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THE EFFECT OF DIGITAL FINANCE ON FINANCIAL DEVELOPMENT IN NIGERIA 2010–2024

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Abstract

This study is about the role of digital finance on financial development with specific emphasis on Nigeria. Despite the rapid growth of digital financial platform and other technological based innovations in finance, the extension of formal financial services remains elusive. The main aim of this study is to determine the level of impact digital finance could have on financial development and the causality between digital financial services and some financial indicators. This study employs secondary data such as quarterly data from the first quarter of 2010 to the last quarter of 2024. The independent variable for the study is e-payment transaction value while credit to the private sector is the dependent variable; other control variables are broad money supply and inflation. The study adopts the ARDL (Auto regressive Distributed lag) bounds testing approach for co-integration test (long-run and short-run) between the variables and an ECM (Error Correction Model) for short-run effects. Also, the study uses Granger causality test to determine the causality between the variables. The empirical finding of the study reveals that digital finance negatively affects financial development significantly both in the long and short-run; likewise, money supply positively influences financial development significantly in the long and short-run, however, inflation may negatively influence financial development in the long and short-run. This shows that Nigeria's digital financial system is largely transactional and may not be deepening financial intermediation, hence reforms may be necessary.

Keywords: Digital finance, financial development, financial depth, ARDL, Nigeria

1.0 Introduction

Financial development is a very important objective for emerging economies. Financial development involves the deepening, broadening, and increasing the efficiency of financial systems, and it serves as an important driver of macroeconomic growth, poverty reduction, and shared prosperity (Levine, 2005; World Bank, 2022). Financial development entails wider use of existing financial instruments as well as the creation and adoption of new ones for intermediating funds and managing risks (Chami et al., 2010). The process of financial development facilitates capital accumulation, technological innovation, and efficient resource allocation by reducing information asymmetry and lowering transaction costs.

In the Nigerian context, financial development has been constrained by structural challenges despite being one of Africa's largest economies. The challenges include a large informal sector, geographical barriers, and limited access to formal banking services particularly among low-income households and rural areas (EFInA, 2020). Financial development is measured through the metrics of financial deepening, financial access, and financial efficiency (Beck et al., 2000). Although financial development involves all of the above-mentioned structural attributes of access, efficiency, and depth, empirical evaluation requires centering on its core engine of capital accumulation, which is financial deepening (Beck et al., 2000; Levine, 2005). Therefore, while digital finance influences overall payment access, evaluating its

systemic macroeconomic contribution makes it necessary to isolate its direct transmission into financial deepening, measured through the allocation of domestic credit to the private sector (King & Levine, 1993; Sahay et al., 2015).

Over the years Nigeria's performance in these metrics has been mixed. Whereas the banking sector has grown significantly to become one of the largest in Africa, a large segment of the population remained financially excluded. The 2008 Global Financial Crisis and the subsequent 2009 domestic banking crisis further exposed these systemic issues, thus emphasizing the need for a more inclusive, stable, and resilient financial framework (Sanusi, 2010).

The emergence of Digital Finance has served as a paradigm shift in dealing with these challenges. Digital finance refers to the use of digital devices and digital technology to acquire, use and distribute financial resources to economic agents such as individuals, households, firms and government (Ozili, 2023). It refers to a range of finance services and activities accessed and delivered via digital channels (Ukoh, 2019). Digital finance basically refers to the digitization and migration of traditional banking activities that historically were only available to customers when physically in a banking hall, into convenient online platforms, as well as various modern innovations that are made possible only through digital finance frameworks.

Over the past fifteen years, the Central Bank of Nigeria (CBN) has created enabling policy environment to facilitate digital finance. Some of the policy initiatives include the introduction of the Guidelines on Electronic Banking in Nigeria that was initially issued in 2003 and formally revised/re-issued in 2007, the introduction of the Cashless Policy in 2012, Bank Verification Number (BVN) system in 2014, and licensing of Payment Service Banks (PSBs) in 2020 (CBN, 2020). And through these policies the total value of digital transactions grew from ₦9.03 trillion in 2015 to ₦387.07 trillion by 2023 (NIBSS, 2024).

Despite the rising trends of digital finance in Nigeria and numerous studies on the subject, an empirical gap still exists (Mohammed, 2021). There is the need for data-driven quantitative evaluations centered specifically on its macroeconomic impact on broader financial development in Nigeria, particularly on financial deepening. This study aims to fill this gap in the digital finance literature of Nigeria and offer an empirical assessment of the impact of digital finance on overall financial development.

