

Assessing the Moderating effect of Research and Development on Financial Development and Economic Growth Nexus in Nigeria: A Non-Linear Ardl Approach

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Abstract

Nigeria's economic growth remains persistently volatile and below potential despite decades of policy reforms, with financial development's role remaining contested. While theoretical literature suggests research and development (R&D) amplifies finance-driven growth, Nigeria's chronically low R&D expenditure raises questions about its moderating effectiveness. Studies in Nigeria regarding whether positive and negative shocks to financial development exert asymmetric effects on growth while accounting for R&D's moderating influence remains underexplored. This study addresses this gap using time series data from 1990 to 2023. Employing the Nonlinear Autoregressive Distributive Lag (NARDL) technique, it captures asymmetric responses to financial shocks, with government expenditure on education as R&D proxy. Result reveal that in the short run, both positive and negative financial development shocks significantly affect economic growth, a unit increase raises growth by 92.85% while a unit decrease reduces it by 64.56%. However, all long run effect becomes statistically insignificant. The interaction between financial development and R&D yields positive but statistically insignificant coefficients in both time horizons, indicating that R&D does not meaningfully moderate the finance-growth nexus in Nigeria. The findings imply that while financial development drives short term growth asymmetrically, its long run effectiveness remains weak, and Nigeria's chronically low R&D fails to serve as a reliable moderating mechanism. The study recommended that Central Bank of Nigeria should through its implement policies that expand digital financial services, reduce credit access barriers, and expand competition among banks and financial technology alternative to ensure that individuals, businesses, and corporations obtain affordable financial services.

Keywords: *Economic growth; Financial development; NARDL; Nigeria; R&D*

1.0 Introduction

Sustaining economic growth remains a fundamental challenge for developing economies, particularly for Nigeria, where growth has remained volatile and below potential despite decades of policy reforms. Globally, economic growth recovered modestly in 2021 but decelerated sharply in 2022 under the combined pressures of rising inflation, monetary policy tightening, geopolitical conflicts, and persistent supply-chain disruptions. The G20 economies recorded approximately 0.5% growth in early 2022, while Sub-Saharan Africa was projected to grow at 3.6% and 3.8% in 2022 and 2023 respectively (International Finance Forum [IFF], 2022). Within this regional context, Nigeria's growth trajectory has lagged behind peers, prompting renewed scholarly attention to the fundamental drivers of growth particularly the roles of financial development and research and development.

Financial development stimulates growth primarily by funding risky, long-term research and development investments, which in turn drive productivity gains and technological adoption (Giri *et al.*, 2023; Manigandan *et al.*, 2023). From this perspective, research and development is not merely an independent driver but an active moderator that amplifies the growth effects of financial development by enhancing the economy's absorptive capacity and innovation efficiency. Proponents contend that without adequate research and development activity, financial development cannot translate into sustainable growth, particularly in knowledge-intensive sectors.

Research and development are too chronically underfunded and institutionally weak to exert any meaningful moderating influence especially in developing economies like Nigeria where research and development expenditure consistently remains below 0.2% of GDP. According to this view, the finance-growth nexus remains largely unchanged regardless of research and development intensity, as financial resources are predominantly channeled into short-term, low-risk activities rather than innovation-driven projects (Adekunle, 2013; World Bank, 2012).

However, does financial development unambiguously promote economic growth, or can it become growth impeding under certain conditions? A substantial body of evidence supports a positive "supply-leading" effect, whereby well-functioning financial systems mobilize savings, diversify risk, reduce information asymmetries, allocate capital efficiently, and ultimately accelerate growth (Lerohim, Affandi and Mahmood, 2014; Giri *et al.* 2023). However, a growing counter literature warns that excessive financial development or poorly designed regulatory frameworks can distort incentives, encourage speculative lending, and generate financial fragility, ultimately impeding long-term growth. In the Nigerian case, despite abundant natural resources, excessive regulation has historically constrained financial intermediation, encouraged disintermediation, and limited private sector credit (Adekunle, 2013). This tension suggests that the finance growth relationship may not be universally positive but rather context dependent and potentially non-linear a possibility that linear models have largely ignored.

Despite this theoretical grounding, to the best of our knowledge no prior study on Nigeria has systematically tested whether positive and negative shocks to financial development exert equal or unequal effects on economic growth, particularly while accounting for the moderating role of research and development. This omission is striking, as policy responses to financial expansion versus financial contraction are unlikely to be symmetric. For example, policies that successfully expand credit may not simply be reversed during contractions without asymmetric real effects.

This study contributes to empirical literature in two fundamental ways. First, it empirically tests whether research and development significantly moderate the effect of financial development on economic growth in Nigeria, Second, it deploys the Non-Linear Autoregressive Distributed Lag (NARDL) technique to capture potential asymmetric effects that is, whether positive and negative changes in financial development exert different impacts on growth, while simultaneously accounting for the moderating influence of research and development.

