

Bassey, Kufre J.; Mba, Michael K.; Abraham, Ochoche

Article

On economic growth-reserve accumulation nexus in Nigeria: A nonlinear asymmetric cointegration estimation

West African Journal of Monetary and Economic Integration

Provided in Cooperation with:

West African Monetary Institute (WAMI), Accra

Suggested Citation: Bassey, Kufre J.; Mba, Michael K.; Abraham, Ochoche (2019) : On economic growth-reserve accumulation nexus in Nigeria: A nonlinear asymmetric cointegration estimation, West African Journal of Monetary and Economic Integration, ISSN 0855-594X, West African Monetary Institute (WAMI), Accra, Vol. 19, Iss. 1, pp. 35-51

This Version is available at:

<https://hdl.handle.net/10419/264257>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

ON ECONOMIC GROWTH - RESERVE ACCUMULATION NEXUS IN NIGERIA: A NONLINEAR ASYMMETRIC COINTEGRATION ESTIMATION

Kufre J. Bassey¹, Michael K. Mba² and Ochoche Abraham^{3,4}

Abstract

This paper examines the relationship between economic growth and reserve accumulation in Nigeria using quarterly data from 2011:Q3 to 2019:Q1 in a nonlinear autoregressive distributed lag (NARDL) framework which allows for the short- and long-run nonlinearities to be investigated through positive and negative partial sum decompositions of the explanatory variable. The bounds-testing analysis confirms the existence of an asymmetric (cointegrating) long-run relationship based on the NARDL error correction model (ECM). The OLS estimation provides a reliable inference notwithstanding the variables' orders of integration. The estimated long-run coefficient of a negative change in reserve accumulation was statistically significant at 1%. The asymmetric cointegration relationship shows that 1% negative shock to the reserve results in about 0.2% increase in economic growth in Nigeria. The asymmetric dynamic multiplier captures the patterns of adjustment from the initial equilibrium to a new equilibrium following economic trepidation. This suggests that the imposition of long-run symmetry where the underlying relationship is nonlinear will muddle efforts to test for the existence of a stable long-run relationship between the two variables. In all, the nonlinear analysis provides more reliable parameter estimates that suggests that the relationship anchored on the interaction between positive productivity shocks and attrition in reserve accumulation.

Keyword: Asymmetry, Cointegration, Economic Growth, External Reserve Accumulation

JEL classification: C32, C51

¹ Corresponding Author: kjbassey@gmail.com

² mikemba2203@gmail.com

³ abochoche@gmail.com

⁴ Authors are staff of Statistics Department, Central Bank of Nigeria, Abuja. The views expressed in this paper are purely those of the authors and do not represent the views of the Central Bank of Nigeria.

1.0 INTRODUCTION

In recent times, different countries attach enormous importance to holding an adequate reserve variously referred to as international reserves, external reserves, foreign reserves or foreign exchange reserve. According to IMF (2008), reserve consists of “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”.

Generally, countries hold foreign reserves as formal backing to safeguard the value of their domestic currencies. After its use under the gold standard was at its height until after the Second World War under the Breton Woods system, reserve became a backing to provide confidence in domestic currency. Nonetheless, for most developed countries, its prime use extends beyond domestic currency backing to include timely meeting of international payment obligations, wealth accumulation, monetary authority intervention tool (to manage the domestic foreign exchange market, in addition to enabling an orderly absorption of international money and capital flows), boosting of a country’s credit worthiness as a fall back for the “rainy day”, and to provide a buffer against external shocks.

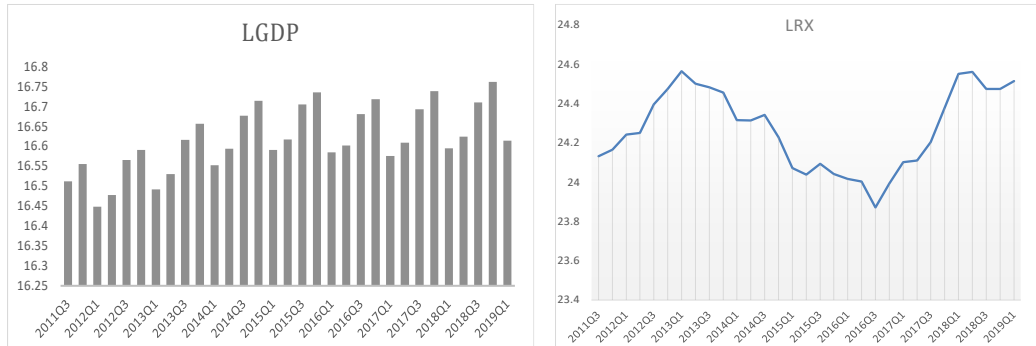
In Nigeria, reserve is known to be driven mainly by the proceeds from crude oil sales, which the country’s economy has persistently depended on for foreign exchange earnings since 1970s, with the attendant cycles of economic booms and bursts. More so, the country’s high import bills have exacerbated the fluctuations in the level of its foreign reserve and consequently the way it is managed. The 2014 to 2016 economic downturn in the country was also attributed to a drop in the foreign reserves following the fall in oil prices. According to a report by the National Bureau of Statistics (NBS, 2016), the eventual collapse in the crude oil prices during the glut in the global oil market in 2014 was responsible for a drawdown on Nigeria’s external reserves.

