2012) that utilized Vector Autoregression (VAR) approach that reported a significant relationship between external reserves and exchange rates in Nigeria. Also, Ajibola et al., (2015) investigate the long-run relationship between exchange rate and external reserves in Nigeria using quarterly time-series data spanning the first quarter of 1990 to the fourth quarter of 2012. Model results revealed that cointegration between the variables occurs only when the equilibrium error exceeds an estimated threshold parameter of 0.52. Having partitioned the TVECM into two regimes based on the obtained threshold, the study found that the error correction coefficients of the exchange rate in the two regimes are not significant, implying that exchange rates do not respond to equilibrium error during the estimation period. On the other hand, external reserves adjust to correct past divergence, albeit only when the

equilibrium error exceeds the threshold parameter. Overall, external reserves adjust to maintain long-run equilibrium while exchange rates do not, which seems to align with the monetary authority's action of deploying external reserves to maintain exchange rate stability in the country. In line with this assertion, another study by Nwachukwu et al. (2016) for Nigeria on the long-run relationship between the Bureau De Change exchange rate and external reserves using the Threshold Vector Error Correction Model (TVECM) framework on high frequency daily data from Jan 1, 2014 to Jul 31, 2015, found that the adjustment mechanism flows from external reserves to BDC exchange rate.

From the third perspective, the argument is that neither external reserves nor exchange rate causes each other. This implies the absence of any meaningful cause-effect nexus between the two variables, this position is found in the works of (Gokhale & Raju, 2013; Nwude, 2012). Gokhale & Raju (2013) investigate the existence of a forward-backwards and the long-run cointegrating relationship between exchange rate and external reserves for India using annualized time-series data that cover the period between 1980 and 2010. The study the results of their analysis led to the conclusion that there is neither short nor long-run relationship between the exchange rate and reserves. However, their position invalidates earlier study by Romero (2005) for the same economy but lends credence to the empirical report by Nwude (2012) for Nigeria.

The fourth perspective is the existence of a bi-directional causal relationship between exchange rate and external reserves. This possibility has not been established in economic literature to the best of our knowledge. Thus, the quest for further empirical inquiry into the relationship between both variables remains an issue in the front burner amongst policymakers and researchers. This study hopes to contribute to the on-going exercise by considering the volatility in both variables, which again lacks empirical consideration amongst previous studies as deduced from the reviewed literature.

4. Methodology

Estimation Technique

This study distinguishes itself from previous empirical analyses on external reserve and exchange rate in Nigeria by adopting a dynamic methodology of the standard vector

autoregression (VAR) technique. Though previous studies (Abdullateef & Waheed, 2010; Nwachukwu et al., 2016; Ajibola et al., 2015) used ordinary least square (OLS), threshold vector error correction model (TVECM), threshold cointegration technique respectively, in analyzing the relationship between exchange rate and external reserve, this paper departs considerably by adopting similar approach as Chinaemerem (2012) that employed the standard vector autoregressive causality test.

Data

The paper employed monthly time series data on the variations exchange rate, that is, depreciation/appreciation and external reserve volatility sourced from the Central Bank of Nigeria statistical bulletin spanning 108 months from January 2010 to December 2018 for the empirical analyses.

Model Specification

The general VAR model is expressed as follows:

$$z_{1t} = \alpha_1 + \alpha_{11} z_{1t-1} + \alpha_{12} z_{2t-1} + \beta_{11} z_{1t-2} + \beta_{12} z_{2t-2} + \epsilon_{1t} \quad \text{(a)}$$

$$z_{2t} = \alpha_1 + \alpha_{21} z_{1t-1} + \alpha_{22} z_{2t-1} + \beta_{21} z_{1t-2} + \beta_{12} z_{2t-2} + \epsilon_{2t} \quad \text{(b)}$$

The compact form of the above VAR equations is expressed in the equation below.

$$z_t = \Omega + \alpha_1 z_{t-1} + \beta_2 z_{t-2} + \mu_t \quad \text{(c)}$$

Where

Ω *depicts an* n x 1 Column vector

$\alpha_{j's}$ are the n x n square metrics

μ_t is an n x 1 column vector of serially uncorrelated vector of innovations variable which is independently, identically and normally distributed with zero mean and constant variance $\{\mu_t \sim iidn(0, \sigma^2)\}$.