2.0 Literature Review

2.1 Conceptual review

Three key concepts are critical to this study. These are financial development, economic growth, and research and development. Financial development as defined by Levine (2004) is the level to which a country's financial system is advanced, efficient, and effective, and it will serve as the working definition in the study. While Solow (1956) defined economic growth as the sustained increase in an economy's output of goods and services over time, resulting from improvements in the productivity of resources, such as labor and capital as this definition has the best indicator for economic growth and it's our working definition. Romer (1990) defined Research and Development as a systematic activity undertaken to generate new knowledge, discoveries or innovations and apply them to develop or improve products, processes, or services. It often encompasses scientific research, experimental development, and application of knowledge for practical purpose and this will be the working definition in the study.

2.2 Theoretical framework

This study is underpinned by endogenous growth theory which focuses on explaining economic growth by integrating technological advancement and progress, and it acknowledges the pivotal role of technological discoveries. However, Aghion and Howitt (1998) argued that economic decisions of agents can influence technological progress, but the technological progress is viewed as the primary determinant of long-term economic growth, and also introduce the concept of increasing returns to scale. However, the theory aims to indigenize technological progress through three prominent models and this study used the AK model as pioneered by Arrow (1962) which suggests that productivity can depend on output per worker, with technological progress occurring through learning by doing.

It opines that for economic growth to take place, innovation, human capital development and the creation of knowledge must be present. The theory suggests that investment in research and development, education, and technological innovation can lead to sustained increases in productivity and long-term economic growth. As such, this research adopted and modified the AK model of the endogenous growth theory, which is a special case of Cobb-Douglas growth theory specified as:

$$Y = AK^\alpha L^{1-\alpha} \dots\dots\dots 2.1$$

Y represents the total production in an economy, in our case, the economic growth. A stands for the total factor productivity, K is the capital, and L represents the labor factor. The parameter α represents the production elasticity of capital. Though the AK version transformed the model to become linear in capital outputting constant return to scale, this research used it as is, since the research used the nonlinear modeling technique. Therefore, modifying the above equation to include our primary explanatory variables, we would have it as follows:

$$Y = AK^\alpha L^{1-\alpha} X_3 X_4 \dots\dots\dots 2.2$$

Where X_3 and X_4 represent financial development and research and development, respectively.

2.3 Empirical review

On the empirical front, the relationship between financial development and economic growth has remain one of the most debated issues in development economics. It is rooted in theoretical traditions such as the supply-leading hypothesis and demand-following hypothesis, several empirical studies have attempted to establish whether financial development act as a mechanism for growth or just merely a respond to it. Omankhanlen and Samuel-Hope Ehikioya (2022) utilizing ARDL techniques for Nigeria, the study found that financial development significantly enhances economic growth, suggesting a strong long-run relationship and the results support the argument that improvements in financial development stimulate investment and productivity. While Fakudze and Siband (2021) using Granger causality and ARDL technique in Eswatini found a long-run relationship between financial development and growth, the findings contradict the traditional supply-leading hypothesis, implying that the direction of causality may not be straightforward. Nwosu and Metu (2020) employed the ARDL bound testing and cointegration technique in Nigeria, found that financial development has a positive and statistically significant long-run effect on economic growth. Which reinforces the argument that financial deepening enhances economic performance.

Conversely, Musaakwa and Odhiambo (2022) found no causal relationship between financial development and economic growth in Botswana and the study suggested financial expansion does not automatically translate into real sector growth in all contexts. Farouq, Sulong, Ahmad, Jakada, and Sambo (2020) employed non-linear modeling technique in Nigeria, the study showed a long-run symmetric nexus between financial development and economic growth. Which indicate that, in growth there is both bidirectional changes in financial development. Hussein, Ahmed, and Sid-Ahmed (2020) deployed ARDL and ECM technique in analyzing the impact of financial development on economic growth in Sudan and show that financial development and economic growth have a positive link and confirming the importance of financial systems in promoting economic performance.

Studies like (Omankhanlen & Ehikioya 2022; Nwosu & Metu 2020; Farouq et al. 2020 and Hussein et al 2020). consistently find that financial development positively influences economic growth but (Musaakawa & Odhiambo 2022) shows no causal link, which highlight that financial development does not universally drive growth. Looking at the methodological variation, most studies rely on ARDL techniques, indicating a preference for handling mixed integration orders, while Farouq et al. 2020 introduce the nonlinear modeling in order to capture asymmetric often ignored in linear frameworks but Fakudze and Siband used Granger causality to emphasize directionality rather than just association. Several studies support the supply-leading hypothesis while other challenge it suggesting context-specific dynamics.