Statement of the Problem

Although Nigeria is said to have one of the largest and most capitalized banking sectors in Africa, a large segment of the population remains excluded from the formal financial sector and continue to rely on informal systems to save and to secure loans. This structural mismatch exposes a weakness within the nation's broader financial framework. Traditional banking approaches that relied heavily on expanding physical branches have yielded mixed results, and the severe shocks of the 2008/2009 financial crises exposed more weaknesses, including deficiency of risk-management protocols, and a disconnect from the real economy.

While digital finance is seen as a paradigm shift capable of reducing these structural limitations, the actual extent to which digital finance is impacting real financial development in Nigeria remains more or less unverified (Ozili, 2018; Adeola & Evans, 2017). There is a disconnect between high-volume accounts of digital finance growth and a lack of empirical studies analyzing its true statistical impact on the core pillars of financial development, financial depth and credit allocation in particular (Sahay et al., 2015; Demirgüç-Kunt et al., 2018).

There is a deficit of academic research that use quantitative modeling techniques to map the relationships between specific digital finance parameters such as electronic transaction values, and established macroeconomic measures like private sector credit as a percentage of GDP. Without such econometric testing, any assertion on the developmental benefits of digital finance remains suggestive rather than

definitive. The underlying problem is the absence of integrated, empirical studies that go beyond descriptions to provide rigorous quantitative determination of how digital finance affects this fundamental pillar of financial development, specifically financial deepening, within the Nigerian economy.

1.3 Research Questions

The main focus of this research is to answer the question “what is the effect of digital finance on financial development in Nigeria?”. In order to achieve that, the following research questions were formulated to provide a clear and structured direction for this empirical study:

1. What is the empirical effect of digital finance on financial depth in Nigeria?
2. What is the nature of the causal relationship between digital finance indicators and financial depth in Nigeria?

1.4 Objectives of the Study

The primary aim of this research is to empirically examine the effects of digital finance on financial development in Nigeria for the period spanning 2010Q1 to 2024Q4. To achieve this goal, the study outlines the following specific objectives:

1. To examine the empirical effect of digital finance on financial depth in Nigeria.
2. To analyze the nature of both the short-run and long-run causal relationships between digital finance metrics and financial depth in Nigeria.

2.0 Literature Review

Conceptual Framework

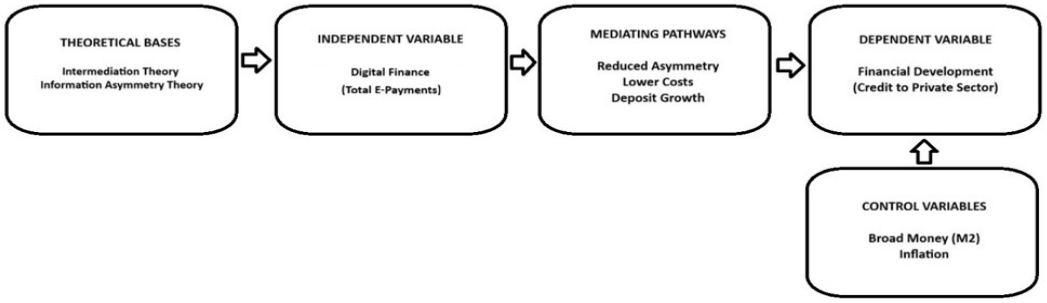


Fig. 1: Visualization of the Conceptual Framework

2.1.1 Financial Development

Financial development refers to the size, efficiency, and quality of capital flows in financial institutions and markets, which reduces transaction costs, and enhances financial intermediation.

The concept of financial development is rooted in the works of Goldsmith (1969), McKinnon (1973), and Shaw (1973). Goldsmith introduced the concept of the financial interrelations ratio (FIR) which measures the size of a country's financial assets relative to its national wealth. Both authors asserted that financial deepening is the process of eliminating repressive financial policies in order to allow the financial system to grow in size and efficiency. This view was later expanded by Levine (1997, 2005), who linked financial depth to the core functions of the financial system. Levine argued that a deep financial system is one which excels at mobilizing savings into large, usable pools of capital; and allocating capital by channeling these pooled resources into their most productive uses.

