MODELLING FINANCIAL SECTOR EFFECTS ON NIGERIA'S REAL ECONOMY: A NONLINEAR ARDL APPROACH

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Abstract

The history of the financial sector in Nigeria is characterised by set-backs and reforms which may lead to nonlinear effect on growth. Previous studies predicated on linear models yielded conflicting results on the effect of finance on economic growth. Thus, there is need for further evidenced-based research and to achieve this; the paper employed the recently developed non-linear autoregressive distributed lag (NARDL) methodology. The main objective of the study is to evaluate the existence of asymmetric long-run macroeconomic relationship between financial sector development and economic growth in Nigeria between 1990 and 2015. The findings show that a long run nonlinear or asymmetric cointegration relationship exist between economic growth and two financial proxy indicators (total banking asset to GDP and currency in circulation to GDP) while the outcome for the other indicators were inconclusive.

Key words: Financial sector, economic growth, nonlinear ARDL, Asymmetric cointegration

JEL Classification: C51, G20, O47

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1.0 INTRODUCTION

An efficient financial system has tremendous role to play in the process of capital accumulation and technological innovation, which in turn promotes economic growth. Some of the well-acknowledged functions of the financial system that are growth-enhancing include: facilitating the mobilization of savings as well as investment in the economy; providing efficient payment mechanism for transactions, especially through the use of money which lubricates the wheel of economic progress; providing a veritable system of protecting economic agents from risks; and by overcoming incentive-related problems that undermine financial contracts such as moral hazards, adverse selection and information asymmetry (Merton and Bodie 1995).

The race to build an efficient financial system started in pre-colonial Nigeria during the twilight years of the nineteenth century. However, the severe banking crisis that occurred between 1940 and 1960 left the nascent financial system prostrate with the closure of several banking institutions (Moh and Eboemie 2011). The post-independence experience with financial sector development in Nigeria was characterised by weak institutions that operated under the ambit of direct control policies which negatively affected financial intermediation.

A turning point in the history of financial sector development in Nigeria came with the introduction of the structural adjustment programme (SAP) in 1986 which resulted in financial sector deregulation and liberalization. The number of commercial and merchant banks leaped from less than 40 before SAP to 120 in 1992. But according to Alade (2016), “the fragility of the financial system showed up when the number of banks declined to 89 as a result of the liquidation of over 30 terminally distressed banks.” Aside the liberal licensing of banks by the Central Bank of Nigeria (CBN), the imperative for a financial system that is supportive to growth brought about further reforms such as: universal banking in 2000; banking system consolidation in 2004; several other policies of the CBN aimed at regulatory over-hauling between 2005 and 2008; quantitative easing during the period of global financial crisis in 2008/2009 and the ‘Alpha Project Initiative’ that resulted in a new banking model (Alade 2016).

The preceding overview shows that setbacks continued to plague the orderly progress of the nation’s financial system even after the introduction of SAP. Given this vacillating scenario, it is germane to ask, what is the long run impact of financial development on economic growth in Nigeria? To answer this question, the prevailing finance-growth literature has focused on multivariate linear econometric models which may fail to account for the observed non-linear dynamics between growth and financial development. Therefore, “existing findings could become grossly inadequate should symmetry restrictions be rejected, which provide evidence of misspecification error, and
thus, associated policy prescriptions there from would have misled policymakers over time”.

The fluctuating experiences or rather, the successive acceleration and deceleration in the trend of financial sector performance in Nigeria calls for innovative and evidenced-based research initiatives to determine the effect of financial development on economic growth and to draw relevant policy conclusions. In this regard, several Nigerian studies produced conflicting outcomes with either finance promoting or impeding growth (Ndebbio 2004 and Nnanna 2004, cited in Madichie et al. 2014). Furthermore, divergent opinions on this issue have existed amongst economists since the time of Schumpeter (1912), Robinson (1952), Patrick (1966), Goldsmith (1969), McKinnon (1973) and Shaw (1973), and this makes the finance-growth controversy a subject of further empirical investigation.

One of the major methodological shortcomings of previous studies lies in the application of linear-based analytical approaches to possibly non-linear economic relationships. This present study differs markedly from previous ones by employing the recently developed non-linear autoregressive distributed lag (NARDL) methodology of Shin, Yu and Greenwood-Nimmo (2014) to investigate the asymmetric relationship between financial development and economic growth in Nigeria. The specific objectives of the study are to:

- to evaluate the asymmetric long-run macroeconomic relationship between financial sector development and economic growth in Nigeria between 1990 and 2015;
- to assess the asymmetric short-run dynamics in the finance-growth nexus;
- To ascertain the veracity of symmetric effects based on Nigerian data.

This study extends the frontiers of literature and is unique in several respects. One, the study not only applies the recent NARDL approach, but it is also the first study we know that applied this methodology to the finance-growth nexus. Two, we applied the recently rebased GDP using the 2010 constant prices for entire scope of the study from 1990 to 2015.

Following the introduction, section two focuses on trend analysis while section three dwells on the review of literature. Section four provides an exposition on the methodology and the fifth section relates to empirical analysis and discussion of findings. Finally, section six concludes the paper.
2. Trend Analysis of Financial Sector Development in Nigeria

Since the introduction of SAP in 1986, Nigeria began to implement financial sector reforms as part of broader market oriented reforms. The objective of the reforms was to build a more efficient, robust and deeper financial sector. Although, the financial sector seems to have improved since the commencement of reforms, yet, the depth of financial development in Nigeria is still questionable.