3.0 Methodology

3.1 Type and source of data

The paper utilizes time series data covering 1990 to 2023 on Nigeria economy. The choice of period was due to the availability of data. The variables used, their measurement, and sources of data are presented in Table below.

Table 1: Variables, Measurement, and Sources of Data

Variables	Measurement/proxy(acronym)	Source
Economic growth	GDP per capita (GDPP)	World Bank (WDI, 2023)
Financial development	Financial development index (FINDEV)	World Bank (WDI, 2023)
Labor	Labour participation rate (LB)	ILO (2023)
Capital	Fixed capital formation (KP)	National Bureau of Statistics (NBS, 2023)
Research and Development	Government expenditure on education (GEE)	National Bureau of Statistics (NBS, 2023)

Source: Author's compilation (2026)

3.2 Model Specification

To assess the moderating effect of research and development on financial development and economic growth in Nigeria, the study adopts and modifies the AK model of endogenous growth theory. The AK model is a special case of the Cobb–Douglas production function with constant returns to capital, expressed as:

$$Y_t = A_t \cdot K_t$$

where Y_t is output (GDP per capita), K_t is capital, and A_t represents technology and other factors. In this study, we extend the AK model by incorporating labour (L_t), financial development (FD_t), and research & development ($R\&D_t$) as shifters of technology. Thus, the general functional form is:

$$GDPP_t = f(K_t, L_t, FD_t, R\&D_t) \quad (1)$$

3.2.1 Linear Model Specification

The mathematical (linear) form of the model is:

$$GDPP_t = \beta_0 + \beta_1 K_t + \beta_2 L_t + \beta_3 FD_t + \beta_4 R\&D_t \quad (2)$$

The econometric form, including the stochastic error term (e_t), is:

$$GDPP_t = \beta_0 + \beta_1 K_t + \beta_2 L_t + \beta_3 FD_t + \beta_4 R\&D_t + e_t \quad (3)$$

Expected signs of the coefficients:

- $\beta_1 > 0$: Capital formation is expected to positively influence economic growth.
- $\beta_2 > 0$: Labour force participation is expected to positively contribute to growth.

- $\beta_3 > 0$: Financial development is hypothesized to enhance growth by improving resource allocation.
- $\beta_4 > 0$: Research and development (proxied by government expenditure on education) is expected to foster innovation and growth.

3.2.2 Moderation Model Specification

To test whether research and development (R&D) moderates the relationship between financial development and economic growth, we first introduce R&D as an additional independent variable (3). If the coefficients of FD_t and $R\&D_t$ remain statistically significant after inclusion, we then specify a **moderation (interaction) model** as:

$$\begin{aligned} GDPP_t &= \beta_0 + \beta_1 K_t + \beta_2 L_t + \beta_3 FD_t + \beta_4 R\&D_t + \beta_5 (FD_t * R\&D_t) \\ &+ e_t \end{aligned} \quad (4)$$

Here, $FD_t * R\&D_t$ is the interaction term. A statistically significant β_5 would indicate that the effect of financial development on economic growth depends on the level of R&D (moderation effect). The expected sign of β_5 is ambiguous a priori: it could be positive if R&D amplifies the growth effects of financial development, or negative if R&D diverts resources from financially driven growth.

3.2.3 Time Series and ARDL Framework

Given the time series nature of the data, the variables may be integrated of different orders, i.e., I(0) and I(1). Therefore, the study adopts the Autoregressive Distributed Lag (ARDL) bounds testing approach, which is valid irrespective of whether the regressors are purely I(0), purely I(1), or mutually cointegrated. The general ARDL model (without interaction) is specified as:

$$\begin{aligned} \Delta GDPP_t &= \alpha_0 + \sum_{i=1}^p \gamma_i \Delta GDPP_{t-i} + \sum_{i=0}^{q_1} \delta_{1i} \Delta K_{t-i} + \sum_{i=0}^{q_2} \delta_{2i} \Delta L_{t-i} + \sum_{i=0}^{q_3} \delta_{3i} \Delta FD_{t-i} \\ &+ \sum_{i=0}^{q_4} \delta_{4i} \Delta R\&D_{t-i} + \theta_1 GDPP_{t-1} + \theta_2 K_{t-1} + \theta_3 L_{t-1} + \theta_4 FD_{t-1} + \theta_5 R\&D_{t-1} \\ &+ e_t \end{aligned} \quad (5)$$

The Error Correction Model (ECM) representation is:

$$\begin{aligned} \Delta GDPP_t &= \alpha_0 + \sum_{i=1}^p \gamma_i \Delta GDPP_{t-i} + \sum_{i=0}^{q_1} \delta_{1i} \Delta K_{t-i} + \sum_{i=0}^{q_2} \delta_{2i} \Delta L_{t-i} + \sum_{i=0}^{q_3} \delta_{3i} \Delta FD_{t-i} \\ &+ \sum_{i=0}^{q_4} \delta_{4i} \Delta R\&D_{t-i} + \lambda ECT_{t-1} \\ &+ e_t \end{aligned} \quad (6)$$

where ECT_{t-1} is the lagged error correction term, and λ is the speed of adjustment expected to be negative and statistically significant.