The ratio of domestic credit to private sector to the GDP is the most robust proxy for this capital allocation function of a financial system (Beck et al., 2000). Credit to private sector is the preferred metric because

it directly measures the funding for private investment, private enterprise, and innovation, all of which are considered as the primary drivers of sustainable economic growth (King & Levine, 1993).

2.1.2 Determinants of Financial Development

In their works, King & Levine, 1993; and Levine et al., 2000, used domestic credit to the private Sector as % of GDP as the indicator of financial depth, while the determinants of financial depth also include factors such as macroeconomic stability, legal and institutional quality, and economic structure (Beck et al., 2003; Djankov et al., 2007). According to Boyd et al. (2001), macroeconomic stability increases financial depth, because low and stable inflation rates encourage long term savings in financial assets, which would in turn increase the availability of capital for investments. Secondly, a good legal and institutional environment, characterized by strong creditor rights, effective contract enforcement, and low levels of corruption, will increase investor confidence, and encourage financial intermediation (La Porta et al., 1998). And finally, a well-structured and highly formalized economy will facilitate financial depth as fewer transactions take place outside the formal financial system (Beck et al., 2000).

2.1.3 Digital Finance

Digital finance refers to the integration of digital technology into financial intermediation processes, with particular focus on the mechanisms through which capital, credit, and financial resources are mobilized, allocated and managed across the economic agents (Gomber et al., 2017; Ozili, 2018). Digital finance directly addresses the financing functions of the formal financial system, which include digital credit extension, credit underwriting aided by digital algorithms, peer-to-peer (P2P) lending, and technology-enabled capital distribution (Liem et al., 2022; Ozili, 2018). By replacing traditional physical collateral with a data-driven credit evaluation score, digital finance facilitates expansion of credit to previously under-served market segments, and thereby transformed financial intermediation mechanisms (Antwi & Kong, 2023; Ozili, 2018).

Within the framework of this study, digital finance serves as an independent driver of financial development and overall financial depth. By capturing the extent to which digital technology expands the supply and overall efficiency of loanable funds, digital finance reflects the functional impact of digital innovation on aggregate credit expansion (Antwi & Kong, 2023; Liem et al., 2022; Ozili, 2018).

2.1.4 Disruptive Innovation

Christensen's (1997) theory of disruptive innovation highlights the emergence of digital finance. From his perspective, branch-based banking was a "sustaining innovation" that improved services for existing customers. But digital finance is a disruptive innovation because right from the start it served previously unbanked or under-banked populations by offering simpler, more affordable and more accessible financial products and services.

2.1.5 How Digital Finance Influences Financial Development

The primary mechanism by which digital finance affects financial depth is by the mitigation of information asymmetry; as well as the secondary effects of reduced transaction costs and increased savings mobilization.

Information asymmetry is a situation where one party in a transaction is better informed than the other, and it is a fundamental market failure in credit markets (Stiglitz & Weiss, 1981). Digital finance directly solves information asymmetry by generating and leveraging digital data about potential borrowers. This data serves as a proxy for income stability, cash flow patterns, and financial behavior (Bazot, 2018; Zetzsche et al., 2017). As a result, FinTech lenders and also traditional banks use computer algorithms to analyze this data and build alternative credit scores that enable them to assess the risk of borrowers who were previously invisible to the formal financial system (Berg et al., 2020).

In addition, it helps in the reduction of moral hazard and adverse selection, because lenders can more accurately price risk and monitor the use of funds after disbursement. This leads to an expansion of the credit landscape, as lenders can now profitably serve previously excluded segments of the population, leading to a direct increase in domestic credit to the private sector.

McKinnon and Shaw (1973) asserted that high cost of transactions plays a key role in causing financial repression. But digital finance lowers the cost of providing and accessing financial services, because the marginal cost of a digital transaction is negligible compared to the cost of operating a physical branch and processing cash (Evans & Pirchio, 2015).

2.2 Theoretical Review

2.2.1 The Finance-Growth Nexus Theories

In his seminal work “The Theory of Economic Development”, Joseph Schumpeter (1911), assigned an important role to the financial system in fostering economic growth. He argued that the core function of economic development is to carry out new combinations of resources, which he referred to as innovation. However, entrepreneurs require credit in order to divert resources from established, often stagnant firms and put into new innovative enterprises. Schumpeter asserted that banks are not just passive intermediaries, but rather, the overseers of the development process, by creating purchasing power to finance innovative enterprises.

