

FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN NIGERIA: ASYMMETRIC COINTEGRATION AND THRESHOLD ANALYSIS

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ABSTRACT

This study examines the nonlinear relationship between financial development and economic growth in Nigeria, covering the period from 1980 to 2018, in an effort to explain the direction of linearities and determine the exact threshold policy points for financial development variables. The financial development proxies adopted in the study are broad money and credit to the private sector. While deploying the nonlinear autoregressive distributed lag (NARDL) approach to ascertain the asymmetric cointegration status of financial development and GDP growth, the turning point between the variables of study is estimated using the threshold regression approach. The findings from the NARDL analysis show that the relationship between the financial development variables and economic growth are cointegrated in the long run and have a U-shaped asymmetrical relationship. Furthermore, the discrete threshold regression analysis reveals that while the switching point for broad money is 17.73% of GDP, it is 6.03% of GDP for credit to the private sector. Therefore, whenever the level of the financial development indicators falls below the estimated tipping point, there is a drag on the country's economic growth. The study recommends the implementation of the financial development threshold points as the minimum levels by which to achieve positive effects on the country's economic growth. A further recommendation to achieve rapid progress in financial development entails the rapid monetisation of financial transactions and the expansion of financial access as well as the strengthening of efficiency and regulation of the financial markets.

KEY WORDS

Financial development, broad money, credit to private sector, economic growth, Nonlinear Autoregressive Distributed Lag (NARDL), Threshold Regression.

DOI: 10.23762/FSO_VOL8_NO4_3

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Introduction

In the development of nations, financial development has been closely related to economic growth in the fields of economics and finance. For many decades, even without implying causality, several studies have concluded that finance is positively

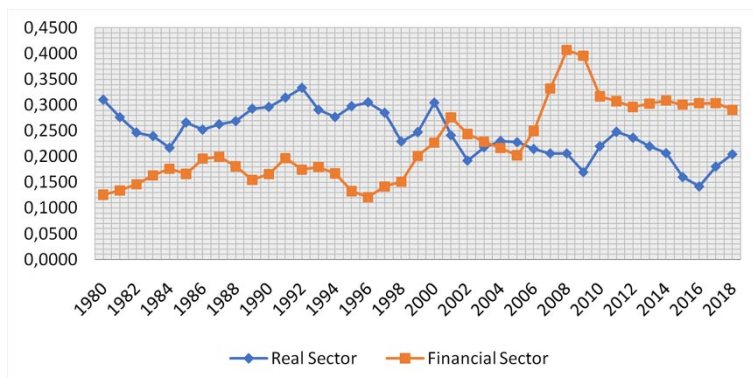
associated with growth. However, there are both theoretical and empirical ambiguities in considering the direction of causality between finance and growth (Adusei, 2013). One of the earliest studies on the relationship between finance and growth,

by Schumpeter in 1911, posited that a well-functioning financial system promotes the growth of an economy (Adusei, 2012). While the Schumpeterian proposal amassed support from other early empirical studies on the subject matter (Gurley and Shaw, 1955; McKinnon, 1973; Ben-civenga and Smith, 1991), other writers, led by Robinson (1952) and supported by Friedman and Schwartz (1963) and King and Levine (1993), differed on the direction of causality between finance and growth.

More recent studies covering the debate on the relationship between finance and growth concern the nonlinear relationship between the variables (Mihci, 2003; Rioja and Valev, 2004; Inuobli and Khallouli, 2011). The proponents of the nonlinear hypothesis argue in favour of a switching trend in the relationship between finance and growth. The threshold relationship takes the form of a U-shape or an inverted U-shape depending on the effect of financial development on economic growth in

the development process of a nation. The issues of nonlinearities in the inter-relationship between financial development and economic growth in Nigeria came to the fore at the end of the four phases of the country's financial reforms in 2010. With the huge volume of liquidity at the disposal of banks in the country's financial system at the end of 2009, some authors have argued that the banks were in direct competition with firms in the real sector for the country's available financial liquid resources (Adekunle et al., 2013; Uremadu et al., 2016). Hence, the authors contend that the over-regulation of the country's financial system over the years has brought financial disintermediation to the producing sectors of the economy. Furthermore, Adekunle et al. (2013) opine that the financial sector may not only have been in competition with the producing sectors of the economy for the resources available, but could have directly contributed to retarding their growth.

Figure 1. Real sector and financial sector growth



Source: Own elaboration based on Central Bank of Nigeria Annual Statistics.

A study of the trends in Figure 1 shows that the phenomenal growth of the financial service sector compares very unfavourably with the growth in the producing (real) sector of the Nigerian economy (CBN, 2019). The output of the real sector was higher than that of the financial sector

between 1980 and 2000. However, since 2006 (after the Soludo banking consolidation exercise), the growth of the financial sector has outpaced that of the real sector of the economy.

The disparity between the growths of both sectors reached a peak in 2009,

which marked the end of the banking consolidation exercise in the country. Thus, it becomes imperative to ask whether the volume of available financial services in the economy has grown too large for the level of economic activity in other sectors of the economy. Arcand et al. (2012) and Samargandi et al. (2015) maintain that when the relative growth of the financial sector is faster than the growth of the other sectors of the economy, a switching point is reached where there is 'too much finance' for the level of economic activity. Furthermore, Mesagan et al. (2019) show the existence of a long-term relationship between both short- and long-term financial market indicators and economic growth. This study intends to examine the nonlinear relationship between financial development and economic growth in Nigeria and focuses on the direction of linearities and the exact threshold policy points for the proxy financial development variables. The justification for this study stems from the fact that earlier studies on the Nigerian economy in this subject area could only emphasise the direction of the nonlinear relationship between financial development and economic growth without establishing the specific switching point between the variables (Rafindadi and Yusof, 2014; Adeniyi et al., 2015). This study intends to re-examine the nature of linearity between financial development and economic growth (using an asymmetric cointegration test) and establish the specific turning points between the variables (using threshold regression) so as to come up with policy suggestions on how to improve financial development in Nigeria based on the results from the nonlinear analyses.