If z_t is a column vector (n x 1) matrix which encompasses all the logged variables in the model, the VAR model establishes a link between the current z_t, its lags (z_{t-i}) and the white noise variable (μ_t).

Furthermore, the Granger causality test is employed to estimate equations 4 and 5 to establish the empirical linkages between $\Delta EXRT$ and $\Delta INTRZ$.

$$log\Delta EXRT_t = \alpha_0 + \sum_{t-1}^{n} \alpha_1 \, log\Delta EXRT_{t-1} + \sum_{t-1}^{n} \beta_2 \, log\Delta INTRZ_{t-1} + \mu_t \quad \text{(d)}$$

$$log\Delta INTRZ_t = \alpha_0 + \sum_{t-1}^{n} \alpha_1 \, log\Delta INTRZ_{t-1} + \sum_{t-1}^{n} \alpha_2 \, log\Delta EXRT_{t-1} + \varepsilon_t \quad \text{(e)}$$

Equations (d) and (e) produce the following hypotheses:

$$H_0 = \sum_{t-1}^{n} \beta_i = 0, \text{ and } \sum_{t-1}^{n} \alpha_i = 0 \quad \text{(f)}$$

The H_0 states that there is no causality between ΔEXRT and ΔINTRZ

$$H_1 = \sum_{t-1}^{n} \beta_i \neq 0, \text{ and } \sum_{t-1}^{n} \alpha_i \neq 0 \quad \text{(g)}$$

While H_1 states otherwise, that is, causality exists between ΔEXRT and ΔINTRZ. From equations (d) to (e), if the estimates β_2 and α_2 are statistically significant, it indicates the existence of a bi-directional relationship between ΔEXRT and ΔINTRZ. But if β_2 is statistically significant and α_2 is not, a unidirectional causal relationship exists running from ΔEXRT to ΔINTRZ, and if α_2 is statistically significant and β_2 is not, a unidirectional relationship exists that runs from ΔINTRZ to ΔEXRT.

5. Empirical Analyses and Discussion of Results

Descriptive and Summary Statistics

Table 1

Summary Statistics

	ΔEXRT	ΔINTRZ
Mean	1.961776	4.852056
Median	0.300000	-200.2100
Maximum	40.05000	4123.720
Minimum	-65.22000	-5208.400
Std. Dev.	13.71028	1438.063
Skewness	-0.746362	-0.081225
Kurtosis	10.38063	4.563940

Jarque-Bera	252.7961	11.02234
Probability	0.000000	0.004041
Sum	209.9100	519.1700
Sum Sq. Dev.	19925.00	2.19E+08
Observations	107	107

Source: Computed by Author using eviews 10

In Table 1 above, the summary and descriptive statistics reveal interesting results. First, the standard deviation of both series lies above their average values; this implies that the exchange rate and international reserves fluctuate considerably within the period under observation. The skewness test indicates that both variables are negatively skewed. This shows that the observations are tilted to the left or fatter to the left than the right. Kurtosis test reveals whether the series are flat or peak. The values of kurtosis of 10.38 and 4.56 for the exchange rate and international reserves respectively show that the series is normally distributed because they are greater than 3. This Jarque-Bera statistics further affirms the normality of the series with a statistical value of 252.79 and 11.02 and corresponding p-values of 0.0000 and 0.0040. Thus, the overall preliminary statistics implies that the data employed for analyses are in good nature, as such, the author proceeded to the unit root test.

Test for Stationarity (Unit Root Test)

In Table 2 the results unit root tests from the Dickey Fuller (DF), Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) techniques are presented. The null hypothesis states the absence of unit root in data series at 1%, 5% and 10% significance levels, while the alternative hypothesis states otherwise. To validate either of the hypotheses, the study utilized the Mackinnon critical values as summarized in Table 3.

The DF result is inconclusive as the series are stationary at without trends but fails the stationarity test with the trend; thus, the null hypothesis is accepted at 5% significance level. However, the ADF results in the first-difference series confirm that the series is stationary at 1%

significant level. The Phillips-Perron stationarity results validate the ADF test results at 1% level of significance. Therefore, the pre-test estimation reveals that the series would produce reliable results at the first difference.