3.2.4 Moderation in the ARDL and NARDL Frameworks

To incorporate the moderation effect into the ARDL model, we include the interaction term $FD_t * R\&D_t$ and its lags. The moderation ARDL model (in ECM form with lag selection based on AIC) is:

$$\begin{aligned} \Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \gamma_i \Delta GDP_{t-i} + \sum_{i=0}^{q_1} \delta_{1i} \Delta K_{t-i} + \sum_{i=0}^{q_2} \delta_{2i} \Delta L_{t-i} + \sum_{i=0}^{q_3} \delta_{3i} \Delta FD_{t-i} \\ & + \sum_{i=0}^{q_4} \delta_{4i} \Delta R\&D_{t-i} + \sum_{i=0}^{q_5} \delta_{5i} \Delta (FD \times R\&D)_{t-i} + \lambda ECT_{t-1} \\ & + e_t \end{aligned} \quad (7)$$

Given that financial development may have asymmetric (nonlinear) effects on growth, the study further adopts **the Nonlinear ARDL (NARDL)** framework of Shin, Yu, and Greenwood (2014). This requires decomposing the financial development variable into positive and negative partial sums:

$$FD_t^+ = \sum_{j=1}^t \max(\Delta F D_j, 0), FD_t^- = \sum_{j=1}^t \min(\Delta F D_j, 0)$$

The asymmetric moderation NARDL model (including the interaction of positive and negative shocks of FD with R&D) is specified as:

$$\begin{aligned} \Delta GDP_t = & \alpha_0 + \sum_{i=1}^p \gamma_i \Delta GDP_{t-i} + \sum_{i=0}^{q_1} (\phi_{1i}^+ \Delta FD_{t-i}^+ + \phi_{1i}^- \Delta FD_{t-i}^-) + \sum_{i=0}^{q_2} \phi_{2i} \Delta R\&D_{t-i} \\ & + \sum_{i=0}^{q_3} (\phi_{3i}^+ \Delta (FD^+ * R\&D)_{t-i} + \phi_{3i}^- \Delta (FD^- * R\&D)_{t-i}) + \theta_1 GDP_{t-1} \\ & + \theta_2 FD_{t-1}^+ + \theta_3 FD_{t-1}^- + \theta_4 R\&D_{t-1} + \theta_5 (FD^+ * R\&D)_{t-1} + \theta_6 (FD^- \\ & * R\&D)_{t-1} + e_t \end{aligned} \quad (8)$$

Equation (8) captures the short-run and long-run asymmetric effects of financial development on economic growth, as well as the asymmetric moderation effect of R&D.

3.3 Techniques of data analysis

The obtained data having passed different stages of estimation using different techniques based on the outcome of the behavior of the variables tested, include the Kapetanios, Shin, and Shell (KSS) nonlinear unit root test to test the variables' ESTAR process and the Co-Integration Bound test to test whether long run relationship exist amongst the variables of interest. In the estimation stage nonlinear Autoregressive Distributed Lag was used in decomposing the independent variables that possess asymmetric properties into positive and negative, and also examined their effects on the dependent variable. This is because it's observed either in theory or reality that most relationship in time series are nonlinear (Romilly et al., 2001). Finally, diagnostic tests were conducted to ensure the healthiness of the model, such as normality and serial correlation tests.

4.0 Results and Discussion of findings**Table 2: Results of Descriptive Statistics**

Statistics	GDPP	FINDEV	GEE	INTR1	KP	LB
Mean	1481.40	0.1948	218.073	47.543	12956.06	51992679
Median	1764.28	0.1996	128.067	27.172	7266.45	5075112
Max.	3200.95	0.2727	702.979	154.66	65227.13	75721345
Min.	270.03	0.1231	0.2913	0.0455	262.77	32844703
Std.Dev	920.34	0.0350	226.41	50.569	17171.86	12872785
Skewness	0.1095	-0.2916	0.8202	0.8329	1.8297	0.228739
Kurtosis	1.5514	2.6288	2.3297	2.3486	5.3129	1.852444
J-B	3.0409	0.6771	4.4481	4.5318	26.550	2.162077
Prob.	0.2186	0.7128	0.1082	0.1037	0.000002	0.339243
Sum	50367.6	6.6246	7414.47	1616.47	440506.2	1.77E+09
Sum Sq.Dev.	2795164	0.0405	1691562	84388.2	9.73E+09	5.47E+15

Source: Author's Computation (2026)

The descriptive statistics presented in Table 2 summarize the behavior of all variables used in the study over the period 1990 to 2023, based on 34 observations with no missing values. The dependent variable, GDP per capita (GDPP), has a mean of 1481.40, with a maximum of 3200.95 and a minimum of 270.03. It exhibits a positive skewness near zero, indicating a roughly symmetric distribution, and a kurtosis of 1.55 (platykurtic), suggesting fewer extreme values than a normal distribution. The Jarque-Bera probability (0.22) is above 0.05, confirming normality.