Figure 1. Relationship between TBAGDP, PSCGDP and RGDPG

![Graph showing the relationship between TBAGDP, PSCGDP, and RGDPG]

Source: The Authors

Figure 1 indicates some form of co-movement between total banking assets to GDP (TBAGDP) and real GDP growth (RGDPG) but some divergences could be observed. For instance, the peaks in TBAGDP in 1991, 2001 and 2009 correspond well to that of RGDPG. Similarly, at several points in time when TBAGDP fell, we note that RGDPG fell as well. Thus, TBAGDP seems to be a driver of economic growth.

The trend noticed in private sector credit to GDP (PSCGDP) represents a significant level shift and it shows a steady rise following the banking consolidation exercise in 2004, which resulted in an upswing in economic activities, while the RGDPG reveals that the global economic crisis of 2008/2009 triggered slower growth in the Nigerian economy. Furthermore, the recent plunge in crude oil prices starting from July 2014...
affected economic activities to such an extent that the economy began to show signs of negative growth in 2015.

**Figure 2. Relationship between CICGDP, M2GDP, MKCGDP and RGDPG**

![Figure 2: Relationship between CICGDP, M2GDP, MKCGDP and RGDPG](image)

*Source: The Authors*

Figure 2 shows that at different points in time from 1990 to 2003, real GDP growth (RGDPG) seems to be a key driver of market capitalization (MKCGDP). However, between 2003 and 2007, the MKCGDP ratio rose significantly and reached its highest peak while RGDPG fell on the average. The substantial rise in market capitalization was due mainly to the bank consolidation exercise at that time. During the period covered by the study, the currency in circulation to GDP ratio (CICGDP) and broad money supply to GDP ratio (M2GDP) co-moved with RGDPG and diverged at different times. In summary, the simple trend analysis captured above portrays a nonlinear relationship between real GDP growth and other financial variables, thereby lending credence to the application of a nonlinear technique to data analysis.

### 3. Literature Review

#### 3.1 Theoretical Literature

Investigations into the nature of relationship between financial system development and economic growth has spanned over a century. There are several competing and
divergent paradigms on the finance–growth nexus but two of these are dominant, namely the supply-leading and demand-following paradigms.

Marwa and Zhanje (2015) and Levine (1997) undertook an extensive literature survey on the relation between financial development and economic growth. The reviewed works include Bagehot (1873), who showed that capital spillovers from the financial system increased the rate of industrial revolution in Britain as resources were pooled together and allocated to entrepreneurs with the most profitable opportunities. In a ground-breaking work, Schumpeter (1912) contends that a well-functioning financial system will drive technological innovations (growth) through efficient distribution of resources from unproductive to industrious sectors. This view is often considered as the first strategy in analyzing the finance-led growth hypothesis. However, Robinson (1952) avers that causality proceeds from growth to finance as summarized by the frequently quoted statement in this regard that “finance follows where enterprise leads”. Robinson (1952) stressed that a growing real sector will turn into a great response for the services of the financial sector, and this implies that, a developed financial sector is a direct result of the demands of the expanding real sector of the economy. This view asserts a unidirectional causation from economic growth to financial sector development.

Patrick (1966) emphasized the “stage of development hypothesis” in which finance plays the initial catalytic role in propelling the expansion of the real sector and afterwards, growth takes over as the main driver of financial development. Thus, Patrick (1966) avers that a robust financial sector can induce real investment in the early stages of economic progress but this becomes less important as development gets well underway and the demand-following response takes over and becomes dominant. Accordingly, this view gives cause to believe that a bi-directional relationship exists between growth and finance.

McKinnon (1973) and Shaw (1973), emphasized the importance of financial liberalization in the enhancement of domestic savings and hence, investment. Consequently, the works of McKinnon (1973) and Shaw (1973) constitute the foundations for the financial sector liberalization in many developing countries, including Nigeria. The financial liberalization argument is based on the premise that financial repression reduces the real rate of economic growth and the real size of the financial sector compared to the size of non-financial sector. Therefore, while financial liberalization promotes financial sector development, financial repression through governmental controls, planned restrictions and price alterations hinder it.
The theoretical analysis of Eggoh and Villeu (2014) seems to provide some insight on possible asymmetric relationship between finance and growth. They focused on the role of financial intermediation in a simple endogenous growth model. The analysis reveal that the finance-growth nexus can result in conflicting impacts as various levels of financial development can generate multiple endogenous growth paths due to reciprocal externality between financial sector and the real economy.

**The Finance-Growth Nexus**

To illustrate the possible effects of financial development on economic growth, we follow the exposition of Pagano (1993) which is predicated on the simple ‘AK’ model where aggregate output, \( Y_t \), is dependent on aggregate capital stock, \( K_t \):

\[
Y_t = AK_t \tag{1}
\]

where \( A \) is the total factor productivity. The gross investment, \( I_t \), is given by:

\[
I_t = K_{t+1} - (1-\delta)K_t \tag{2}
\]

If the economy’s output is invested, the depreciation at end of \( t \) period is given by \( \delta \). The equilibrium condition for a two-sector economy without government and an external sector is given as gross saving equal gross investment:

\[
S_t = I_t \tag{3}
\]

In line with Pagano’s framework, the proportion of gross saving channeled to investment is \( \phi \) while another proportion of 1- \( \phi \) is assumed to be lost in the process of financial intermediation:

\[
\phi S_t = I_t \tag{4}
\]

The economic growth rate is given by the ratio of change in output (see AK model in Todaro and Smith, 2009)

\[
\frac{\Delta Y}{Y} \tag{5}
\]

Given the proportional relation between output and capital, Pagano (1993) posits that growth rate at time \( t + 1 \) is given as:

\[
g_{t+1} = \frac{Y_{t+1}}{Y_t} = \frac{K_{t+1}}{K_t} - 1.
\]
With appropriate substitutions in the above equations, the steady-state growth rate is given as (time subscripts dropped):

\[ g = \frac{A_1}{Y_1} \delta = A_\phi s \delta \]………………………………………(6)

\( s \) is the saving rate. Equation (6) provides the intuition on the channels through which financial sector development (FSD) impact on growth: FSD can increase the value of \( \phi \); it can improve the value of \( A \) through innovation; and FSD can positively influence the saving rate, \( s \).