Table 2

Unit root tests: Exchange rate dep/app (Δexrt) and change in external reserve (Δintrz) from Jan. 2010 to Dec. 2018

	DF test at levels		ADF test in first difference				PP test in first difference			
Series	**No trend**	**With trend**	**No trend**	**Lag**	**With trend**	**Lag**	**No trend**	**Lag**	**With trend**	**Lag**
ΔEXRT	-2.49**	-2.69	-5.13***	12	-5.10***	12	-18.2***	12	-18.10***	12
ΔINTRZ	-3.03***	-3.38**	-5.97***	12	-6.01***	12	-27.6***	12	-27.5***	12

Source: Author's computation using eviews 10. Note: *, **, *** respectively indicates the rejection of the null hypothesis of unit root at 10%, 5% and 1%.

Table 3

Mackinnon critical values for rejection of the hypothesis of unit root

	DF test at levels		ADF test in first difference		PP test in first difference	
Critical Value	No trend	With trend	No trend	With trend	No trend	With trend
1% level	-2.58	-3.59	-3.50	-4.05	-3.49	-4.05
5% level	-1.94	-3.04	-2.89	-3.46	-2.99	-3.45
10% level	-1.61	-2.75	-2.58	-3.15	-2.58	-3.15

Source: Mackinnon (1996).

Cointegration Test

The co-integration test is used to examine the existence of a long-run association between volatility in the exchange rate and changes in international reserves. The concept of cointegration introduced by Engle and Granger (1991) is as follows. The variables ΔEXRT and ΔINTRZ are said to be cointegrated if there is a long-run association or co-movement between these variables.

"More generally a vector of I(1) random variables is said to be cointegrated if there exists a vector if- such that βi-Yt is trend stationery" (Gokhale & Raju, 2013). Hence, the study considers a linear combination of vectors which exhibit long-run co-movement. The Trace and Maximum Eigen Value tests indicate that ΔEXRT and ΔINTRZ are co-integrated. The affirmation of co-integrating relationship at 0.05 significant levels, suggests the presence of long-run equilibrium between ΔEXRT, and ΔINTRZ variables in this study.

Table 4

Co-integration Results

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.155280	27.12273	15.49471	0.0006
At most 1 *	0.092589	9.910272	3.841466	0.0016

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.155280	17.21246	14.26460	0.0166
At most 1 *	0.092589	9.910272	3.841466	0.0016

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's computation using eviews 10

Hence, the paper proceeds to the estimation of the adjustment parameters using the VECM method since co-integrated trends are observed as shown in Table 4 above.

Optimal lag selection criteria

In Table 5, the optimal lag selection criteria employed in the estimation of the adjustment estimates of the VECM are presented. The criteria include the sequential modified LR test, final prediction error test, Akaike information criterion, Schwarz information criterion and the Hann-Quinn information criterion. Interestingly, the results from the FPE, AIC, and HQ criteria affirmed a one-period lag as optimal lag for the VECM model estimation.

Table 5

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1216.108	NA	4.70e+08	25.64438	25.69815*	25.66610
1	-1209.119	13.53738	4.42e+08*	25.58144*	25.74274	25.64662*
2	-1206.313	5.315290	4.53e+08	25.60660	25.87543	25.71522
3	-1202.567	6.941286	4.55e+08	25.61193	25.98829	25.76401
4	-1198.008	8.253101	4.50e+08	25.60017	26.08407	25.79570
5	-1197.043	1.707054	4.81e+08	25.66406	26.25549	25.90304
6	-1194.441	4.491832	4.96e+08	25.69349	26.39245	25.97592
7	-1189.518	8.291093	4.87e+08	25.67407	26.48055	25.99995
8	-1187.010	4.118695	5.04e+08	25.70547	26.61949	26.07480
9	-1180.954	9.68883*	4.84e+08	25.66220	26.68375	26.07498
10	-1178.956	3.113292	5.07e+08	25.70434	26.83342	26.16057
11	-1178.738	0.330220	5.51e+08	25.78396	27.02058	26.28365
12	-1176.760	2.914438	5.79e+08	25.82654	27.17068	26.36967

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: Author's computation using eviews 10