Financial development (FINDEV) has a mean of 0.1948, ranging from 0.1231 to 0.2727. Its skewness is slightly negative (-0.29), and kurtosis is 2.62 (platykurtic), implying more values below the mean. The Jarque-Bera probability (0.71) supports normality.

The variable GEE shows a mean of 218.07, with a wide range (0.29 to 702.98). Skewness (0.82) and kurtosis (2.33) suggest a platykurtic shape, but the Jarque-Bera probability (0.11) is borderline, leading to rejection of normality at the 5% level.

The interaction term (INTR1) has a mean of 47.54 and a median of 27.17, with values ranging from 0.045 to 154.66. Skewness (0.83) and kurtosis (2.35) indicate near-normality, but the probability (0.10) suggests marginal non-normality.

Capital (KP) has a mean of 12,956.06, ranging from 262.77 to 65,227.13. It is positively skewed (1.83) and leptokurtic (5.31), indicating a right-heavy tail with many high values. The Jarque-Bera probability (0.000002) confirms non-normality. Labor (LB) shows a mean of

51,992,679, with a platykurtic kurtosis (1.85) and skewness (0.23), supporting normality (prob. = 0.34).

Table 3: KSS (2003) Nonlinear Unit Root Test Results

Criteria	Lags	KSS stat.	P-value	1% CV	5%CV	10%CV
GDPP						
FIXED	1	-1.989	0.319	-3.569	-2.913	-2.604
AIC	1	-1.989	0.340	-3.661	-2.987	-2.666
SIC	1	-1.989	0.329	-3.649	-2.964	-2.641
GTS05	1	-1.989	0.321	-3.625	-2.943	-2.623
GTS10	1	-1.989	0.331	-3.647	-2.968	-2.647
FINDEV						
FIXED	1	-4.281	0.002	-3.569	-2.913	-2.604
AIC	1	-4.281	0.002	-3.661	-2.987	-2.666
SIC	1	-4.281	0.002	-3.649	-2.964	-2.641
GTS05	0	-3.670	0.009	-3.625	-2.943	-2.623
GTS10	1	-4.281	0.002	-3.647	-2.968	-2.647
GEE						
FIXED	1	-0.542	0.897	-3.569	-2.913	-2.604
AIC	0	0.069	0.957	-3.661	-2.987	-2.666
SIC	0	0.069	0.956	-3.649	-2.964	-2.641
GTS05	0	0.069	0.956	-3.625	-2.943	-2.623
GTS10	0	0.069	0.956	-3.647	-2.968	-2.647
KP						
FIXED	1	-6.021	0.000	-3.569	-2.913	-2.604
AIC	1	-6.021	0.000	-3.661	-2.987	-2.666
SIC	1	-6.021	0.000	-3.649	-2.964	-2.641
GTS05	1	-6.021	0.000	-3.625	-2.943	-2.623
GTS10	0	-6.021	0.000	-3.647	-2.968	-2.647
LB						

FIXED	1	-2.469	0.413	-3.569	-2.913	-2.604
AIC	1	-6.021	0.081	-3.661	-2.987	-2.666
SIC	1	-6.021	0.016	-3.649	-2.964	-2.641
GTS05	1	-6.021	0.215	-3.625	-2.943	-2.623
GTS10	1	-6.021	0.015	-3.647	-2.968	-2.647

Source: Authors' Computation (2026)

The KSS (2003) nonlinear unit root test results presented in Table 3 above assess whether the variables follow a stationary nonlinear Exponential Smooth Threshold Autoregressive (ESTAR) process. For GDP per capita (GDPP) yield a KSS statistics of -1.989, which is less than the 5% critical value (-2.913) in absolute terms. The corresponding p-values (0.319) exceeds the 0.05 significance level. Therefore, the null hypothesis of a unit root cannot be rejected, indicating that GDPP is not a stationary nonlinear ESTAR process.