### 3.1 Empirical Review

The outcome of an extensive review of empirical studies by Levine (1997) indicates that cross country comparisons, specific country studies, industry-level and firm-level investigations overwhelmingly suggest that financial system development is vitally associated with economic growth. For instance, countries with larger banks and more active stock markets grow faster in succeeding decades, while, industries and firms that rely heavily on borrowed funds “grow disproportionately faster in countries with well-developed banks and securities markets than in countries with poorly developed financial systems”. In the same vein, country-level studies show that countries with better financial sector have better growth performance.

Liang and Reichert (2006) studied the causal relationship between economic growth and financial sector development by using a panel of twenty advanced countries and 70 emerging/developing countries with data spanning from 1960 to 2000. The methodology employed includes Granger causality and the ‘Odedokun (1996) multifactor aggregate production function models which controlled for some other notable variables which influence real GDP in order to eliminate the problem of omitted variable bias. Inter alia, the Granger causality test involving data set of the emerging and developing countries provides strong evidence to the effect that causality runs from economic growth to financial sector development – a demand following relationship. However, the results of the panel least squares and fixed effect regressions based on the multivariate model reveals that the finance proxy, M3, has a positive and highly significant impact on growth, thus supporting the supply–leading paradigm.

Shen and Lee (2006) re-studied how financial development affects real GDP growth per capita in a sample of 48 countries. The result of the linear regression model show that stock market developments (SMD) produce positive impact on economic growth while banking sector development (BSD) has a negative impact or no impact on growth. However, further investigations indicate that when conditional variables such as
financial liberalization, high income level (economy) and good shareholder protection were built into the model, the unfavourable effect of BSD on growth was lessened. On the contrary, when the conditional variable combination include middle income level, banking and currency crises, good creditor protection, higher corruption as well as specific regional grouping (Latin America, sub-Sahara Africa and East Asia), the negative effect of BSD on growth exacerbated but if only the regional grouping and SMD are integrated into the model, growth is promoted. Furthermore, Shen and Lee (2006) used a quadratic functional form to provide evidence that the finance-growth nexus may actually be non-linear.

Huang and Lin (2009) studied the growth effects of financial intermediary development for a data set of 71 countries with distinct levels of income by employing the instrumental variable threshold regression approach. The finding shows a non-linear positive effect of finance on economic growth, with the impact on low income countries being more pronounced than high income economies. In terms of the channel of transmission, the result indicate that finance affect growth in high income countries through capital accumulation, whereas, for low income countries, financial development impact positively on growth through the mechanism of productivity growth and capital accumulation.

Odeniran and Udeaja (2010) explored the relationship between financial sector development and economic growth in Nigeria using time series data from 1960 to 2009. The financial sector proxies used include: broad money to GDP, bank deposit liability to GDP, net domestic credit to GDP and private sector credit to GDP. Evidence from the cointegration analysis suggest that a long run relationship exist between real output and the financial sector variables which is in harmony with the finance-led theories. Furthermore, the granger test reveals that causality runs from financial sector development to growth – supply leading. However, the evidence in respect of a bidirectional relationship stems from the fact that causality also runs from per capita output to net domestic credit and private sector credit.

Chea’s (2011) study distills some key factors that can accelerate or impede economic growth in sub-Saharan African (SSA) countries. The findings show that financial deepening could reduce the problems associated with income inequalities and poverty provided that financial liberalization (interest rates and lending) is accompanied by institutional reforms that, in particular, emphasizes stronger property rights and reduction in information asymmetries with respect to borrowers and lenders. Furthermore, SSA must tackle the challenges of low saving and impediments to expansion of domestic bond markets to promote growth.
Similarly, DFID (2004) observe that the development of the financial sector can make important contributions to long-run economic growth and poverty reduction, especially in developing countries through enhancement in savings, encouraging inflows of foreign capital and optimizing the allocation of capital between competing uses.

Adua, Marbuah and Mensah (2013) investigated the long-run growth effects of financial development in Ghana. The study employed the autoregressive distributed lag (ARDL) approach and principal component analysis. Findings based on cointegration test shows that out of the eight financial proxy variables, long run growth effects were established with respect to only three financial indicators, namely: credit to private sector to GDP ratio, credit to private sector as a ratio to total domestic credit and broad money supply to GDP ratio. However, results from the principal component analysis indicate that the growth effect of financial development is sensitive to the choice of proxy. For example, both the private sector credit and aggregate domestic credit variables were found to be conducive to growth while broad money supply to GDP is not growth-promoting. Thus, they concluded that whether financial development is good or bad for growth depends on the indicator used as proxy for financial development.