Causality Test

Table 6

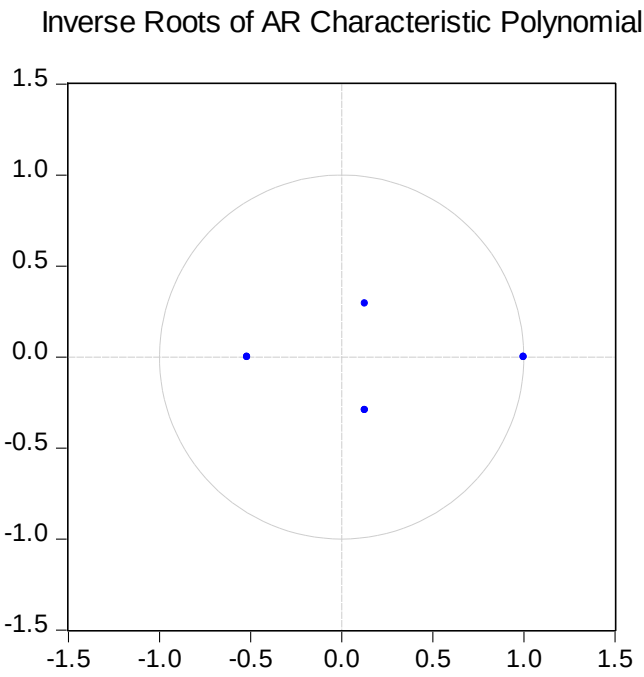
VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(ΔEXRT)			
Excluded	Chi-sq	df	Prob.
D(ΔINTRZ)	3.122104	2	0.2099
All	3.122104	2	0.2099
Dependent variable: D(ΔINTRZ)			
Excluded	Chi-sq	df	Prob.
D(ΔEXRT)	0.473874	2	0.7890
All	0.473874	2	0.7890

Source: Author's computation using eviews 10

The causality test is employed to further test if the observed long-run association from the trace test and maximum eigenvalue co-integration test between exchange rate changes and international reserves volatility have elements of causality. Surprisingly, the VEC granger causality results presented in Table 6 indicate that despite the long-run association between exchange rate volatility and fluctuations in international reserve, neither exchange rate nor external reserves cause each order. This is revealed by the chi-square value of (3.12) with p-value (0.2099) and (0.47) with p-value (0.7890) respectively. This implies that exchange volatility does not translate to external reserve volatility and vice versa.

The findings of this study lend credence to previous and disagree with some others. For instance, for Nigeria, Nwude (2012) reported an absence of causality between exchange rate and external reserves and Gokhlae & Raju (2013) found a similar result for the Indian economy. Thus, the result of this paper buttresses the positions of Nwude (2012) and Gokhale & Raju (2013) that the exchange rate does not lead international reserves and international reserves do not lead exchange rate. However, the study's empirical result departs from earlier empirical findings that external reserves causes exchange rate (Nwachukwu, Ngozi et al., 2016; Tiwari & Kyophilavong, 2017) and (Ahmad & Pentecost, 2009; Olayunga & Akinbobola, 2011) that reported the existence of a uni-directional causality flow from exchange rate to external reserves.



Source: Author's computation using eviews 10

Figure 4: Inverse Root Test

The inverse AR root characteristic test for the VEC granger causality result reveals that the empirical results are reliable and stable as the roots of the polynomial fall within the unit circle. Thus, indicating reliable and stable policy outcome on the based on recommendations drawn from the findings.

6. Conclusion

Essentially, international reserves accumulation and its fluctuation do not necessarily have a lead-lag relationship with exchange rate volatility in the case of the Nigerian economy. Although the accumulation of external reserves are high in recent times due to rising crude oil price in the face of worsening exchange rate which is a deviation from the reports of previous researchers, it does not have a direct bearing on the exchange rate as suggested by some authors and there could be many other parameters that propel the excessive volatility in the exchange rate between the dollar and Nigerian Naira. The international reserve accumulation in the Nigerian context could have been largely in anticipation of overcoming financial crisis than a tool for regulating the exchange rate. It could also be looked upon as a facelift to the Nigerian economy through enhanced credit ratings which in turn would attract foreign direct investment and portfolio investments to Nigeria thereby supplying the capital to stimulate economic growth.

Based on our empirical findings, the study strongly concludes that monetary authorities should not rely on the management of the Nigerian exchange rate through intervention using external reserves. This is because external reserves management does not lead or follow fluctuations in the exchange rate.

It will be interesting for future studies to investigate other interventional policies that could be appropriate for the management of the exchange rate of the Nigerian Naira aside external reserve management.

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