Following this introduction is section one, which reviews the literature on the subject matter of this study. While section two focuses on the theoretical framework and methodology of the study, section three

discusses the analysis of data and interpretation of the results. Section four presents a summary of the conclusions and policy recommendations from the study.

1. Literature review

A large volume of empirical literature exists on the relationship between financial development and economic growth. The earliest set of studies on the relationship between finance and growth proposes that finance exerts a causal effect on growth. Along this line, Schumpeter posits that a well-functioning financial system promotes the economic growth and welfare of an economy (Adusei, 2012). The Schumpeterian proposal posits the existence of the "supply-leading hypothesis" based on the unidirectional causality flowing from financial development to economic growth (Gurley and Shaw, 1955; McKinnon, 1973; Bencivenga and Smith, 1991; Abu-Bader and Abu-Qarn, 2008; Ogwumike and Salisu, 2010; Alenoghena, 2014; Ugbaje and Ugbaje, 2014; Mahawiya, 2014; Ali et al., 2015; Adayleh, 2018). On the other hand, Robinson (1952) proposes that financial development is the outcome of growth in the real economy; hence, where 'enterprise leads finance follows'. Robinson's proposal, which is called 'the demand-following hypothesis' or 'growth-led finance hypothesis' argues that causation runs from growth to finance and has found support in the works of several other authors (Friedman and Schwartz, 1963; Odhiambo, 2007; Saibu et al., 2009; Muhammad and Umer, 2010; Ndlovu, 2013; Adeyeye et al., 2015; AbuAl-Foul et al., 2016).

The third set of studies advocates the complementary or feedback hypothesis. The results of the feedback hypothesis confirm that bidirectional causality exists between finance and growth. Therefore, the results indicate a mix of two-way causation between financial development and

economic growth (Hassan et al., 2011; Adusei, 2013; Ishioro, 2013; Onuonga, 2014). Another contribution to the debate between finance and growth is the negative causal link hypothesis which opines that finance could have a detrimental effect on economic growth. While King and Levine (1993) argue that financial repression reduces the output of capital and lowers savings which impede economic growth, Lucas dismisses finance as an essential cause of economic growth, insisting that finance is an „over-stressed” determinant of growth (Ogbonna et al., 2013). Also, Mahawiya (2014), while summarising the opinions of McKinnon, Shaw, King and Levine, contends that the various constraints exerted by governments on the banking system may slow financial sector development, and thus would portend an adverse effect on economic growth.

Furthermore, recent studies on the relationship between finance and growth show that the interaction between the variables requires further research work to be thoroughly understood. In this direction, recent empirical findings on the finance and growth nexus suggest the existence of some pronounced discontinuities and nonlinearities. The empirical evidence of a nonlinear relationship between finance and growth is associated with varying outcomes. Some authors (Mihci, 2003; Rioja and Valev, 2004; Oro and Alagidede, 2019; Elya et al., 2019) conclude that financial development will only exert a positive effect on economic growth when it has reached a certain threshold; hence, finance has a U-shaped effect on growth. Contrary to this position, other authors (Inuobli and Khallouli, 2011; Cecchetti and Kharroubi, 2012; Samargandi et al., 2015; Swamy and Dharani, 2019; Barra and Ruggiero, 2020) argue that the relationship portrays an inverted U-shape effect of finance on growth, meaning that financial develop-

ment contributes to economic growth up to a threshold point, beyond which the outcome becomes a drag.

Another set of studies concludes that the relationship between financial development and economic growth is monotonic and linear; hence, there is very low or no threshold in the relationship between the variables (Rafindadi and Yusof, 2013; Egert and Jawadi, 2018). The final set of studies discusses the non-monotonic and nonlinear relationship between financial development and economic growth without the specification of the exact nature and direction of the threshold (Nieh et al., 2009; Inuobli and Khallouli, 2011; Arcand et al., 2012; Cecchetti and Kharroubi, 2012; Ýyidođan, 2013; Adeniyi, et al., 2015; Alaabed and Masih, 2016). The empirical results of studies in this category merely suggest the existence of a nonlinear relationship between finance and growth without an indication of the specific nature of the nonlinear relationship.

There are few existing studies on the nonlinear relationship between financial development and economic growth which estimate the exact threshold point between the variables and show the precise nature of the relationship between them (whether U-shaped or otherwise). The two known critical studies conducted on the Nigerian economy have clear deficiencies. While Adeniyi et al. (2015) conclude that the relationship between the variables is non-monotonic, they could not finalise a specific threshold point for financial development. Also, Rafindadi and Yusof (2014) concluded that the relationship between the variables is non-monotonic and nonlinear based on the choice of proxy for financial development that was used in the study. The study used Principal Component Analysis (PCA) to estimate a composite proxy for financial development, thus leaving out the opportunity to determine an exact threshold for any

of the important policy variables that are specified and often utilised as a proxy for financial development by the Central Bank of Nigeria (broad money and credit to the private sector). This study fills this lacuna by estimating the nonlinear relationship and threshold point for broad money and credit to the private sector on economic growth, and testing for the nature of the relationship between financial development and economic growth (whether it is U-shaped or otherwise).

2. Theoretical background

The framework for analysing this study is based on the Solow growth model, as presented in Romer (2006). In presenting this version of the neoclassical growth model, some important assumptions are made about the costs of productive resources such as capital, labour and technology. Y is GDP, K is capital and L is labour. However, capital can be further subdivided into financial development and gross fixed capital formation. As a result of modernisation and trade liberalisation, labour in African countries can actually be regarded as effective labour (AL). If labour and knowledge grow at constant rates, then, at a particular point in time,

$$\dot{L}(t) = nL(t), \text{ and } \dot{A}(t) = gA(t) \quad (1)$$

$$\text{Where } \dot{L}(t) = \frac{dL(t)}{dt} \text{ and } \dot{A}(t) = \frac{dA(t)}{dt}$$