Kapingura (2013) examined the dynamic relationship between financial development and economic growth in South Africa. The results suggest that financial intermediaries and financial markets have different impacts on economic growth given their different roles in the economy. In particular, there is bi-directional causality between stock market and economic growth. Also, a unidirectional causality from the bond market to economic growth was established.

Kiprop, Kalio, Kibet and Kiprop (2015) studied the finance-growth nexus in Kenya based on the autoregressive distributed lag method. The findings validates the supply-leading hypothesis in Kenya as the effect of financial development on economic growth was positive and statistically significant, both in the short and long run.

Nkoro and Uko (2013) examined the finance-growth relationship in Nigeria. The study employed the Johansen cointegration/ECM methodology with annual dataset covering the period, 1980-2009. The findings show that financial variables such as market capitalisation to GDP, interest rate and broad money supply to GDP are stimulators of the Nigerian economy in the long run. The outcome of the error correction mechanism confirms the importance of the financial sector in the short run with economic growth adjusting speedily to financial sector development. However, the authors noted that there exists an inverse relationship between credit to GDP and Nigeria’s economic growth. This was attributed, inter alia, to the crowding out of private investment due to large government borrowing.
Balago (2014) studied financial sector development and economic growth in Nigeria. The result shows that development in the financial sector as measured by banking sector credit, total market capitalisation and foreign direct investment positively affect economic growth. This result is consistent with a number of earlier studies reviewed in the literature that found financial sector to positively affect real gross domestic product.

A major shortcoming of majority of studies is the implicit assumption that the relationship between finance and growth is linear. Hence, this present work takes a different investigative approach by adopting a non-linear methodology.

4. Methodology

4.1 The Non-linear ARDL Approach

Many relationships among macroeconomic variables tend to follow a non-linear path as opposed to the more common linear assumptions. The speed at which macroeconomic variables move in the downward direction is often not the same as that of the upward side, thus suggesting non-linear behavior. Consequently, the information content embedded in linear relationships may be inappropriate in making strong inference (Shin, Yu and Greenwood (2014). The implication is that the vacillation of positive and negative components of regressors around an assumed zero threshold have crucial role to play in establishing long run economic relationships.

The asymmetric ARDL of Shin, Yu and Greenwood (2014) derive from the expansion of the linear ARDL formulation of Pesaran, Shin and Smith (2001). Following the works of Schoderet (2003) and Shin , Yu and Greenwood (2014), the non-linear long run equation is specified as (also see Olayeni 2016; Ibrahim 2015; and Athanasios et al. 2016)

\[ y_t = \beta^+ x^+_t + \beta^- x^-_t + \varepsilon_t \]  

Where \( x_t \) is a k x 1 vector of regressors.

Given that \( x_t \) is defined to be a random walk, such that:

\[ x_t = x_{t-1} + e_t, \quad e_t \sim N(0, \sigma^2_e) \]  

The above data generating process may be re-written as follows after recursive substitution;

\[ x_t = x_0 + \sum_{j=1}^{t} e_j, \quad t=1,\ldots,T \]  

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Assuming zero threshold, the error term can be partitioned as:

\[ e_t = e_t^+ + e_t^- \] \hspace{1cm} (10)

Taking partial sum yield;

\[ \sum_{j=1}^{t} e_j = \sum_{j=1}^{t} e_j^+ - \sum_{j=1}^{t} e_j^- \] \hspace{1cm} (11)

From the foregoing, the following expression follows:

\[ e_j^+ = \Delta x_j^+ \text{ and } e_j^- = \Delta x_j^- \], \hspace{1cm} (12)

\( x_t^+ \) and \( x_t^- \) are partial sums of the positive and negative changes in \( x_t \).

Thus, \( x_t \) which is a \( k \times 1 \) vector of regressors is defined as;

\[ x_t = x_t + x_t^+ + x_t^- \] \hspace{1cm} (13)

When equation (1) is linked to the symmetric ARDL of Pesaran Shin and Smith (2001), the following non-linear variant of the unrestricted ECM is obtained;

\[ \Delta y_t = \alpha + \rho y_{t-1} + \omega_2^+ x_{t-1} + \omega_2^- x_{t-1} + \sum_{j=1}^{p-1} \theta_j \Delta y_{t-1} + \sum_{j=0}^{q-1} \pi_j^+ \Delta x_{t-j}^+ + \sum_{j=0}^{q-1} \pi_j^- \Delta x_{t-j}^- + \epsilon_t \] \hspace{1cm} (14)

Where \( \omega_2^+ = -\rho \beta^+ \) and \( \omega_2^- = -\rho \beta^- \) and \( \theta_j \) is the autoregressive parameter; \( \pi_j^+ \) and \( \pi_j^- \) are the symmetric distributed lag parameters; \( \epsilon_t \) is the stochastic error term that is independently and identically distributed with zero mean and constant variance. Equation (14) may be re-written as;

\[ \Delta y_t = \alpha + \rho y_{t-1} + \omega_2^+ x_{t-1} + \omega_2^- x_{t-1} + \sum_{j=1}^{p-1} \theta_j \Delta y_{t-1} + \sum_{j=0}^{q-1} \pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^- + \epsilon_t \] \hspace{1cm} (15)

The restricted ECM may be written as;

\[ \Delta y_t = \kappa_1 ecm_{t-1} + \sum_{j=1}^{p-1} \theta_j \Delta y_{t-1} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + \epsilon_t \] \hspace{1cm} (16)

4.2 Data and Variables
The study is based on annual data set over the period 1990 to 2015. Inter alia, higher frequency data could not be used as quarterly data for the rebased GDP were available only for 2010 to 2015 period. The various time series were expected to capture the dynamics of a deregulated economy as the effect of the Structural Adjustment Programme (SAP) which was introduced in 1986 would have been well underway in 1990. The Central Bank of Nigeria (CBN) statistics database is the basic source of data employed in the ensuing analysis.