When the economic growth in 2015 was well below the average growth rate achieved between 2011 and 2014, with its associated effect on the non-oil sectors (which also suffered setbacks during the year⁵), the fiscal and monetary authorities intensified efforts towards developing the non-oil sector to diversify the economy away from total dependent on oil. Specifically, the monetary authority came up with a policy that restricted the importation of some items to boost their domestic production, enhance exports and deter the depletion of the country’s external reserve. The accumulation of external reserve seen as a fiscal expenditure stabilizer⁶ is in this case expected to induce capital investment in the productive non-oil sector, given that growth in most developed countries is largely driven by positive technology shocks and resultant capital accumulation (see Nelson and Pack, 1999; Bond *et al.*, 2010; Ahuja and Nabar, 2012). The trends in the economy and reserve from 2011: Q3 to 2019:Q1 are as shown in Figure 1.

⁵ The National Bureau of Statistics (NBS) however argued that crude oil production and oil refinery were not the only sectors to have recorded a decrease in the growth rates.

⁶ Cheng G. (2015) viewed the demand for foreign reserves from the perspective of interaction between positive productivity shocks, borrowing constraints and the lack of domestic financial assets and posited that it is part of a catching-up strategy in an economy with underdeveloped financial market.

Figure 1: Nigerian Quarterly GDP (N' million) and External Reserve (N' billion) from 2011Q3 – 2019Q1



According to Irefin and Yaaba (2012), the pace of reserves accumulation is without regard to its diminishing marginal benefits and rising marginal costs. The spectacular demand for foreign reserve accumulation driven by the fiscal and monetary policies toward economic diversification, which include prohibition on importation of some items, therefore generated growing public and research interest, specifically on the underlying relationship between external reserve and economic growth. Of interest are some reports available in most of the peer-reviewed literature. Most recent are the findings by Johnny and Johnnywalker (2018) and Nwosa (2017) that show that there exist a long-run cointegration and statistically significant positive linear relationship between the two macroeconomic variables. On the other hand, Nwafor (2017) and Udo and Antai (2014) reported otherwise, among others. It was observed that in both findings in favour and against the existent of a linear relationship between the two variables, all estimates were products of linear model framework used in modelling the relationship, thereby creating inferential discrepancy that can impact negatively on policy formulation and implementation.

In consideration of this inferential impasse, this paper attempts to re-model the relationship between reserves accumulation and economic growth in Nigeria in a nonlinear framework using nonlinear autoregressive distributed lags (NARDL) model which allows for simultaneous evaluation of both the short and long-run asymmetry in the relationship.

The remaining sections of the paper include section two that presents some stylized facts on Nigerian economic history in relation to oil prices and foreign reserve. Section three discusses the related theoretical and empirical literature, while section four presents statistical model and estimation procedure. The results of the estimation and concluding remarks are presented in sections five and six, respectively.

2.0 SOME STYLIZED FACTS

There are several episodes in economic history that have caused global shocks that have had spillover effects on monetary policy in Nigeria. These shocks mainly originated from financial and commodity markets. Because Nigeria is an oil exporting country that depends almost entirely on proceeds from oil to fund its annual budget, oil price has been identified as the global variables whose shock impacts on external reserve and real GDP the most. The growth rates of the variables used in the analysis that follows were first computed and average values derived according to each identified episode for point analysis.

The global oil and gas market experienced a supply glut which created a shock in 2014. The glut was caused by the shale oil and gas revolution in the United States of America, which resulted in a massive crash in prices of oil and gas across the globe. Suddenly, the US that was typically a major buyer of oil and gas became one of the top producers. The outcome was a global crisis that propelled Nigeria into a recession in 2016: Q1.

To validate this argument, the periods 2012:Q3 – 2013:Q4 and 2014:Q1 – 2019:Q1 were selected to represent before and during the shale oil revolution. Figure 2 shows the existence of a positive relationship between real GDP growth and rate of accretion to the external reserves. From figures 3 and 4, it can be seen, that the crash in global oil prices as a result of the shale oil crisis had resulted in a significant drop in accretion to Nigeria's foreign exchange reserves and real GDP growth. The decline in the growth rate of real GDP is surprising because a drop in international crude oil prices usually results in a drop in the pump price of fuel, which would then translate to drop in cost of production and hence higher real GDP. However, as a major oil exporting country, a drop in international price of Bonny light meant a serious loss of revenue to the Federal Government of Nigeria and so in order to augment this revenue shortfall, the pump prices of fuel were reviewed upward which must have increased production cost. For example, premium motor spirit (PMS) was increased from ₦86.50 to ₦145.00 in May 2016.