Therefore, labour and technology grow at n and g rates respectively. Hence, total output may be subdivided into investment and consumption. The part of total output which is allocated to investment, s , is defined as constant and exogenous. Thus, a unit of total output that may be allocated to investment would produce one unit of new capital. Furthermore, the rate of depreciation of existing capital is given as δ . Therefore,

$$\dot{K}(t) = sY(t) - \delta K(t) \quad (2)$$

Hence, output per unit of labour can be derived by dividing equation (1) by AL:

$$\frac{Y}{AL} = F\left(\frac{K}{AL}, \frac{AL}{AL}\right) = F\left(\frac{K}{AL}, 1\right) \quad (3)$$

Hence, $\frac{Y}{AL}$ = output per unit of effective labour, and $\frac{K}{AL}$ = capital per unit of effective labour

$$\text{Further definition: } k = \frac{K}{AL}, y = \frac{Y}{AL}, \text{ and} \\ = f(k) = F(k, 1)$$

The entire equation can now be written as $y = f(k)$. It can be interpreted that output per unit of effective labour depends on capital per unit of effective labour. This functional relationship shows that when labour utilises zero capital, then total production comes to zero [$f(0) = 0$]. Since

$F(K, AL)$ equals $ALf\left(\frac{K}{AL}\right)$, it can be concluded that the marginal product of capital

$\frac{\partial F(K, AL)}{\partial K} = ALf'\left(\frac{K}{AL}\right)$, which is the same thing as $f'(k)$. The model further assumes that $f'(k) > 0$ and $f''(k) < 0$. This shows that the marginal product of capital is positive, but will decline as the capital-labour ratio goes beyond a certain point. On the contrary, the productivity of labour rises with an increase in the K/L ratio. In analysing developing economies, where there is an abundance of labour, this combines with less capital; thus, the marginal product of labour is less than the marginal product of capital. Besides, the situation becomes worse as K/AL declines with time when more labour and technology is added to the depreciation of the existing capital. The dynamics of k can be estimated by adopting the chain rule in differential calculus, as follows:

$$\begin{aligned} \dot{k}(t) &= \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{[A(t)L(t)]^2} [A(t)\dot{L}(t) + L(t)\dot{A}(t)] \\ &= \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)} \frac{\dot{L}(t)}{L(t)} - \frac{K(t)}{A(t)L(t)} \frac{\dot{A}(t)}{A(t)} \end{aligned} \quad (4)$$

Recall that $K/AL = k$ and observe that $\frac{\dot{L}(t)}{L(t)} = n$ and $\frac{\dot{A}(t)}{A(t)} = g$ from equation (2), hence substitute into (4) to obtain the following:

$$\begin{aligned} \dot{k}(t) &= \frac{sY(t) - \delta K(t)}{A(t)L(t)} - k(t)n - K(t)g \\ &= s \frac{K(t)}{A(t)L(t)} - \delta k(t) - nk(t) - gk(t) \end{aligned} \quad (5)$$

Note that k is a function of K , L , and A . Each of them is a function of t , hence

$$\dot{k} = \frac{\partial k}{\partial K} \dot{K} + \frac{\partial k}{\partial L} \dot{L} + \frac{\partial k}{\partial A} \dot{A} \quad (6)$$

Given that $f(k) = Y/AL$, it can be concluded that

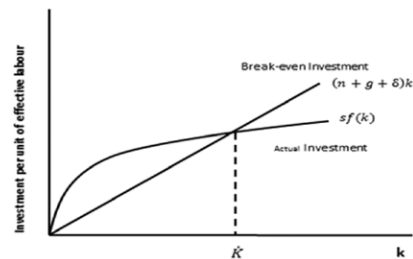
$$\dot{k}(t) = sf[k(t)] - (n + g + \delta)k(t) \quad (7)$$

The equation given by (7) is the cardinal equation of the Solow Model. This can be interpreted to mean that the difference between the two terms in the equation shows the rate of change of the capital stock per unit of effective labour. One, the actual investment per unit of effective labour at a point in time is $sf[k(t)]$; hence, $f(k)$ is the actual investment per unit of effective labour at a specified time, and s is the fraction of that output that is invested. Two, the break-even investment is given by $(n + g + \delta)k(t)$. The break-even investment refers to the investment which is required to maintain k at the existing level. Therefore, the break-even investment is the capital which is required to ensure steady growth. In less developed economies such as the African countries, the capital-labour ratio falls below the point $\hat{k}$; hence, the ratio will fall as a result of the depreciation of existing capital as new effective labour is recruited.

Figure 2 shows the match between the actual and break-even levels of investment which is required to maintain a steady-state level of output in the economy given

the supply of effective labour. While the investment per unit of effective labour is presented on the vertical axis, the horizontal axis shows the output per unit of effective labour is $f(k)$. Furthermore, $sf(k)$ shows the total actual investment that accrues as a result of the employment of the unit labour and capital, noting that the portion of that output which is reinvested is s . Therefore, the break-even point of the investment which is required at any level of the economy is $(n + g + \delta)k$. The break-even point represents the amount of investment that must be undertaken for k to maintain the steady-state. To ensure that $\dot{K}$ does not drop below the required level, an optimal level of capital replacement must be undertaken, particularly in developing economies such as those in Africa. The level of capital replacement must be undertaken on a steady basis to engage the employment of abundant labour supply.

Figure 2. Actual & Break Even Investment



Source: Romer, 2006.

3. Methodology

3.1. Data sources

This research study utilises the NARDL model over the period of 1980 to 2018 to estimate the asymmetric cointegration of financial development changes in economic growth. Furthermore, the study adopts the threshold regression approach to establish the critical point at which financial development elicits a tipping point on changes in economic growth. The variables adopted include GDP growth and broad money and

credit to the private sector by banks. The full name, description and sources of the data are presented in Table 1. The study relies on secondary data, namely sources from World Development Indicators (World

Bank) WDI. The World Development Index (World Bank) data for Nigeria can be obtained under the link: <https://data.world-bank.org/country/NG>.

Table 1. Variable description, measurement and data source

Variable	Description and Measurement	Source
GDPR	Economic growth is the annual percentage growth rate of GDP at market prices: defined as $\left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right)\%$ for each year	WDI
BMON	Broad money is defined by the value of currency outside banks; demand deposits other than those held by the federal government; the time, savings, and foreign currency deposits of resident sectors other than the federal government. It is divided by GDP.	WDI
PCRED	Domestic credit to the private sector is the sum of financial resources provided to the private sector like financial corporations, such as trade credits, through loans and purchases of non-equity (taken as share of GDP).	WDI

Source: Own elaboration.