The data for both nominal and rebased GDP (1990-2015) at 2010 constant prices come from the Central Bank of Nigeria Statistical Bulletin. The computed growth rate of real GDP (RGDPG) is the proxy for economic growth in this study.

The financial sector development indicators considered in this paper include: Private Sector Credit to GDP (PSCGDP), Broad Money Supply to GDP (M2GDP), Total Banking Asset of deposit money banks to GDP (TBAGDP), Total Market Capitalisation to GDP (MKCGDP), Currency in Circulation (CIC) to GDP (CICGDP), and Bond Market Capitalisation to GDP (BCGDP). The indicators are in percentage form and were computed using nominal GDP as the denominator. Specifically, the data on PSCGDP and M2GDP were obtained directly from CBN Statistical Bulletin while all other financial ratios were computed (the data for numerator of the ratios, that is, total assets of deposit money banks, total market capitalisation, bond market capitalization and currency in circulation are available in the CBN Statistical Bulletin. However, the following should be noted: the 2015 figure of total market capitalization is from the May 2016 CBN Economic Report; the BCGDP ratio for 2014 and 2015 were estimated based on a three year moving average.

4.3 Model Specification and Techniques of Data Analysis

The test for asymmetric cointegration is based on the following general form of non-linear ARDL (NARDL) model;

\[ \Delta R_G_t = \alpha + \rho R_G_{t-1} + \omega_1^+ F_D^+_{t-1} + \omega_2^- F_D^-_{t-1} + \sum_{j=1}^{p-1} \theta_j \Delta R_G_{t-1} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta F_D^+_{t-j} + \pi_j^- \Delta F_D^-_{t-j}) + \epsilon_t \]  

(17)

Where RG stands for the real GDP growth rate at the 2010 constant prices and FD represents a number of financial development indicators as mentioned in the previous section. Furthermore, $F_D^+_{t-1}$ and $F_D^-_{t-1}$ are partial sums of positive and negative changes in the specific financial sector development indicator while p and q stand for the selected lag order for the dependent and the exogenous variables in distributed lag
part, respectively. The automatic lag selection framework in Eviews 9 was adopted for the analysis.

The ordinary least square (OLS) technique is used to estimate the NARDL model. The NARDL approach to cointegration enjoys some of the advantages associated with the symmetric ARDL such as being particularly good for small sample size as it is the case in this study. The battery of econometric tests conducted is detailed below.

The Asymmetric Cointegration Test:

The following null hypothesis of no cointegration involving the coefficients of the level form of $RG_t$, $FD_t^+$, and $FD_t^-$ were tested (Pesaran et al. 2001, Atil et al. 2014 and Eng and Wong undated).

$$H_0: \rho = \omega_2^+ = \omega_2^- = 0$$

If the empirical value of the F-statistics exceeds the upper bound critical value at the appropriate level of significance, it provides evidence on the existence of long run relationship between the variables but if the computed value is below the lower bound, it means there is no cointegration. The test is considered inconclusive if the calculated F-statistics lies between the two bounds. If the above hypothesis is rejected, then an error correction model must be formulated to account for the short run and long run relationships simultaneously.

Test for Symmetry Effect:

The test of both SR and LR symmetry effect employed the Wald statistics.

The short run (SR) symmetric effect;

$$H_0: \pi_j^+ = \pi_j^- , (\forall j)$$ for all $j = 0, \ldots, q - 1$.

The long run (LR) symmetric effect is tested as follows (see eq. 7);

$$H_0: \beta^+ = \beta^-$$ where, $\beta^+ = -\omega_2^+/\rho$ and $\beta^- = -\omega_2^-/\rho$

A non-rejection of the hypotheses of SR and LR symmetric effects means that the original symmetric ARDL formulation of Pesaran et al. (2001) will hold (also see Eng and Wong, undated). However, a non-rejection of the LR symmetry but not the SR will result in the following relationship in Eq. (12);
\[ \Delta R_G_t = \alpha + \rho R_G_{t-1} + \omega_2 F D + \sum_{j=1}^{p-1} \theta_j \Delta R_G_{t-1} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta F D_{t-j}^+ + \pi_j^- \Delta F D_{t-j}^-) + \varepsilon_t \] .................................................(18)

Equation (19) will apply if LR symmetry is rejected but not the SR;

\[ \Delta R_G_t = \alpha + \rho R_G_{t-1} + \omega_2^+ F D_{t-1}^+ + \omega_2^- F D_{t-1}^- + \sum_{j=1}^{p-1} \theta_j \Delta R_G_{t-1} + \sum_{j=0}^{q-1} \pi_j \Delta F D_{t-j} \\
+ \varepsilon_t \] .................................................(19)

The cumulative dynamic multiplier or the asymmetric responses of \( R_G_t \) to a unit change in \( F D_t^+ \) and \( F D_t^- \), respectively, based on the coefficients of eq. (11) is given as:

\[ m_h^+ = \sum_{j=0}^{h} \frac{\partial R_G t+j}{\partial F D_t^+}, \quad m_h^- = \sum_{j=0}^{h} \frac{\partial R_G t+j}{\partial F D_t^-}, \quad h = 0.12 \] .................................................(20)

As \( h \to \infty \) by construction, \( m_h^+ \to \beta^+ \) and \( m_h^- \to \beta^- \). As indicated earlier, \( \beta^+ \) and \( \beta^- \) represents the asymmetric long run coefficients. The dynamic multiplier (\( m_h^+ \) and \( m_h^- \)) traces the dynamic adjustment paths from the initial point to long-run equilibrium through short-run disequilibrium between the variables after the system is hit by a shock.