The primary independent variable (FINDEV) shows strong evidence of nonlinear stationarity. The KSS statistic is -4.281(or -3.670 under GTS05), which exceeds the 5% critical value in absolute term, with p-values of 0.002 or 0.009 all below 0.05. Thus, the null hypothesis is rejected, concluding that FINDEV is a stationary nonlinear ESTAR process. While government expenditure on education (GEE) exhibits a unit root. The KSS statistics are very low (e.g., -0.542 or 0.069), far below critical values, with high p-values (above 0.89). hence, the null hypothesis is not rejected, meaning GEE is not a stationary nonlinear ESTAR process.

While the interaction between financial development and research and development (INTRI) reported a similar record. All the criteria statistics of Capital (KP) and its probability show nonlinearity properties; the KSS statistics are greater than the critical value of 5% in their absolute terms. Therefore, the null hypothesis of the unit root test should be rejected, and further concluded that Capital (KP) is a stationary nonlinear exponential smooth threshold autoregressive (ESTAR) process.

On the other hand, the fixed statistics of labor are less than the critical values at 5% levels, which is (-2.469<-2.91) in their absolute terms, and it is insignificant at 5% significance level, indicating that it's not an exponential smooth threshold autoregressive (ESTAR) process. The outcome from the nonlinear unit root indicated that only financial development (FINDEV) and Capital (KP) show a stationary nonlinear Exponential Smooth Threshold Autoregressive (ESTAR) process, while the moderator and interactive variables and labor are not.

4.1 NARDL Co-integration test

The Bound test indicates whether there exists a long-run relationship among the variables of interest in the models. The results, as presented in Table 3 below shows the outcome of the nonlinear co-integration test using the bound test.

Table 4: NARDL Bound Test

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	10.20515	10%	1.76	2.77
K	10	5%	1.98	3.04
		2.5%	2.18	3.28
		1%	2.41	3.61

Source: Authors' Computation using E-views 10

The bound test presented in Table 4 shows the F-statistic of 10.20515 with lower and upper bounds of 1.98 and 3.04 at 5% significance level. The F-statistic therefore shows that it is greater than the upper bound ($10.20515 > 3.04$) at 5% level of significance, which implies that the test is statistically significant and also concludes that the series has a long-run nonlinear association.

4.2 NARDL RESULT

Table 5: NARDL Estimation Result

Short-run unmoderated model	Variable	Coefficient	Std Error	t-Statistic	Prob
	D(FINDEV_POS)	9285.139	2281.136	4.070401	0.0009
	D(FINDEV_NEG)	6456.223	2786.749	2.316758	0.0341
	D(KP_POS)	0.029888	0.008721	3.427260	0.0035
	D(KP_NEG)	0.071401	0.015101	4.728257	0.0002
	D(LB)	-0.000239	4.69E-05	-5.090157	0.0001
	CointEq (-1)*	-0.353009	0.043953	-8.031521	0.0000
Long-run unmoderated model	FINDEV_POS	27731.01	16216.51	1.710048	0.1044
	FINDEV_NEG	396.0791	10408.39	0.038054	0.9701
	KP_POS	-0.017521	0.015598	-1.123291	0.2761
	KP_NEG	0.630113	1.082636	0.582018	0.5678
	C	904.8154	751.6764	1.203730	0.2443
Short-run moderated model	D(FINDEV_POS)	9121.988	2317.801	3.935622	0.0015
	D(FINDEV_NEG)	7249.456	2884.762	2.513017	0.0248
	D(GEE)	-0.158345	0.622357	-0.254428	0.8029
	D(KP_POS)	0.033179	0.009087	3.651253	0.0026
	D(KP_NEG)	0.068348	0.015258	4.479412	0.0005
	D(LB)	-0.000231	4.73E-05	-4.878619	0.0002
	CointEq (-1)*	-0.333557	0.044982	-7.415269	0.0000
	FINDEV_POS	41630.29	20270.76	2.053711	0.0592

Long-run moderated model	FINDEV_NEG	-14013.74	11256.13	-1.244987	0.2336
	KP_POS	0.071252	0.053364	1.335195	0.2031
	KP_NEG	0.839737	1.032119	0.813605	0.4295
	GEE	-1.377566	3.982790	-0.345880	0.7346
	LB	-0.000336	0.000217	-1.550614	0.1433
	C	11309.27	6915.072	1.635452	0.1242
Short-run Interaction model	D(FINDEV_POS)	-3394.156	1466.046	-2.315177	0.0431
	D(FINDEV_NEG)	20258.23	2437.843	8.309898	0.0000
	D(GEE)	-4.771216	1.682596	-2.835627	0.0177
	D(INTR1)	1.361302	7.691871	0.176979	0.8631
	D(KP_POS)	0.028498	0.004621	6.167475	0.0001
	D(KP_NEG)	-0.207256	0.014434	-14.35928	0.0000
	D(LB)	0.000532	4.07E-05	13.06055	0.0000
	CointEq (-1)*	-0.344434	0.021478	-16.03652	0.0000
Long-run Interaction model	(FINDEV_POS)	-9518.033	17391.07	-0.547294	0.5962
	(FINDEV_NEG)	-50351.95	21913.63	-2.297746	0.0444
	(GEE)	-84.71800	39.62162	-2.138176	0.0582
	(INTR1)	277.4043	140.1170	1.979805	0.0759
	(KP_POS)	0.019389	0.029710	0.652612	0.5287
	(KP_NEG)	0.821421	0.819473	1.087593	0.3398
	(LB)	0.000177	0.000162	1.087593	0.3023
	C	-6867.815	5743.256	-1.195805	0.2594