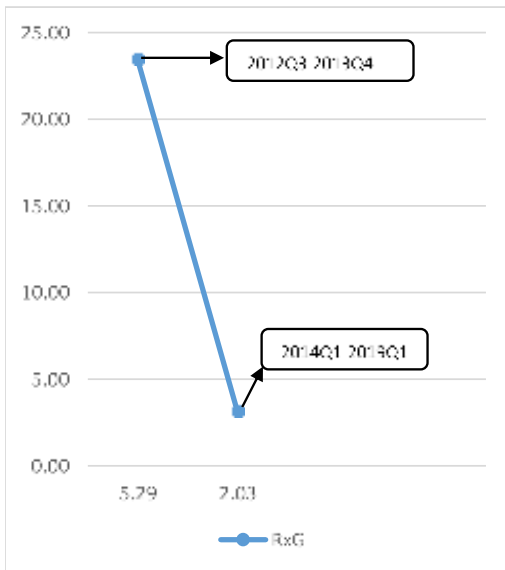


Figure 2: Foreign Reserve and GDP

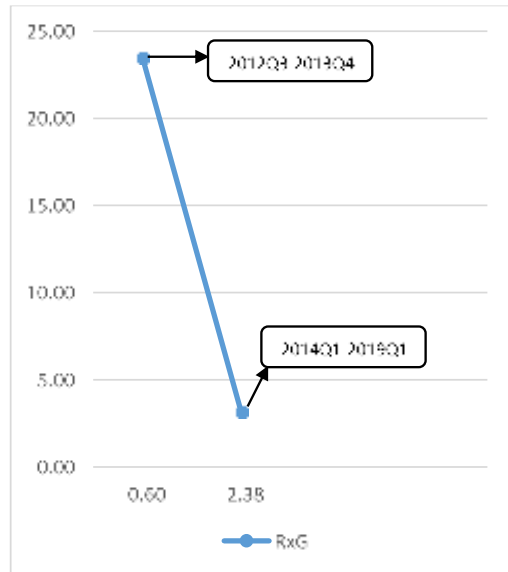


Figure 3: Foreign Reserve and Oil Price

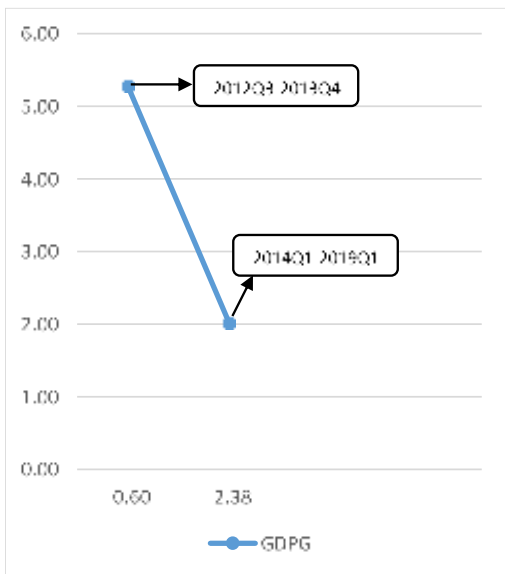


Figure 4: GDP and Oil Price

3.0 LITERATURE REVIEW

The theoretical underpinnings of reserve accumulation could be linked to the perceptions of foreign reserve holding from two perspectives: the precautionary and the mercantilist. From the precautionary perspective, foreign reserves accumulation is directly linked to exposures to sudden stops, capital flight and volatility (Nwosa, 2017). The precautionary theory hinges on the traditional use of reserves as savings for potential times of crises, especially balance of payments crises. According to Johnny and Johnnywalks (2018), increase in savings leads to investment and that leads to greater output which in turn supports higher external reserves. This sees most African countries including Nigeria leveraging on adequate foreign reserves as a prerequisite for foreign capital attraction to promote domestic private investment and reduction of vulnerability to external shocks. It is therefore believed that maintaining adequate reserves can boost investors' confidence and enhance investment and growth (see also Awoderu *et al.* (2017), Elhiraika and Ndikumana, 2007). The mercantilists viewed foreign reserves accumulation as a by-product of an industrial policy that may impose negative externalities on other trading partners (Aizenman and Lee, 2007).

On the link between reserve accumulation and growth, there have been several but differing economic models of growth that have stressed alternative causes of economic growth in both developed and developing economy. This include the mercantilism, which emphasized that the wealth of a nation is determined by the accumulation of gold and running trade surplus; the classical theory, which placed emphasis on the economies of scale/specialisation; the neo-classical theory that based growth on supply-side factors like labour productivity and factor inputs; the endogenous growth theories of human capital and rate of technological innovation; the Keynesian demand-side theory and the Harrod-Domar theory which is considered to be the extension of Keynes' short-term analysis of full employment and income theory (Pettinger, 2017). Of all these theories, only mercantilism, which argued that a country could be made healthier by seeking to accumulate gold and increasing exports and Harrod Domar model that states that growth rate depends on a function of the savings rate seem to be directly linked to reserve accumulation.

The seminal paper by Balassa (1978) that supported the existence of such direct relationship based on exports and economic growth, gave emphasis on how external reserves accumulation could be used to keep a country's exports relatively cheaper in order to boost trade and economic growth. However, most commentators argued that the accumulation of foreign reserves can only contributes to economic growth through the increase of both the investment/GDP ratio and capital productivity (see, for example Polterovich and Popov, 2007; Cruz and Walters, 2008). But Fukuda and Kon (2010) opined that consumption and permanent income (which are growth indicators) decline when there is persistent and prevailing increase of foreign reserves, while Cheng (2013) argued in his theoretical framework on a growth perspective towards foreign reserve accumulation that a combined use of foreign reserves and capital controls could lead to a faster economic transition during economic transition with positive productivity shock.