3.2. The asymmetric cointegration (NARDL) approach

The nonlinear ARDL model for modern applications was developed by Shin et al. (2014). The approach utilises both positive and negative partial sum decompositions for estimating the asymmetric effects on the variables in both the short and long run. The NARDL approach is an improvement in the orthodox cointegration models as it gives a better result when the sample is small, and the purpose is to determine the long-run relationship (Romilly et al., 2001).

Furthermore, NARDL can be applied to variables with a different order of integration - with stationarity at level [I(0)] or at first difference [I(1)] except for variables that are stationary at second difference [I(2)]. Furthermore, the technique will reveal the concealed cointegration between the variables, and this exposes the effect of positive or negative variation of financial development on economic growth in the short run and long run. The asymmetric long-run equation of economic growth and financial development can be specified:

$$GDPR_t = \alpha_0 + \alpha_1 GDPR_{t-1} + \alpha_2 FDEV_{t2}^+ + \alpha_3 FDEV_{t3}^- + \mu_t \quad (8)$$

Where α_0 to α_3 are the long-run coefficients of the cointegrating vectors and $FDEV_{t2}^+$ and $FDEV_{t3}^-$ are the partial sums of

positive and negative changes in financial development.

$$FDEV_{t2}^+ = \sum_{i=1}^t \Delta FDEV_{t2}^+ = \sum_{i=1}^t \max(\Delta FDEV_{ti}, 0) \quad (9)$$

and

$$FDEV_{t2}^- = \sum_{i=1}^t \Delta FDEV_{t2}^- = \sum_{i=1}^t \min(\Delta FDEV_{ti}, 0) \quad (10)$$

The long-run relationship between growth and financial development is reflected in the coefficient α_2 and is expected to be positive. Meanwhile, α_3 captures the long-run relationship between

growth and financial development when it turns negative. However, the relationship between the variables is expected to be more positive than negative, hence $\alpha_2 > \alpha_3$. Therefore, the long-run relationship that

is presented in equation (8) captures the asymmetric long-run financial development that affects growth. In line with Shin et al. (2014), equation (10) can be modelled in

$$\Delta GDPR_t = \alpha + \beta_0 GDPR_{t-1} + \beta_1 FDEV_{t-1}^+ + \beta_2 FDEV_{t-1}^- + \sum_{i=1}^p \phi_i GDPR_{t-i} + \sum_{i=0}^q (\theta_i^+ \Delta FDEV_{t-1}^+ + \theta_i^- \Delta FDEV_{t-1}^-) + \mu_t \quad (11)$$

Where p and q are the lag orders and $a_2 = -\beta_1/\beta_0$ and $a_3 = -\beta_2/\beta_0$, expressing the long-run impacts of the respective changes in terms of the increase and decrease in financial development. However, $\sum_{i=0}^S \theta_i^+$ measures the short-run positive effect of financial development on growth while $\sum_{i=0}^S \theta_i^-$ measures the short-run negative effect of financial development on growth. Equation (11) may be estimated using the regression estimation method while adopting the general-to-specific procedure to arrive at the specification of the NARDL model by trimming insignificant lags. The next step is to test for the presence of

an ARDL framework in consonance with the proposal of Pesaran and Shin (1998) as follows:

cointegration among the variables using the traditional bound testing approach as stipulated by Pesaran et al. (2001). This step entails confirmation from the Wald F-statistic test with the null hypothesis: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = 0$. On confirming the presence of cointegration, the short-run and long-run asymmetries in the relationship between financial development and economic growth can be examined. Furthermore, the asymmetric cumulative dynamic multiplier effects of a one per cent change in $FDEV_{t-1}^+$ and $FDEV_{t-1}^-$ can be estimated respectively as shown in equation (13):

$$m_h^+ = \sum_{j=0}^h \frac{\partial GDPR_{t+j}}{\partial FDEV_{t-1}^+}, \quad m_h^- = \sum_{j=0}^h \frac{\partial GDPR_{t+j}}{\partial FDEV_{t-1}^-}, \quad h = 0, 1, 2, 3, \dots \quad (12)$$

Note that as $h \rightarrow \infty$, $m_h^+ \rightarrow a_2$ and $m_h^- \rightarrow a_3$. Hence, the dynamic multipliers capture the positive and negative effects of financial development on economic growth as the economy transits from an initial equilibrium to the new equilibrium.

3.3. Threshold Regression Approach

The threshold model is designed to test for the presence of a tipping point in the growth-promoting attribute that is as-

sociated with financial development. The threshold regression model is adopted for this study because it generates a simple yet very reliable way to model the nonlinear relationships between the predictor and outcome. With the method, there is consistency in the estimating procedure such that the type 1 error rates of the Monte Carlo approach are very apt in their applicability to indicative finite samples (Fong et al., 2017). A threshold regression model is given by

$$y_t = \alpha + \beta_0' x_t + \beta_1' x_t h(q_t; \theta) + \varepsilon_t \quad (13)$$

Where y is the dependent variable, β_0 and β_1 represent $K \times 1$ vectors, θ is the vector of parameters and $h(q_t; \theta)$ is the transition function. Where the transition function is presented in a binary function, then it is given as

$$h(q_t; \theta) = \begin{cases} 1 & \text{if } q_t \geq \gamma \\ 0 & \text{if } q_t < \gamma \end{cases} \quad (14)$$

Hence equation 13 can be presented as

$$y_t = \alpha + \beta_0' x_t + \beta_1' x_t \mathbb{I}(q_t \geq \gamma) + \varepsilon_t \quad (15)$$

Where $\mathbb{I}(\cdot)$ presents the indicator function, γ is the location parameter, and q represents the threshold variable that divides the sample into the various regimes; x is the explanatory variable(s); y is the dependent variable; and ε is the stochastic error term.