Source: Author's Computation (2026)

Table 5 shows both the short-run and long-run estimates for the model without moderation, with moderation and the interaction model

In the short model without moderation, both the positive and negative shocks of financial development exert significant positive effects on economic growth, with a unit increase in financial development raising economic growth by 92.85% and a unit decrease reducing growth by 64.56%, both significant at 5% level of significant. Similarly, positive and negative change in capital are significant in the short run, with a unit increase in capital yielding a 0.02%

rise in growth and a unit decrease leading to a 0.007% decline. The error correction mechanism is negative and significant (-0.353), confirming a moderate annual adjustment speed of 35.3% toward long run equilibrium. In the long run, both the positive and negative financial development shocks become statistically insignificant, although positive change retain a 27.73% positive effect and negative changes show a 39.6% negative effect on growth. Long run capital effects are also insignificant, with a unit increase in capital unexpectedly reducing growth by 0.001% and a unit decrease lowering growth by 0.63. contrary to the theoretical expectation.

When moderator is introducing in the short run model, both positive and negative financial development shocks remain positive and become statistically significant, with a unit increase in financial development raising growth by 91.21% and a unit decrease reducing growth by 72.49%, both at the 5% significance level. Short run capital effects also maintain significance, with a unit increase in capital improving growth by 0.003% and a unit decrease lowering growth by 0.06%. in the long run moderated model, positive financial development shocks remain positive but insignificant at 5% level, showing a 41.63% growth increase per unit rise. However, the negative component of financial development with moderation becomes negative and insignificant, with a coefficient of -14013.74, implying a perverse positive response of 14.01% to a unit decrease in financial development. Long run capital effects under moderation are both positive and statistically insignificant, with a unit increase in capital raising growth by 0.7% and a unit decrease lowering growth by 0.83%.

The interaction between financial development and research and development in the short run yields a positive coefficient of 1.361302, indicating that a unit increase in the interaction term is associated with a 1.36% rise in economic growth; however, this effect is statistically significant at the 5% level. In the long run, the interaction term also demonstrates a positive coefficient of 277.4043, suggesting that a unit increase in the interaction leads to a 27.7% increase in economic growth, but this relationship remain statistically insignificant. Collectively, these findings imply that while the joint effect of financial development and R&D appears economically meaningful in magnitude, particularly in the long run, the Lack of statistical significance indicates a weak and unreliable moderating influence of R&D on the finance-growth nexus across both time horizons.

4.3 Post -Estimation Diagnostic Test

This is a stage where several diagnostic tests were carried out in order to assess the healthiness of the model that was employed in the study.

4.3.1 Normality Test

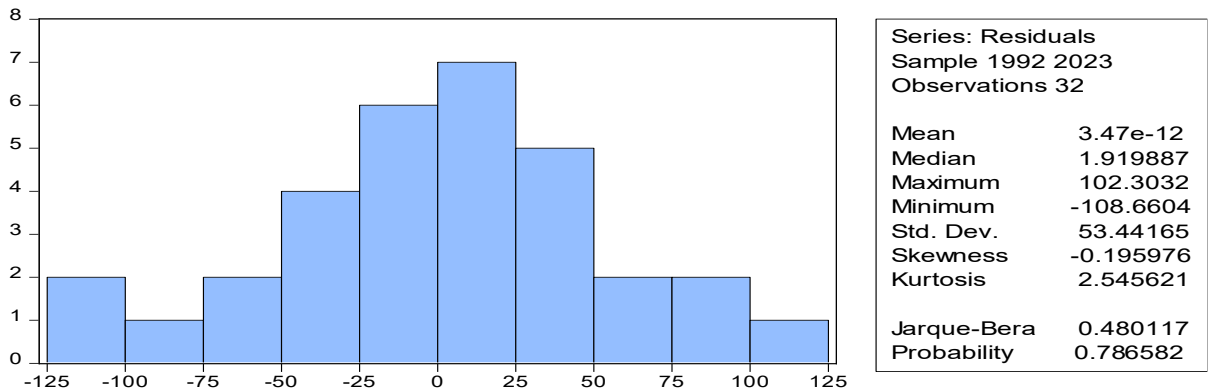


Figure 2: Normality Test Result

Source: Author computation using E-Views 10, 2026

Figure 2 represent the result obtained from Nonlinear ARDL normality test, the result revealed a Jarque- Bera statistical value for nonlinear ARDL of 0.480117 with an insignificance probability value 0.786582 respectively, which is a clear indication that the model is normally distributed.