Empirically, numerous literatures classify foreign reserve accumulation as a multi-faceted phenomenon with time-varying and country specific underlying motives (Heller, 1966; Landell-Mills, 1989; Cheng, 2013). Krušković and Maričić (2015) analysed the relationship between reserve accumulation and economic growth in emerging countries using panel data analysis technique and reported that

accumulation of foreign exchange reserves in emerging countries correlated with a higher rate of economic growth.

Krušković and Maričić (2015) investigated the impact of foreign exchange reserves accumulation on economic growth in emerging economies using annual data of real GDP per capita, share of investment in GDP and population and foreign exchange reserves in a panel data analysis for the period 1993 – 2012. The results indicated that there exists a positive relationship between foreign exchange reserves and GDP growth.

Available studies for Nigeria have evaluated the relationship between these macroeconomic variables mostly on a linear framework with mixed observations. Olokoyo *et al.* (2009) reported a long run relationship between reserve and GDP with a slow speed of adjustment using vector error correction model in an autoregressive distributed lag framework over the period 1970–2007.

Udo and Antai (2014) reported that external reserves negatively influence the level of domestic economic productivity and investment using Greenspan-Guidotti method and multiple regression techniques over an annual time series data from 1970 to 2011. This result agrees with Eniekezimene and Apere (2016) who also show that external reserve has a negative relationship with real GDP in the short run, and statistically significant in the long run using Ordinary Least Square method over the period 1981 – 2014.

On the other hand, Akinwunmi and Adekoya (2016) and Alabi *et al.* (2017) showed that accumulating external reserves affected growth positively. This position was also supported by Awoderu, *et al.* (2017) who posited that there is a long run relationship between external reserve and economic growth in Nigeria using time series data from 1980 to 2014, where a unit increase in external reserve was reported to have increased economic growth by US\$3.42billion. Nwosa (2017) also reported a positive and significant relationship between external reserves and economic growth in Nigeria using Ordinary Least Squares (OLS) regression technique over the period 1981 to 2014. Similarly, Johnnywalker (2018) reported that there is a positive and significant relationship between external reserve and real gross domestic product in Nigeria, using a linear framework with time series data from 1980 to 2016.

However, Nwafor (2017) opined that external reserve has no positive significant impact on economic growth in Nigeria using through an Ordinary Least Squares (OLS) regression technique over the period 2004 to 2015,

These mixed findings are found to be from estimations conducted under a linear model framework which imposed a linear relationship between the two variables. This inspired the inquisitive mind of the authors of this paper to assume that there may be a nonlinear effect in the data and therefore a nonlinear relationship should rather be investigated. Thus, the paper seeks to re-examine the relationship through a nonlinear framework in order to provide more reliable parameter estimates on the assumption that most economic theories do not support linear link between the two macroeconomic variables.

4.0 STATISTICAL MODEL AND ESTIMATION

4.1 Model and Estimation Procedure

Let the linear specification of the relationship between the two macroeconomic variables (economic growth and external reserves) be given as

$$GDP_t = \beta_0 + \beta_1 Rx_t + u_t \quad (1)$$

where economic growth is designated by real GDP (GDP in short), and external reserve is designated as Rx, while β_1 measures the direction and magnitude of impact exerted on output growth by external reserves, which typically is expected to take a positive sign (in the case of Nwosa, 2017 and others).

The asymmetric ARDL technique (also called NARDL) developed by Shin *et al.* (2013) allows for capturing both the short-run and the long-run asymmetries simultaneously. Following Shin *et al.* (2013) therefore, equation (1) can be expressed in following nonlinear ARDL (NARDL) form:

$$GDP_t = \beta^+ Rx_t^+ + \beta^- Rx_t^- + u_t; \Delta Rx_t = \varepsilon_t \quad (2)$$

where GDP_t is a $k \times 1$ vector of real output growth at time t ; Rx_t is a $k \times 1$ vector of regressors, where, $Rx_t = Rx_0 + Rx_t^+ + Rx_t^-$ are the decompositions of Rx_t , μt is the error term, while β^+ and β^- are the associated asymmetric long-run parameters, indicating that output growth responds asymmetrically during positive and negative shocks in external reserves. That is to say, the NARDL model introduces nonlinearity by means of partial sum decompositions into the conventional ARDL model by Pesaran *et al.* (2001) such that;

$$GDP_t = \beta_0 + \beta_1^+ Rx_t^+ + \beta_2^- Rx_t^- + u_t \quad (3)$$

where the partial sums of the positive (Rx_t^+) and negative (Rx_t^-) changes in reserves are given as:

$$Rx_t^+ = \sum_{i=1}^t \Delta Rx_i^+ = \sum_{i=1}^t \max(Rx_i, 0) \quad (4)$$

and

$$Rx_t^- = \sum_{i=1}^t \Delta Rx_i^- = \sum_{i=1}^t \min(Rx_i, 0) \quad (5)$$

Here, the first differenced series is assumed to be normally distributed with zero mean, and the asymmetric impact of reserves (Rx) on economic growth (GDP) is accounted for by the positive and negative changes in Rx_t . The magnitude of the long run relationship is evaluated through β_1 for positive shock and β_2 for negative shock, respectively, where $\beta_1 > \beta_2$.