The existence of a limit would result in the threshold effect arising from the asymmetrical response of economic growth to the money supply or domestic credit to the private sector. The regime switching mechanism depends on the location parameter γ and the threshold variable q . In

this case, there are two regimes which are presented by the slope parameters β_0 and $\beta_0 + \beta_1$ as follows:

$$y_t = \alpha + (\beta'_0 + \beta'_1)x_t + \varepsilon_t \text{ if } q_t \geq \gamma \quad (16)$$

$$y_t = \alpha + \beta'_0 x_t + \varepsilon_t \text{ if } q_t < \gamma \quad (17)$$

The estimation process began with the computation of the sum of square errors (SSE) for a designated threshold. The next step is to minimise the sum of squares to arrive at $(\bar{\gamma})$. As a follow-up, an F-Test is conducted to decide if a threshold exists by testing a null hypothesis that is specified as follows:

$$F(\gamma) = \frac{(SSE_0 - SSE_1(\bar{\gamma}))/1}{SSE_1(\bar{\gamma})/n(T-1)} = \frac{(SSE_0 - SSE_1(\bar{\gamma}))}{\hat{\sigma}^2} \quad (18)$$

A threshold effect exists if the null hypothesis from the F-Test is rejected. However, a bootstrap approach is often adopted to estimate the asymptotic distribution of the required test statistic as a way to test for the significance of the threshold effect (Hansen, 2000). In furtherance of the objective, the confidence interval may be constructed in favour of γ by utilising the likelihood statistic ratio. Therefore, the hypothesis for the study may be stated thus:

$$H_0: \gamma = \gamma_0$$

$$H_1: \gamma \neq \gamma_0$$

To effectively test the hypothesis, equation (15) will be estimated:

$$LR_1(\gamma) = \frac{(SSE_1(\gamma) - SSE_1(\bar{\gamma}))}{\hat{\sigma}^2} \quad (19)$$

When it is observed that the value of $LR_1(\gamma)$ is very large such that the p-value is lower than the theoretical (table) value, the null hypothesis (H_0) is rejected.

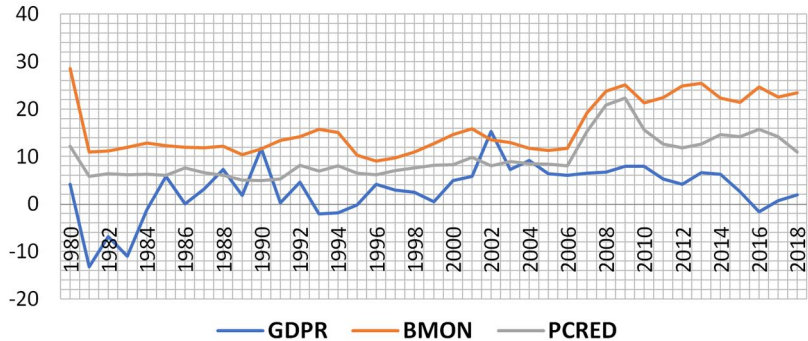
4. Research results

4.1. Trends in the relationship between financial development and economic growth

The trend pertaining to the relationship between financial development and economic growth in Nigeria is shown in Figure

3. The graph does not show a clear pattern in the relationship between economic growth (GDPR) and the financial development variables which are represented by broad money (BMON) and credit to the private sector (PCRED). Nonetheless, some points indicate a negative relationship between economic growth and financial development. For instance, the periods covering 1992 and 1995 and 1996 to 2001 both indicate a negative relationship between financial development and economic growth. Also, the period between 2015 and 2018 reinforces the negative relationship between financial development and economic growth in Nigeria. Hence, on a general note, the relationship between financial development and economic growth is negative.

Figure 3. Trends in economic growth and financial development over 38 years



Source: Own elaboration based on Central Bank of Nigeria Annual Statistics.

4.2. Correlation of regressors

The correlation of all the variables in the study is shown in Table 2. The result shows that the financial development variables have low correlation with economic growth. While the correlation of credit to the private sector with economic growth is 0.28, the correlation value of broad money with economic growth is 0.19. As expected, the correlation of the financial development variables amongst themselves is high at 0.83. This is not important because the variables are separated when analysed with economic growth.

Table 2. Correlation matrix of regressors

	GDPR	PCRED	BMON
GDPR	1	0.2848	0.1878
PCRED	0.2848	1	0.8339
BMON	0.1878	0.8339	1

Source: Own elaboration.

4.3. Time series properties: Unit Root Test

The unit root test conducted for this study adopts the Augmented Dickey-Fuller (ADF) Approach. The test is conducted on three variables, namely economic growth, broad money and credit to the private sector, with the results presented in Table 3.

Table 3. ADF Unit Root Test

Method			Statistic	Prob.*	
ADF - Fisher Chi-square			95.9606	0.0000	
ADF - Choi Z-stat			-8.7934	0.0000	
Series	t-stat	Prob.	Order of Integra- tion	Max Lag	Obs
D(GDPR)	-11.468	0.0000	I(1)	2	37
D(BMON)	-4.7218	0.0005	I(1)	2	37
D(PCRED)	-5.1707	0.0002	I(1)	2	37
Test critical values:	1% level		-3.6268		
	5% level		-2.9458		
	10% level		-2.6115		

Source: Own elaboration.

At level [I(0)], the estimated values of the t-statistics for all the variables (GDPR, BMON and PCRED) are all greater than the critical values at 1%, 5% and 10%. However, at first difference [I(1)], all values of the t-statistics are less than the critical values at all levels of significance. Therefore, at first difference [I(1)], all the variables become stationary since the calculated probability values are less than the theoretical values at all levels of significance.