**Test for Causality Effect:**
The tests of SR and LR causality effect are based on the Wald statistics.

**SR Causality Effect:**
\[ H_0: \pi_j^+ = \cdots = \pi_{q-1}^+ = 0 \text{ for all } j = 0, \ldots, q-1. \]
\[ H_a: \pi_j^+ = \cdots = \pi_{q-1}^+ = 0 \text{ for all } j = 0, \ldots, q-1. \]

**LR Causality Effect:**
\[ H_0: \omega_2^+ = 0 \]
\[ H_a: \omega_2^- = 0 \]

**Strong Causality Effect**
The strong causality is a hybrid test that simultaneously involves both the SR and LR.
\[ H_0: \pi_j^+ = \cdots = \pi_{q-1}^+ = \omega_2^+ = 0 \]
\[ H_a: \pi_j^- = \cdots = \pi_{q-1}^- = \omega_2^- = 0 \]
5. Empirical Analysis

This section is focused on the data properties and the empirical outcome of the various tests.

5.1 Unit Root Test

Given that the NARDL cointegration procedure forbids the admittance of I(2) variables, we examined the unit root properties of the data using the Augmented Dickey Fuller (ADF). Table 1 clearly shows that the variables all fall into the I(1) and I(0) categories.

Table 1. Stationarity Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Test Statistic</th>
<th>Critical Value</th>
<th>Order of Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGDPG</td>
<td>-6.062</td>
<td>-3.738***</td>
<td>1</td>
</tr>
<tr>
<td>PSCGDP</td>
<td>-4.909</td>
<td>-2.664***</td>
<td>1</td>
</tr>
<tr>
<td>MKCGDP</td>
<td>-5.481</td>
<td>-2.664***</td>
<td>1</td>
</tr>
<tr>
<td>BCGDP</td>
<td>-5.643</td>
<td>-3.770***</td>
<td>1</td>
</tr>
<tr>
<td>CICGDP</td>
<td>-5.257</td>
<td>-4.498***</td>
<td>1</td>
</tr>
<tr>
<td>M2GDP</td>
<td>-3.556</td>
<td>-2.664***</td>
<td>1</td>
</tr>
<tr>
<td>TBAGDP</td>
<td>-3.705</td>
<td>-3.612**</td>
<td>0</td>
</tr>
</tbody>
</table>

*** stationary at 1% ** stationary at 5%

In order to detect asymmetric cointegration between the relevant variables, the Fpss statistic of Pesaran et al. (2001) was employed (Table 2). The test provides a good
inference on non-linear cointegration involving both stationary and non-stationary variables. The six bivariate non-linear autoregressive distributed lag models with CICGDP, TBAGDP, BCGDP, M2GDP, MKCGDP and PSCGDP as variables had the following lags, respectively, for the dynamic regressors: ARDL(1, 1, 0), ARDL(3, 4, 3), ARDL(1, 0, 0), ARDL(4, 3, 4), ARDL(1, 0, 0) and ARDL(1, 0, 0). The alkaike information criterion was automatically used to select these lags. Furthermore, the unit root with break test provides indication of structural break in 1998. To account for the break, two types of dummies were employed as fixed regressors to model both level shift and point shift. A level shift was assumed for all models except for the CICGDP framework where a point shift provided better performance. Linear and constant trends apply to CICGDP and TBAGDP models respectively.

Table 2. Bound Test

<table>
<thead>
<tr>
<th>Equation</th>
<th>$F_{PSS}$</th>
<th>Critical Value Bounds</th>
<th>Cointegration Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Significance (%)</td>
<td>Lower</td>
</tr>
<tr>
<td>CICGDP</td>
<td>5.55</td>
<td>2.5 4.41</td>
<td>5.52</td>
</tr>
<tr>
<td>TBAGDP</td>
<td>9.91</td>
<td>1 5.51</td>
<td>6.36</td>
</tr>
<tr>
<td>BCGDP</td>
<td>3.70</td>
<td>10 3.17</td>
<td>4.14</td>
</tr>
<tr>
<td>M2GDP</td>
<td>3.95</td>
<td>10 3.17</td>
<td>4.14</td>
</tr>
<tr>
<td>MKCGDP</td>
<td>3.45</td>
<td>10 3.17</td>
<td>4.14</td>
</tr>
<tr>
<td>PSCGDP</td>
<td>3.27</td>
<td>10 3.17</td>
<td>4.14</td>
</tr>
</tbody>
</table>

5.2 Cointegration and Symmetry Tests:

The null hypothesis of no cointegration could not be rejected in respect of four economic relationships involving BCGDP, M2GDP, MKCGDP, and PSCGDP in Table 2. In these instances, the $F_{PSS}$ test statistics lies between the lower and upper bounds at the 10 percent level of significance, thereby making the cointegration test inconclusive. At better levels of significance (below 10 percent), the evidence suggest that there is clearly no long-run relationship between the variables in the four bivariate models with BCGDP, M2GDP, MKCGDP, and PSCGDP as regressors.