The NARDL specification can then be expressed in the following unrestricted error correction form (Eq.6):

$$\Delta GDP_t = \theta_0 + \theta_1 GDP_{t-1} + \theta_2^+ Rx_{t-1}^+ + \theta_3^- Rx_{t-1}^- + \sum_{j=1}^q \pi_{1j} \Delta GDP_{t-j} + \sum_{j=0}^p \pi_{2j}^+ \Delta Rx_{t-j}^+ + \sum_{j=0}^m \pi_{3j}^- \Delta Rx_{t-j}^- + \varepsilon_t \quad (6)$$

where q, p and m are the respective lag order, $\beta_1 = -\theta_2/\theta_1, \beta_2 = -\theta_3/\theta_1$ denotes the long run impact of positive and negative changes in reserves on economic growth, while the short run positive and negative impacts of changes in reserves on economic growth is given by $\sum_{j=0}^p \pi_{2j}^+$ and $\sum_{j=0}^m \pi_{2j}^-$, respectively (see also Bassey, 2017).

According to Shin *et al.* (2013), Eqn. (6) perfectly corrects for the potential weakly endogeneity of non-stationary regressors for a NARDL model. The null hypothesis of no asymmetry in the long-run coefficients ($\beta^+ = \beta^-$) and in the short-run ($\pi^+ = \pi^-$) will be tested such that a rejection of one or both will be evaluated. A unit root test will be carried out to certify that no variable's order of integration is beyond I(1), Once this is done, Equation (6) will then be evaluated using ordinary least squares (OLS) method.

The NARDL approach enables us to capture both long-run and short-run asymmetries in the reserves - economic growth relationship. Thus, a test for the existence of long-run relationship between the variables will be tested using bounds testing for cointegration (Shin *et al.*, 2011; Pesaran *et al.*, 2001). The null hypothesis of no cointegration: $H_0 = \theta_1 = \theta_2 = \theta_3$ will be tested against $H_1 = \theta_1 \neq \theta_2 \neq \theta_3$, i.e. hypothesis of cointegration. On the other hand, the short-run asymmetric impact will be assessed through the positive and negative dynamic cumulative multipliers of one percent change in Rx_{t-1}^+ and Rx_{t-1}^- , respectively as follows:

$$m_h^+ = \sum_{j=0}^h \frac{GDP_t}{Rx_t^+} \text{ and } m_h^- = \sum_{j=0}^h \frac{GDP_t}{Rx_t^-}; h = 0,1,2, \dots$$

So that as $h \rightarrow \infty, m_h^+ \rightarrow \theta^+$, and $m_h^- \rightarrow \theta^-$ as dynamic adjustment patterns.

4.2 Data

This paper uses two relevant macroeconomic variables: real GDP (GDP) and external reserves (Rx). The data structure includes quarterly data from 2011:03 to 2018:02 due to data availability. Both external reserve data and the quarterly GDP were sourced from the Central Bank of Nigeria Statistics and Reserves Management Departments. The use of GDP and Rx will also allow for proper comparative inference from the nonlinear perspective which the paper is adopting to the linear perspective earlier utilized in previous studies as enumerated in the literature.

5.0 RESULTS

5.1 Preliminary Estimation Results

Prior to the econometric estimation, the statistical characteristics of the variables were examined, and the result is as presented in Table 1. The result shows a negative skewness for external reserve and real GDP, respectively.

Table 1: Summary Statistics of LGDP and LRX

Statistics	LGDP	LRX
Mean	16.61719	24.26984
Median	16.6088	24.25059
Maximum	16.76213	24.56577
Minimum	16.44851	23.8703
Std. Dev.	0.08306	0.203915
Skewness	-0.083056	-0.10011
Kurtosis	2.273379	1.738294
Jarque-Bera	0.717613	2.107985
Probability	0.698509	0.348543
Sum	515.133	752.3652
Sum Sq. Dev.	0.198982	1.247437
Observations	31	31

5.2 NARDL Estimation Results

The NARDL model admits three general forms of asymmetry: long-run or reaction asymmetry, associated with ($\beta^+ \neq \beta^-$); impact asymmetry, associated with the inequality of the coefficients on the contemporaneous first differences ΔRx_t^+ and ΔRx_t^- ; and adjustment asymmetry (i.e. the dynamic multipliers) derives from the interaction of impact and reaction asymmetries in conjunction with the error correction coefficient (see Shin *et al.*, 2013).

First, we seek to ensure the stationarity conditions of the series and the validity of methodology adopted. Table 1 presents the results of the Augmented Dickey-Fuller unit root test that validate the application of ARDL approach to cointegration.

Table 2: Augmented Dickey-Fuller Unit Root Test

Augmented Dickey-Fuller test statistic		LGDP		LRx			
		t-Statistic	Prob.*	t-Statistic	Prob.*	t-Statistic	Prob.*
			I(0)		I(0)		I(1)
	-3.2705	0.0275**	-2.1391	0.2319	-3.5605	0.0133**	
Test critical values:	1% level	-3.7241		-3.6999		-3.6793	
	5% level	-2.9862		-2.9763		-2.9678	
	10% level	-2.6326		-2.6274		-2.6230	

*MacKinnon (1996) one-sided p-values. ** Significant at 1% level

Table 2 shows that GDP and the Rx are stationary at level and first difference, respectively. Using a general to specific procedure, an ARDL(2,1,0) optimal model was selected for the nonlinear specification. The maximum dependent and dynamic regressors lags were selected using Akaike Information Criterion, (AIC). Having established that the variables are cointegrated (Table 3), we proceeded to regression diagnostic which allowed us to examine the parameters for the NARDL specification before estimating the long-run and short-run coefficients. The outcome of the diagnostics is presented in Table 4, while the estimated long-run and short-run coefficients are presented in Table 5.