4.4. The nonlinear relationship between credit to the private sector and economic growth

The estimation of the nonlinear relationship between credit to the private sector

and economic growth is executed in two stages: firstly, the estimation of the asymmetric cointegration using the NARDL approach; and secondly, the estimation of the turning point between the variables using the threshold regression approach. The NARDL approach estimation process utilises the Stepwise Least Squares (STEPLS) regression by inputting the economic growth as the dependent variable, and this is followed with the input of credit to the private sector as the regressor. The first step in testing for the asymmetric cointegration of the variables involves the estimation of values for the two auxiliary models that are derived from our equation (9) as follows:

$$GDPR_t^- + \Delta GDPR_t^+ = \beta_0^- + \beta_1^- PCRED_t^- + \varepsilon_{1t} \quad (20)$$

$$GDPR_t^+ + \Delta GDPR_t^- = \beta_0^+ + \beta_1^+ PCRED_t^+ + \varepsilon_{2t} \quad (21)$$

To test for asymmetric cointegration, we proceed to generate values for three new variables:

1. The difference of GDPR which is $\Delta GDPR$,
2. The positive cumulative values for PCRED ($PCRED_t^+$) which is defined as PCRED_p, and
3. The negative cumulative values of PCRED ($PCRED_t^-$) which is defined as PCRED_n

The set of differentiated variables is set at the chosen lag. In this estimation, the fourth lag is used. The goal is to select the model specification with the appropriate lags.

The next step is to run a stepwise regression for the variables using the appropriate lags. The result of the stepwise regression is presented in Table 4. From the table, we can obtain the long-run equation for the relationship between economic growth and credit to the private sector as follows:

$$GDPR = -1.1058PPCRED_P + 0.3832PCRED_N \quad (22)$$

The negative coefficient on the PCRED_P which is followed by the positive coefficient on PCRED_N gives a prima facie position

that the relationship between economic growth and credit to the private sector seems to be asymmetric in the long run.

Table 4. Stepwise Regression Result for NARDL (GDPR)

Dependent Variable: D(GDPR)			
Method: Stepwise Regression			
Sample (adjusted): 1974 - 2018			
Independent Variable :PCRED		BMON	
Variable		Variable	Coeff.
C	-24.0825*	C	0.5253

	(0.0002)		(0.8269)
GDPR(-1)	-0.8576*	GDPR(-1)	-0.8725*
	(0.0000)		(0.0000)
CREDPRIV_P(-1)	-0.9483*	BMONEY_P(-1)	-0.0779
	(0.0004)		(0.6937)
CREDPRIV_N(-1)	0.3286*	BMONEY_N(-1)	0.036
	(0.0001)		(0.4246)
DCREDPRIV_N	0.7439*		
	(0.0007)		
DCREDPRIV_P(-2)	1.6822*		
	(0.0055)		
DCREDPRIV_N(-2)	0.5358*		
	(0.0124)		
GDPR(-2)	-0.3681*		
	(0.0327)		
R-squared	0.6906	R-squared	0.4444
Adjusted R-sq.	0.6072	Adjusted R-sq.	0.3907
F-statistic	8.2888	F-statistic	8.2658
Prob(F-stat)	0.0000	Prob(F-stat)	0.0003
Durbin-Watson	2.0286	Durbin-Watson	1.9159

Source: Own elaboration.

The long-run equation suggests that the nonlinear relationship between credit to the private sector and economic growth is U-shaped. The result of the Asymmetric Cointegration Test is shown in Table 5.

Since the calculated F-statistic = 13.9676 is larger (Pesaran et al., 2001) than the critical value of F-010 = 7.84 (Table 6), the null hypothesis of no difference between the coefficients c(2), c(3) and c(4) is rejected.

Table 5. Asymmetric cointegration test

Wald Test: GDPR & PCRED				GDPR & BMON		
Test Stat.	Value	Df	Prob.	Value	Df	Prob.
F-statistic	13.9676	(3, 26)	0.000	8.2658	(3, 31)	0.0003
Chi-square	41.9028	3	0.000	24.7974	3	0
Null Hypothesis: C(2)=C(3)=C(4)=0						

Source: Own elaboration.

Table 6. Critical Values of Pesaran et al. (2001)

Table CI(iii) Case III: Unrestricted intercept and no trend

k	0.100		0.050		0.025		0.010		I(0)
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	
0	6.58	6.58	8.21	8.21	9.80	9.80	11.79	11.79	3.05
1	4.04	4.78	4.94	5.73	5.77	6.68	6.84	7.84	2.03
2	3.17	4.14	3.79	4.85	4.41	5.52	5.15	6.36	1.69
3	2.72	3.77	3.23	4.35	3.69	4.89	4.29	5.61	1.51

Source: Pesaran et al., 2001.

Thus, there is evidence in support of a long-run equilibrium cointegration relationship between economic growth and credit to the private sector which is significant at the 0.01 level.

Table 7. Test for asymmetry

Wald Test: GDPR & PCRED			GDPR & BMON			
Test Stat.	Value	Df	Prob.	Value	Df	Prob.*
t-statistic	-3.6107	26	0.0013	-4.9431	31	0.000
F-statistic	13.0373	(1, 26)	0.0013	24.4341	(1, 31)	0.000
Chi-square	13.0373	1	0.0003	24.4341	1	0.000
Null Hypothesis: $-C(3)/C(2) = -C(4)/C(2)$						

Source: Own elaboration.

The conclusion is that both the positive change and the negative change in credit to the private sector have a long-run positive effect on economic growth. However, further examination would be required in order to confirm whether the coefficients are statistically asymmetric. The final step involves an asymmetry test which is required to confirm whether the NARDL coefficients of economic growth and credit to the private sector in the long run are equal or not. The test result is shown in Table 7. The test for asymmetry involves a Wald test for the significance of the equality of the positive

change and negative change of the coefficients of credit to the private sector with respect to economic growth as contained in the long-run equation: $-c(3)/c(2) = -c(4)/c(2)$. The Wald test result shows that the F-statistic (13.0373) and probability (0.0013) indicate the rejection of the null hypothesis of equality between the positive and negative changes in credit to the private sector with respect to economic growth (no asymmetry). Therefore, the relationship between GDPR and PCRED is asymmetrical (not equal) in the long-run.