4.3.2 Serial Correlation LM Test

Table 6: Breusch-Grodfrey Serial Correlation LM Test:

			Probability
F-statistic	1.155177	Prob. F(1, 9)	0.3104
Obs*R-squared	3.640079	Prob. Chi-Square (1)	0.0564

Source: Author’s computation using E-views 10, 2026

Table 6 above is the result of serial correlation, the insignificance p-value of the F-statistic 0.3104 and that of the Chi-Square 0.0564 indicated that the model is not serially correlated.

4.4 Discussion of Results

The findings show that in the short run, there exists a positive and statistically significant relationship between financial development and economic growth. while in the long run, financial development has statistical insignificant relationship with economic growth in Nigeria. This means that development in the financial sectors promotes economic growth in Nigeria, even though in the long run, the relationship is weak. This might be due to the inability of financial institutions to provide financial services to individuals, businesses, and companies, or it might also result from the fact that individuals, businesses, and corporate bodies cannot access financial services and a host of other services. Similarly, economic growth responds negatively if there is no development in the country’s financial system. This finding concurs with the findings of Nwosu and Metu (2020), Hussein et al (2020), and in conformity with finance-growth theory (Schumpeter’s 1911 supply-leading hypothesis).

The short run and long run interaction of financial development and research and development show that, there exist a positive and statistically insignificant relationship in the interaction of financial development and research and development, and economic growth in Nigeria. This means that, the impact of the interaction of financial development and research and development on economic growth in Nigeria is weak and unreliable during the period of this study. This finding aligns with the finding of Liao and Li (2024) who also found an insignificant

impact of R&D on growth in low and middle financial development provinces in China. This might be that the Nigeria's financial development level likely falls below a required threshold, preventing R&D from being an effective moderator. The synergy between finance and R&D only materializes when financial development is sufficiently high, which is not the case in Nigeria.

5.1 Conclusion and Recommendations

The descriptive analysis showed that GDP per capita and financial development were normally distributed, while capital was non-normal (leptokurtic and positively skewed). The nonlinear unit root t (KSS) test revealed that financial development and capital were stationary nonlinear ESTAR processes, whereas GDP per capita, government expenditure on education, and labor contained unit roots. The NARDL bound test confirmed long run nonlinear relationship among the variables (F-statistic=10.205>3.04 upper bound at 5%). In the short run model without moderation, positive and negative shocks to financial development significantly boosted economic growth (a unit increase raised growth by 92.85%, a unit decrease reduced it by 64.54%); capital also had a significant short run effect, and the error correction term (-0.353) indicated a 35.3% annual adjustment to equilibrium. In the long run without moderation, both financial development shocks became insignificant, though positive changes retained a 27.73% positive effect and negative effect changes a 39.6% negative effect. With R&D as a moderator, financial development shocks remained positive and significant in the short run (91.21% increase for a rise, 72.49% reduction for a fall) but turned insignificant in the long run; the interaction term (FINDEV*R&D) had positive but statistically insignificant coefficients in both the short run and long run, implying a weak and unreliable moderating role of R&D on the finance-growth nexus. Finally, the diagnostic tests confirmed the model was normally distributed and free from serial correlation

Base on the empirical results above, the study concludes that financial development drives short run economic growth systematically, but its long run effectiveness is weak. R&D does not serve as a significant long run term moderator of the finance-growth nexus, calling for targeted policy interventions to strengthen both financial sector depth and research incentives.

Therefore, the above conclusion allows us to proffers the following recommendations.

- i. Central Bank of Nigeria (CBN) should, through its financial inclusion secretariat, implement policies that expand digital financial services, reduce credit access barriers, and expand competition among banks and fintechs to ensure that individuals, businesses, and corporations obtain affordable financial services.
- ii. Tertiary Education Trust Fund (TETFUND), in collaboration with the Federal Ministry of Education, should increases research funding and issue specific grant calls on financial development and economic growth, while the Federal Inland Revenue Service (FIRS) approves tax relief for researchers conducting actionable financial sector research.
- iii. Financial Stability Directorate of the Central Bank of Nigeria and the Nigerian Deposit Insurance Corporation (NDIC) should prioritize prudent regulation, crisis preparedness, and countercyclical measures to prevent negative shocks to financial development that immediately harm economic growth.

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