Table 3: Bounds Test for Nonlinear Cointegration

Model Specification	F-statistic	Significance	Lower	Upper	Conclusion
			Bound	Bound	
Nonlinear	12.94725	10%	2.63	3.35	Cointegration
	2	5%	3.1	3.87	
		2.50%	3.55	4.38	
		1%	4.13	5	

The results of the regression diagnostics in Table 4 support the fact that there exists a long-run asymmetric relationship between real GDP (economic growth) and external reserve.

Table 4: Summary of the Regression Diagnostics using NARDL Approach

Parameters	Estimate	Prob
θ_1	-1.606164	0.0000*
β^+	0.004786	0.8790
β^-	-0.155676	0.0000
π^+	-0.429826	0.0311
π^-	26.58613	0.0000
$\sum \pi^+$	-0.422138	0.0318
$\sum \pi^-$	-0.250041	0.0005
Symmetry Test		
$\beta^+ = \beta^-$	68.11023	0.0000*
$\pi^+ = \pi^-$	0.882101	0.3476
$\sum \pi^+ = \sum \pi^-$	49.80163	0.0000
Residual Diagnostic		
Serial Correlation LM	2.435476	0.1119
Heteroskedasticity	0.658307	0.6584

*Indicates significance at 1%

As shown in Table 4, the null hypothesis of long-run symmetry ($\beta^+ = \beta^-$) is statistically significant and cannot be accepted. On the other hand, the null hypothesis of a short-run symmetry ($\pi^+ = \pi^-$) is not significant and hence cannot be rejected. This implies that in the long-run, both the positive and the negative components of external reserves (Rx) impact asymmetrically on economic growth (GDP) and impose different long-run equilibrium relationships between the positive and the negative shocks.

Table 5: Estimated Long-run and Short-run Coefficients using the NARDL Approach

Estimated Short-run Coefficients				
Regressors	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	0.807816	0.170107	4.748876	0.0001*
D(LRX_POS)	-0.422138	0.142435	-2.963728	0.0070*
D(LRX_NEG)	-0.164909	0.166467	-0.990637	0.3322
CointEq(-1)*	-1.606164	0.209917	-7.651411	0.0000*
Estimated Long-run Coefficients				
Regressors	Coefficient	Std. Error	t-Statistic	Prob.
LRX_POS	0.004786	0.031088	0.153968	0.8790
LRX_NEG	-0.155676	0.031005	-5.02105	0.0000*
Constant	16.55256	0.013079	1265.614	0.0000*

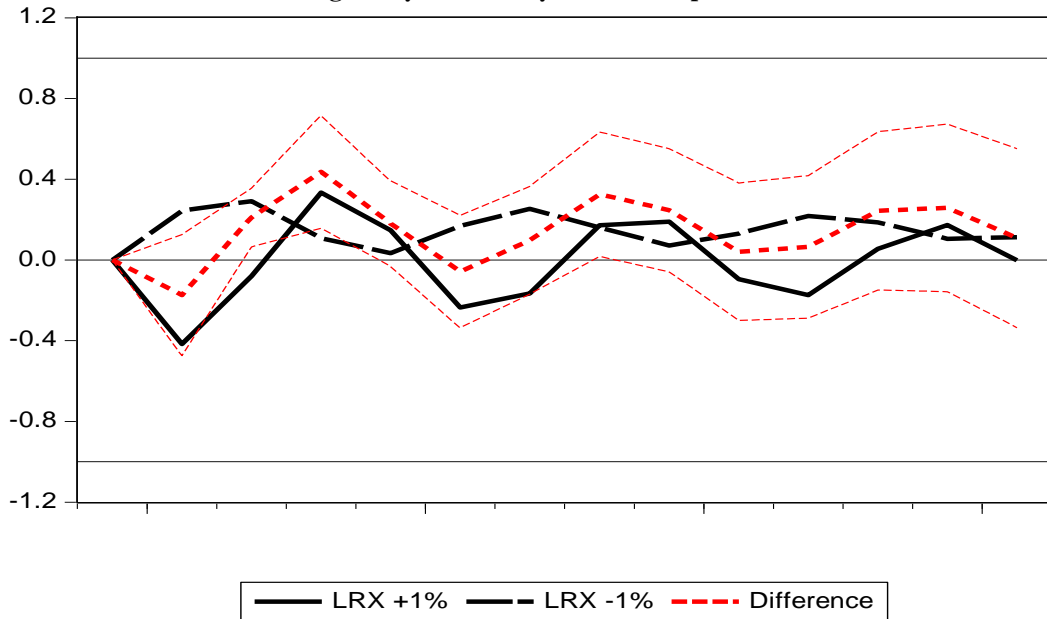
The estimated long-run coefficients in Table 5 show evidence of asymmetric relationship between real GDP and external reserve. The coefficient on the negative changes in external reserve has a negative sign and is statistically significant at 1%. This implies that a 1% depletion in external reserve results in a 0.2% increase in the real GDP.