Table 8. NARDL (PCRED, BMON & GDPR) model diagnostics

GDPR & PCRED		GDPR & BMON	
Breusch-Godfrey Serial Corr. LM Test:			
F-statistic:	0.61306	F-statistic:	0.1706
Prob. F(2,24):	0.5500	Prob. F(2, 29):	0.8440
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic:	1.4934	F-statistic:	0.2820
Prob. F(7,26):	0.2133	Prob. F(3, 31):	0.8380
Normality Test			
Jarque-Bera:	15.9897	Jarque-Bera:	89.1556
Probability:	0.0003	Probability:	0.0000

Source: Own elaboration.

The diagnostics for the GDPR and PCRED (NARDL) model is shown in Table 8. The value of the Durbin-Watson statistic (2.0286) indicates the absence of serial correlation in the model. This position is strengthened by the Breusch-Godfrey Serial Correlation Test [with F-statistic (0.6131)

and probability (0.5500)] showing that the null hypothesis of no serial correlation cannot be rejected.

Furthermore, the Breusch-Pagan-Godfrey heteroskedasticity test [with F-statistic (1.4934) and probability (0.2133)] indicates that we cannot reject the null hypothesis of

homoskedasticity. The model is free from heteroskedasticity. Also, the normality test [with Jarque-Bera (15.9897) and probability (0.0003) indicates that the null hypothesis of normal distribution is rejected. The distribution is not normal.

4.5. Threshold Regression of credit to the private sector on economic growth

The purpose of the threshold regression analysis is to identify the turning point at

which credit to the private sector becomes asymmetrical. The specification for threshold analysis between the variables is shown in Table 9. The investigation is based on the Bai-Perron (2003) critical values for the threshold and it shows the threshold value for credit to the private sector with respect to economic growth in terms of sequential and repartition values.

Table 9. Threshold Regression result

Dependent Variable: GDPR			
Method: Discrete Threshold Regression			
Threshold variable: PCRED		BMON	
Variable	Coeff.	Variable	Coeff.
PCRED < 6.0398 -- 4 obs		BMON < 10.9502 -- 9 obs	
C	-140.6766	C	2.6953
	(0.0007)		(0.0162)
PCRED	-26.6359	BMON	-8.3514
	(0.0007)		(0.0148)
6.0398 <= PCRED -- 35 obs		17.7322 <= BMON -- 38 obs	
C	0.0816	C	3.0648
	(0.9685)		(0.4121)
PCRED	0.3391	BMON	0.0819
	(0.0771)		(0.7263)
Non-Threshold Variable		Non-Threshold Variable	
R-squared	0.3543	R-squared	0.3035
Adjusted R-sq.	0.2989	Adjusted R-sq.	0.2438
F-statistic	6.4003	F-statistic	5.0833
Prob(F-statistic)	0.0014	Prob(F-stat.)	0.0050
Durbin-Watson Stat	1.7805	Durbin-Watson	1.8118

Source: Own elaboration.

The credit to private sector threshold point is 6.04% of GDP, and it is significant at five per cent (%). This is the turning point in the relationship between credit to the private sector and economic growth such that it becomes asymmetrical. The R-Squared result for credit to the private sector is low at 0.35. It means that 35% of the variation in in economic growth threshold is explained by the variation in credit to the private sector. This is understandable as the variation in economic growth is usually

explained by several other variables. The upper part of Table 9 shows estimates for values below the threshold for which the coefficient of credit to the private sector is negative. The lower part of the table shows estimates for values above the threshold for which the coefficient of credit to the private sector becomes positive.

Table 10. Threshold Regression Model Diagnostics

GDPR & PCRED		GDPR & BMON	
Breusch-Godfrey Serial Corr. LM Test:			
F-statistic:	0.1521	F-statistic:	3.0323
Prob. F(2,40):	0.8504	Prob. F(2, 40):	0.0618
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic:	1.0059	F-statistic:	1.9071
Prob. F(4,42):	0.4017	Prob. F(4, 42):	0.1464
Normality Test			
Jarque-Bera:	6.8142	Jarque-Bera:	0.5889
Probability:	0.0331	Probability:	0.7449

Source: Own elaboration.

The diagnostics on the threshold regression results for credit to the private sector (Table 10) reveals that the model does not suffer from serial correlation with the value of the Durbin-Watson statistic (1.87) and Breusch-Godfrey Serial Correlation LM Test value of the F-statistic (0.1521) and probability (0.8504). The model is free from heteroskedasticity (homoscedastic) as the result of the Breusch-Pagan-Godfrey Test (with the F-statistic: 0.2257 and probability: 0.9225). Furthermore, the normality test shows that the Jarque-Bera value is 65.032 with a probability of 0.0000, indicating that the null hypothesis of normality for the data set is rejected.

4.6. Nonlinear relationship between broad money and economic growth

The estimation of the nonlinear relationship between broad money and economic growth is conducted using: one, the NARDL approach; and two, the threshold regression approach. The result of the stepwise regression of the relationship between broad money and economic growth is presented in Table 3. The long-run equation relating economic growth to broad money is shown as follows:

$$\text{GDPR} = -0.0893\text{BMON_P} + 0.0413\text{BMON_N} \quad (23)$$

A close observation shows that the negative coefficient of BMON_P is followed by the positive coefficient of BMON_N. The trend gives a prima facie position which indicates that the relationship between the variables in the long-run is asymmetric. The long-run equation suggests that the nonlinear relationship between broad money and economic growth is U-shaped. The result of the asymmetric cointegration test shows that the Wald test value of the F-statistic = 8.2658 (Table 5) is larger (Pesaran et al., 2001) than the critical value of $F_{010} = 7.84$ (Table 6). The null hypothesis of no difference between the coefficients $c(2)$, $c(3)$ and $c(4)$ is rejected. Thus, there is evidence in support of a long-run equilibrium cointegration relationship between economic growth and broad money at the 0.01 level of significance. The conclusion can be drawn that both the positive change and the negative change in broad money have a long-run positive effect on economic growth. The asymmetric Wald test on economic growth and broad money (Table 7) shows that the F-statistic (24.4341) and probability (0.0000) indicate the rejection of the null hypothesis of equality between the positive and negative changes in broad money with respect to economic growth (no asymmetry). Therefore, we conclude that the relationship between economic growth and broad money is asymmetrical (not equal) in the long run.