However, the bounds tests of Pesaran et al. (2001) based on F-statistic reveal statistically significant evidence (at 5 percent and 1 percent levels) that support the existence of long-run cointegrating relationships in the CICGDP and TBAGDP models. In addition, the BDM cointegration test of Bernerji et al. (1998) provides corroborating evidence of cointegration. In the case of TBAGDP model, the computed $tBDM$ is 4.67 whereas the 10 percent, 5 percent, and 1 percent critical values are -2.91, 3.22 and -3.82. This result points to cointegration at the 1 percent level of significance. Similarly, the computed
tBDM for the CICGDP is 4.98 while the 10 percent, 5 percent, and 1 percent critical values are -2.91, -3.22 and -3.82. Again, there is evidence of cointegration.

We used the Wald statistic (WS) to test for symmetry. Given the WS of 1.15 and a p-value of 0.28, we cannot reject the null hypothesis of long-run symmetry in the CICGDP model. In the same vein, the WS of 6.31 and p-value of 0.01 provides evidence for the rejection of the null hypothesis of short-run symmetry. A reverse result was obtained with respect to the TBAGDP model. With a WS of 12.64 and p-value of 0.0004, we reject the null hypothesis of no long-run symmetry while we cannot reject the null of no short-run symmetry (WS is 2.00 and p-value is 0.16). Therefore, the traditional ARDL model is not the ideal method of investigation. Hence, the NARDL model used in this study is more appropriate. A robustness check using the traditional ARDL for all the models in Table 2 shows clearly that the cointegration tests are inconclusive, that is, no LR relationship (the output of these regressions can be made available on request from the authors). This further proves that the NARDL model is better.

In view of the existence of asymmetry in CICGDP and TBAGDP models, we proceed to discuss the long-run and short-run asymmetric dynamics as presented in Table 3. In the TBAGDP model, the coefficients of the positive and negative components of the explanatory variable have statistically important impact on the behaviour of the economic growth variable in the long-run (LR). A 1 percent increase in TBAGDP results in a statistically significant increase of 1.7 percent in RGDPG in the LR but a 1 percent decline in the total banking asset ratio will significantly reduce growth by 3.2 percent in the LR. Given the LR symmetry in CICGDP, the result indicates that a 1 percent change (an increase or a decrease) in the currency in circulation ratio will result in a symmetric change (a rise or a fall) in the growth outcome.

Table 3. Long Run Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-Value</th>
</tr>
</thead>
</table>

50
The SR asymmetric dynamics of the CICGDP model shows that negative swings in CICGDP will lead to a statistically significant decline in growth in the short-run (SR) (Table 4). The error correction term is negative as expected and the adjustment speed is 93 percent, meaning that economic growth adjust to 93 percent of the changes in CICGDP in the previous period. Thus, complete adjustment to a given change in CICGDP takes place almost within a year. The SR symmetry in TBAGDP implies that a given change in total banking asset generates a symmetric change in growth outcomes. The adjustment speed is 83 percent.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-statistic</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CICGDP+</td>
<td>8.310</td>
<td>1.307</td>
<td>6.357</td>
<td>0.000</td>
</tr>
<tr>
<td>CICGDP-</td>
<td>3.997</td>
<td>0.823</td>
<td>4.855</td>
<td>0.000</td>
</tr>
<tr>
<td>DUM</td>
<td>-2.774</td>
<td>2.114</td>
<td>-1.313</td>
<td>0.206</td>
</tr>
<tr>
<td>C</td>
<td>-8.356</td>
<td>2.221</td>
<td>-3.761</td>
<td>0.001</td>
</tr>
<tr>
<td>TBAGDP_POS</td>
<td>1.659</td>
<td>0.370</td>
<td>4.480</td>
<td>0.003</td>
</tr>
<tr>
<td>TBAGDP_NEG</td>
<td>3.211</td>
<td>0.697</td>
<td>4.607</td>
<td>0.003</td>
</tr>
<tr>
<td>DUM2</td>
<td>4.523</td>
<td>1.658</td>
<td>4.207</td>
<td>0.029</td>
</tr>
<tr>
<td>C</td>
<td>18.372</td>
<td>4.207</td>
<td>2.728</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 4. Short-Run Dynamics and Adjustments
CICGDP Model:
D(CICGDP*)  0.110  2.776  0.040  0.969
D(CICGDP-)  3.714  0.925  4.014  0.001
D(DUM)     -2.578  1.911 -1.349  0.194
ECM_1(-1)   -0.929  0.187 -4.980  0.000

TBAGDP Model:
D(RGDPG(-1))  0.464  0.183  2.540  0.039
D(RGDPG(-2))  0.322  0.187  1.719  0.129
D(TBAGDP*)   0.505  0.159  3.169  0.016
D(TBAGDP+(-1)) -1.406  0.393 -3.580  0.009
D(TBAGDP+(-2))  0.161  0.603  0.267  0.798
D(TBAGDP+(-3)) -0.703  0.290 -2.427  0.046
D(TBAGDP)    2.169  0.483  4.488  0.003
D(TBAGDP -1)) -0.117  0.409 -0.286  0.784
D(TBAGDP -2)) -0.301  0.217 -1.387  0.208
D(DUM2)      3.747  1.511  2.481  0.042
ECM_2(-1)    -0.829  0.177 -4.672  0.002

On the other hand, the net effect of TBA on economic growth is negative. This indicates that economic growth falls at a faster rate following declines in the TBA ratio and rises at a slower rate following increases in TBA. The implication is that the monetary authority should see to it that total banking asset to GDP is constantly rising by ensuring sustainable financial system stability. This is because any financial system crisis which ultimate cut total banking asset may quickly erode the positive TBA gains of several years.