The estimated short-run coefficients are presented at the upper part of Table 5. The result indicates that accretion to external reserve dampens growth in the short run by 0.4% and is statistically significant at 1%. The error correction term is statistically significant at the 1% level with a negative coefficient. According to (Narayan and Smyth, 2006), if the value on the coefficient of the lagged error correction term is between -1 and -2, then the lagged error correction term produces dampened fluctuations in the pass through effect from the external reserve to the real GDP about the equilibrium path. The lagged error correction term in the short-run model in this analysis appears with a coefficient of -1.61, which implies that instead of monotonically converging to the equilibrium path directly, the error correction process fluctuates around the long-run value in a dampening manner.

Howbeit, by the abstraction of Narayan and Smyth (2006), it follows that once this process is completed, convergence to the equilibrium path is rapid (i.e. any discrepancies between shocks and the trend will be reduced in less than a year). The economic growth lagged one period has a positive and significant effect on current economic growth. The coefficient indicates that a 1% increase in economic growth in the preceding quarter results in about 0.8% increase in economic growth in the current quarter.

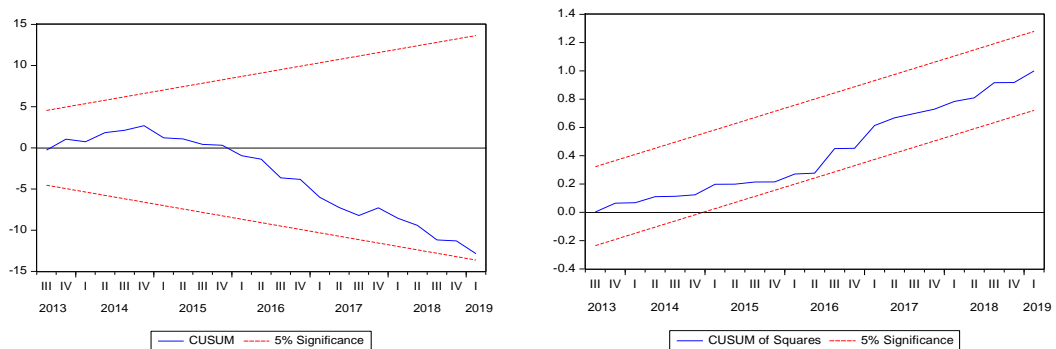
The asymmetric dynamic multipliers associated with unit changes in the positive and the negative components of external reserves is as shown in Figure 3.

Fig.3: Asymmetric Dynamic Multiplier



The adjustment pattern in Figure 3 shows movement from the initial equilibrium to the new equilibrium and captures the asymmetries from the interaction of the positive and negative impacts in conjunction with the error correction coefficient following economic trepidation in the country. At the long-run, the negative adjustment in reserve impacted positively on economic growth, while in the short-run both positive and negative are in equilibrium (no difference in their impacts as the difference line lies in-between them).

Figure 4: Stability Test Results



The stability diagnostic test conducted shows that the NARDL model is stable as shown in Figure 4.

6.0 CONCLUSION

Reserve accumulation is considered in some climes as waste of scarce resources in the middle of growing domestic problems that require financial attention, which may hinder economic growth (Osabuohien and Egwakhe, 2008; Awoderu, *et al.*, 2017). Evaluating the possible relationship between these two variables have also generated conflicting inferences when linear models are used for the analysis (see Nwafor, 2017 and Nwosa, 2017). This study has highlighted the performance of nonlinear application in evaluating the relationship between the two variables for a more informed economic policy. The paper uses nonlinear autoregressive distributed lag model (NARDL) to explore the short-run and long-run asymmetric relationship between the two macroeconomic variables, where the key strength of the NARDL framework is in allowing for the short- and long-run nonlinearities to be investigated through positive and negative partial sum decompositions of the explanatory variable. The bounds-testing result showed the existence of an asymmetric (cointegrating) long-run relationship based on the NARDL ECM. The OLS estimation provided a reliable inference notwithstanding the variables order of integration. The estimated long-run coefficient of a negative change in reserve showed statistical significance at 1%. It has been shown that a 1% negative shock to reserve increased economic growth with about 0.2%. The asymmetric dynamic multiplier of the NARDL model captured the patterns of adjustment from the initial equilibrium to a new equilibrium following economic trepidation. These results suggest that imposing a long-run symmetry where the underlying relationship is nonlinear will muddle the efforts of testing for the existence of a stable long-run relationship between the two variables and gives spurious dynamic responses. Thus, this paper has provided evidence that economic growth – reserve relationship in Nigeria could be best evaluated using non-linear models rather than linear and is anchored on the interaction between positive productivity shocks and decline in reserve accumulation.