The diagnostics for the NARDL model economic growth and broad money are shown in Table 8. The value of the Durbin-Watson statistic (1.9159) and the result of the Breusch-Godfrey Serial Correlation Test [with the F-statistic (0.1706) and probability (0.8440)] show that the null hypothesis of no serial correlation cannot be rejected. In addition, the Breusch-Pagan-Godfrey heteroskedasticity test [with the F-statistic (0.2820) and probability (0.8380)] indicates that we cannot reject the null hypothesis of homoskedasticity. The model is free from heteroskedasticity. Also, the normality test [with Jarque-Bera (89.1556) and probability (0.0000)] indicates that the null hypothesis of normal distribution is rejected. The distribution is not normal.

4.7. Threshold Regression of broad money and economic growth

The Threshold Regression approach builds on the NARDL examination conducted earlier, which observed that the relationship between broad money and economic growth is asymmetrical. The threshold regression analysis is required to identify the turning point at which broad money is asymmetrical. The specification for the threshold analysis of broad money and economic growth is shown in Table 9. The investigation is based on the Bai-Perron (2003) critical values for threshold and shows that the threshold value of broad money with respect to economic growth in terms of sequential value and repartition value is 17.73% of GDP. The threshold value of broad money is significant at the 0.05 level. The upper part of Table 9 shows the values below the threshold for which the coefficient of broad money is negative. The lower part of the table shows the values above the threshold at which the coefficient of broad money becomes positive.

The diagnostics on the threshold regression model (Table 10) reveal that the model does not suffer from serial correlation drawing on the value of the Durbin-Watson statistic (1.8117), which is reinforced by a Breusch-Godfrey Serial Correlation LM Test [F-statistic (0.5826) and probability (0.5631)]. The null hypothesis of no serial correlation cannot be faulted at 0.05 level of significance. The model is free from heteroskedasticity based on the result of the Breusch-Pagan-Godfrey Test (with the F-statistic: 0.2681 and probability: 0.8967), which shows that the null hypothesis of homoskedasticity cannot be rejected. Furthermore, the normality test shows that the Jarque-Bera value is 45.32 with a probability of 0.0000 indicating that the null hypothesis of normality for the data set is rejected.

4.8. NARDL results vs threshold regression results

The NARDL approach is able to clearly show the status of the long-run cointegration status of the variables. In terms of the test results, while the relationship between credit to the private sector and economic growth has long-run cointegration, the same status of cointegration is exhibited by the relationship between broad money and economic growth. The analysis of the cointegration status is not handled by the threshold regression approach. Also, the direction of the relationship in the variable relationship is clearly shown in the NARDL approach (U-shaped) and may be marginally implied by the threshold regression model. However, the strength of the threshold regression approach lies in the identification of the exact turning point in the relationship between the variables of study (credit to the private sector is 6.04% of GDP, and broad money is 17.73% of GDP), while this analysis is weak in the NARDL approach. However, from the re-

sults of the R-squared, F-test and Durbin-Watson statistic, the analysis of the NARDL test proves to be more dependable.

5. Discussion

Furthermore, the investigation of the non-linear relationship between financial development and economic growth through the NARDL reveals that there is a long-run relationship between financial development variables and economic growth with asymmetries. This means that the NARDL results support the nonlinear relationship between financial development and economic growth. The results show that the relationship between financial development indicators and economic growth is U-shaped in Nigeria. Also, the threshold regression results show that while credit to the private sector is 6.04% of GDP, the result of broad money is 17.73% of GDP. Hence, at points below these thresholds, there are asymmetries; credit to the private sector and broad money would thus transmit negative effects onto economic growth. For instance, when the volume of credit to the private sector is disbursed at a level below 6.04% of GDP, there is a drag on economic growth. Some existing empirical studies support the nonlinear and U-shaped threshold relationship between financial development and economic growth (Rioja and Valev, 2004; Oro and Alagidede, 2018; Elya et al., 2019). On the other hand, some authors hold a contrary opinion (Samargandi et al., 2015; Swamy and Dharani, 2019; Barra and Ruggiero, 2020).

Conclusions

This research study investigates the non-linear relationship between financial development and economic growth in Nigeria using NARDL and threshold regression for an analysis covering the period between 1980 to 2018. Utilising credit to the private sector and broad money as proxies for fi-

nancial development, the study sought to investigate the nature of the relationship between the variables using NARDL while establishing the exact threshold between the variables using threshold regression. The asymmetric cointegration test conducted using the NARDL approach confirms the existence of a long-run cointegrated-asymmetrical relationship between credit to the private sector and broad money with economic growth for the period. Also, the estimated long-run equations indicate that the relationship of both credit to the private sector and broad money to economic growth are U-shaped. Furthermore, the threshold of credit to the private sector is 6.04% per cent (%) of GDP and the threshold of broad money is 17.73 per cent (%) of GDP. This means that when financial development indicators fall below the threshold points, they constitute a drag on economic growth.

The study recommends that the minimum levels of credit to the private sector at 6.04% of GDP and broad money at 17.73% of GDP should serve as a guide to the Nigerian monetary authority in the implementation of monetary policies to achieve the growth of GDP. To attain the minimum levels of financial development, the government is required to implement policies to promote financial access, market efficiency and depth in both the primary and secondary markets of the country's developing economy. More specific policies would include the monetisation of financial transactions and improving the access of households and firms to banking services and products. An important step in this direction entails the increase in the commercial banking branch network to new financial activity outlets and rural areas. Also, the promotion of banking services will improve through the activities of micro-finance banks and banking agents. The effort would serve to encourage the policy of

financial inclusion among the country's citizens through the enhancement of services such as internet banking, automated-teller-machine (ATM) services, mobile banking, point-of-sale (POS) terminals and the improved drive for small savings through the activities of Esusu and M-pesa. Furthermore, the authorities need to enhance the efficiency and effectiveness of financial market transactions by strengthening and enforcing the existing applicable laws and regulations. One of the limitations in this study is the absence of control variables such as government expenditure, population, trade and others. Further studies may consider including a wider range of control variables to achieve a more robust outcome in the study of these variables.

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