5.3 Long-run Multipliers:
The long-run multipliers for both models are shown in Figures 3 and 4. The upper solid line represents the cumulative dynamics of real GDP growth with respect to a 1 percent increase (positive shock) in CICGDP while the lower dashed solid line denote the effect of 1 percent negative shock (decrease) hitting CICGDP on real GDP growth. The red thick dashed line between the 95 percent confidence intervals gives the difference between positive and negative responses. Figure 3 shows that the positive component
of CICGDP drives the asymmetry in relation to growth. Thus, the response of growth during times when CICGDP rises outweighs that in times of decline.

Furthermore, Figure 4 indicates that the asymmetric relationship between RGDPG and TBAGDP is driven mainly by the negative component of the latter. But between 2003 and 2006, the asymmetric response was driven by the positive component.

Figure 3. Long-run Multiplier for CICGDP Model

![Figure 3](image)

Figure 4. Long-run Multiplier of TBAGDP Model

![Figure 4](image)
5.6 Diagnostic Tests

In all the tests, the null hypothesis indicates that there is no serial correlation, no heteroscedasticity, and normally distributed errors. The two models passed all the diagnostic tests as seen in Table 5 as all the p-values exceed the various 5 percent levels of significance. The adjusted R-square in CICGDP and TBAGDP models are 0.72 and 0.84, respectively.

<table>
<thead>
<tr>
<th>Test</th>
<th>Test Statistic</th>
<th>p-Value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CICGDP Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breusch-Pagan_Godfrey</td>
<td>2.272</td>
<td>0.091</td>
<td>Homoscedasticity</td>
</tr>
<tr>
<td>Breusch-Godfrey LM test</td>
<td>0.044</td>
<td>0.836</td>
<td>No Serial</td>
</tr>
<tr>
<td>Breusch-Godfrey LM test</td>
<td>0.180</td>
<td>0.914</td>
<td>Correlation</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>0.72</td>
<td></td>
<td>Normally Distributed</td>
</tr>
<tr>
<td>Adj. R Square</td>
<td>1.111</td>
<td>0.466</td>
<td></td>
</tr>
<tr>
<td><strong>TBAGDP Model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breusch-Pagan_Godfrey</td>
<td>3.537</td>
<td>0.164</td>
<td>Homoscedasticity</td>
</tr>
<tr>
<td>Breusch-Godfrey LM test</td>
<td>4.359</td>
<td>0.113</td>
<td>No Serial</td>
</tr>
<tr>
<td>Breusch-Godfrey LM test</td>
<td>0.84</td>
<td></td>
<td>Correlation</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td></td>
<td></td>
<td>Normally Distributed</td>
</tr>
<tr>
<td>Adj. R Square</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The cusum and cusum squares graphs in Figures 5 and 6 is a further diagnostic test in terms of the stability of the model. Both models pass the stability test.

Figure 5. Cusum and Cusum Squares for CICGDP Model
Figure 6 Cusum and Cusum Squares for TBAGDP Model
6. Conclusion

This paper evaluates the asymmetric relationship between financial sector development and economic growth in Nigeria. Using the non-linear autoregressive distributed lag (NARDL) methodology, the outcome of the long-run and short-run analysis as well as the cumulative dynamic multipliers provides evidence of a net positive effect of CICGDP (currency in circulation ratio) on economic growth, whereas the net effect of TBAGDP (total banking asset ratio) on economic growth is negative. Furthermore, the speed at which the CICGDP and TBAGDP models adjust to their long run equilibrium given any short run disequilibrium is considered fast as almost full adjustment takes place within a year. This is important for monetary policy.

An increase in CICGDP will produce a higher upward swing on growth in contrast to a decline which results in a lower downward swing. This finding shows that rising CICGDP is associated with positive movements in growth, and this seems to imply that the desired effect of the cashless policy on the Nigerian economy is yet to be fully realised. The CICGDP ratio is a measure of the sophistication of the banking system. The a priori expectation is that overtime as CICGDP declines, economic growth should follow an upward trajectory because the drive towards a cashless society may reduce transactions costs associated with financial intermediation, promote capital accumulation and engender economic development. However, the degree of adoption of cashless policy is constrained by several factors, including the presence of a large informal sector. Consequently, more effort by stakeholders (the apex monetary authority and the deposit money banks) is required to accelerate the pace of adoption by: vigorously implementing the financial inclusion programme of the government in order to mainstream and integrate unbanked Nigerians into the formal financial system; relentlessly campaigning for greater use of the various electronic payment channels/products such as ATMs, NIP (NIBSS Instant Payment), Mobile Money, PoS (point of sale) terminals, E-Bills Pay, Internet Banking, amongst others; and, ensuring the ample availability and access to e-payment infrastructure nationwide, especially in rural areas.

On the other hand, the negative net effect of TBAGDP on economic growth indicates that growth falls at a faster rate following declines in the TBAGDP ratio and rises at a slower rate following increases. The significance of this is that the monetary authority
should consolidate on its close surveillance of the banking system because any financial system crisis which ultimately cuts total banking asset may quickly erode the positive TBA gains of many years.

On the balance (especially, in connection with total banking assets ratio), this work suggests that financial system development has not impacted significantly on economic growth in Nigeria. In this sense, this study corroborates some earlier findings which conclude that financial sector development does not support growth or is negatively related to growth in Nigeria (for instance, Nnanna (2004) cited in Madichie et al. 2014).
REFERENCES