REFERENCES

- Ahuja, A., & Nabar M. (2012). Investment-led growth in China: Global spillovers. IMF Working Papers 12/267.
- Aizenman, J. and Lee, J. (2007). International reserves: precautionary versus mercantilist views: Theory and evidence. *Open Economies Review*, Vol. 18, No. 2: 191– 214.
- Akinwunmi, A. A. & Adekoya, R. B. (2016). External reserves management and its effect on economic growth of Nigeria. *International Journal of Business and Finance management Research*, 4 (2016) 36-46
- Alabi, M. K., Ojuolape, M. A. & Yusuf, H. A. (2017). The impact of accumulating foreign reserve on economic growth in Nigeria. *Sokoto Journal of the Social Sciences*, Vol. 7, No. 2: 344 – 355.
- Awoderu, B. K., Ochalibe, A. I. & Hephziba, O. O. (2017). Policy implications of long-run relationship between external reserve and economic growth in Nigeria. *International Journal of Academic Research and Reflection*, Vol.5, No. 1: 82-95.
- Balassa B. (1978). The New Protectionism and the International Economy. *Journal of World Trade Law*, Vol. 12, No. 5: 409 – 436.
- Bassey, K. J. (2017). Money supply growth and unemployment rate in Nigeria: Investigating a long-run relationship using asymmetric ARDL approach. *West African Journal of Monetary and Economic Integration*, West African Monetary Institute, vol. 17(1): 45-60.
- Bond, Steve, Asli Leblebicioglu, & Fabio Schiantarelli (2010). Capital accumulation and growth: A new look at the empirical evidence. *Journal of Applied Econometrics*, Vol. 25, No. 7, 1073–1099.
- Cheng, G. (2015). A growth perspective on foreign reserve accumulation. *Macroeconomic Dynamics*, Vol. 9, Issue 6: 1358-1379.
- Chen, R. (2013). The impact of china's foreign exchange reserves on currency mismatch. International Conference on Education and Management Science (ICETMS), held at Nanjing, Jiangsu, China, June 8-9, 2013.
- Cruz, M. & Walters, B. (2008). Is the accumulation of international reserves good for development? *Cambridge Journal of Economics*, Vol. 32: 665-681.
- Elhiraika, A. & Ndikumana, L. (2007). Reserves accumulation in African countries: Sources, motivations and effects, University of Massachusset, Economic Department Working Paper, Vol. 12, pp. 19–27.
- Eniekezimene F. A. and Apere T. O. (2016). External reserve management and economic growth in Nigeria. *International Journal of Empirical Finance* Vol. 5, No. 2: 101-111.
- Fukuda, S. & Kon, Y. (2010). Macroeconomic impacts of foreign exchange reserve accumulation: A theory and some international evidence. ADBI Working Paper, Tokyo: Asian Development Bank Institute.
- Heller, H.R. (1996). Optimal international reserves. *Econs. J.* No: 76: 296-311.

- International Monetary Fund, (2008). *Balance of Payments Manual*, 5th Edition.
- Irefin, D. & Yaaba, B. N. (2012). Determinants of foreign reserves in Nigeria: An autoregressive distributed lag approach. *CBN Journal of Applied Statistics*, Vol. 2, No.2: 63 – 82.
- Johnny, N. & Johnnywalker, W. (2018). The relationship between external reserves and economic growth in Nigeria (1980-2016). *International Journal of Economics, Commerce and Management*, Vol. VI, Issue 5: 213-241.
- Krušković, B. D. & Maričić, T. (2015). Empirical analysis of the impact of foreign exchange reserves to economic growth in emerging economics. *Applied Economics and Finance* Vol. 2, No. 1: 102-109.
- Landell-Mills, J. M. (1989). The demand for international reserves and their opportunity cost. *International Monetary Fund Staff Papers*, Vol. 36, No. 3:107–32.
- Lin, M. (2011). Foreign reserves and economic growth: Granger causality analysis with panel data. *Economics Bulletin*, Vol. 31, No.2: 1563-1575.
- National Bureau of Statistics Report (2016). <https://www.nigerianstat.gov.ng/>
- Narayan, P. K. & Smyth, R. (2006). What determines migration flows from low-income to high-income countries? An empirical investigation of fiji-u.s. migration 1972-2001. *Contemporary Economic Policy*, Vol. 24, No. 2:332-342.
- Nelson, R. R. & Pack, H. (1999). The Asian miracle and modern growth theory. *Economic Journal*, Vol.109, No. 457: 416–36.
- Nwafor, M. C. (2017). External reserves: Panacea for economic growth in Nigeria. *European Journal of Business and Management*, Vol. 9, No. 33: 36 – 47.
- Nwosa, P. I. (2017). External reserves on economic growth in Nigeria. *Journal of Entrepreneurship, Business and Economics*, Vol. 5, No. 2: 110–126.
- Olokoyo, F. O., Osabuohien, E. S. C. & Salami, O. A. (2009). Econometric analysis of foreign reserves and some macroeconomic variables in Nigeria (1970–2007). *African Development Review*, Vol. 21, No. 3: 454-475.
- Osabuohien, E. S. and Egwakhe, A. J. (2008). External reserves and the Nigerian economy: The Dual Folded Debate. *African Journal of Business and Economic Research*, Vol. 3, No. 2, pp. 28-41.
- Pesaran, M. H, Shin, Y. & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, Vol.16: 289-326.
- Pettinger, T. (2017). Explaining theories of economic growth. <https://www.economicshelp.org>.
- Polterovich, V. & Popov, V. (2002). Accumulation of foreign exchange reserves and long-term growth. MPRA Paper, University Library of Munich, Germany.
- Polterovich, V. & Popov, V. (2007). Economic growth, real exchange rate and inflation. New Economic School, Research Project 2006-2007.

Shin Y., Yu, B. & Greenwood-Nimmo M. (2013). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ardl framework.

Udo, A. B. & Antai, A. S. (2014). Opportunity cost of Nigeria's external reserves. *IOSR Journal of Economics and Finance*, Vol. 3, No. 5: 7-16.