McKinnon (1973) and Shaw (1973) provided a more direct and policy-oriented theory of financial depth, which focused on the constraints to financial deepening in developing economies. They coined the term “financial repression” which is a syndrome where government policies, such as interest rate ceilings, high reserve requirements, and directed credit programs, inhibit the functioning of the financial system. The Complementarities Hypothesis of McKinnon posited that in fragmented developing economies, firms must rely on self-finance for investment.

The "Debt Intermediation View" of Shaw (1973) emphasized that financial repression reduces the real return on financial assets, and reduces the size of the financial system, thereby making it shallow. It hinders the development of financial intermediaries and their ability to allocate capital efficiently.

2.2.2 The Endogenous Growth Synthesis

Levine (1997, 2005) expanded upon earlier views of the financial system by moving beyond merely its size in order to focus on its functions. He identified five key functions through which finance influences growth, which include mobilizing and pooling savings; allocating resources; facilitating risk management, diversification, and hedging; monitoring managers and exerting corporate control; and easing the exchange of goods and services. Levine argues that it is the improvement in these functions that reduces information disparities and transaction costs, thereby accelerating economic growth. He implied that financial depth is not an end in itself, but it is a necessary condition for the financial system to perform these growth-enhancing functions at scale.

2.2.3 Information Asymmetry and the Theory of Financial Intermediation

The Theory of Financial Intermediation states that financial institutions exist to channel funds from surplus units, or savers, to deficit units or borrowers, by solving two core market frictions, namely information asymmetry and transaction costs.

The seminal work of Akerlof (1970) on the "market for lemons", and its application to finance by Stiglitz and Weiss (1981), forms the bedrock of this theory. Information asymmetry occurs when one party to a transaction is better informed than the other. In credit markets, borrowers inherently know more about

their own risk profile and project viability than lenders do. This leads to two critical problems, namely adverse selection and moral hazard.

Faced with these problems, lenders do not simply raise interest rates, but instead, they ration credit (Stiglitz & Weiss, 1981). This credit rationing is a primary cause of a shallow financial system, as large portions of the economically active population, particularly SMEs and those in the informal sector are deemed unbankable.

Digital finance represents a paradigm shift in the technology of financial intermediation, and it directly addresses the core problem of information asymmetry through digital data. Digital data trail acts as a form of digital collateral (Bazot, 2018; Zetzsche et al., 2017). It is a proxy for income stability, business viability, and financial discipline of borrowers. Fintech lenders also employ computer algorithms to analyze this alternative data in order to build predictive credit scores (Berg et al., 2020). This process is often referred to as alternative credit scoring, and it dramatically lowers the cost of screening.

2.2.4 Disruptive Innovation Theory and the Digital Finance Ecosystem

Christensen (1997) introduced the theory of disruptive innovation to explain how innovations that create simpler and more affordable products or services can gradually take over established markets. Disruptors do not initially compete with the high-end products of incumbent firms. Instead, they first target potential consumers who previously lacked the necessary skill, or could not afford to use the existing product, or they create new markets in low-end segments. Digital finance emerged as a disruptive innovation by targeting non-consumers, by having a lower cost structure, and by bringing simplicity.

2.3.0 Empirical Review

The global narrative on digital finance has been significantly shaped by the Kenyan experience with M-Pesa, which is a mobile money platform operating in Kenya. The seminal work by Suri and Jack (2016) provided robust evidence that the expansion of M-Pesa increased financial inclusion in Kenya and also had impact on household welfare. They found that access to M-Pesa lifted an estimated 2% of Kenyan households out of poverty by enabling financial resilience and by facilitating occupational change, especially for households that are headed by females.

Demirgüç-Kunt et al., (2017) established a strong cross-country correlation between the use of digital payments and broader account ownership, using Global Findex data. They asserted that digital finance reduces the common barriers to financial access, especially for traditionally excluded groups like women, poor people and rural populations.

In their panel study on the subject of digital finance, Andrianaivo and Kpodar (2012) found that mobile phone penetration positively affected economic growth in African countries, mainly through an increase in savings mobilization and through financial inclusion. Their findings suggest a potential indirect route to financial depth, i.e. digital finance could increase the availability of credit for the private sector by mobilizing more deposits.

Muthiora and Cámara (2015) documented the rapid growth of mobile money and its positive correlation with increased financial inclusion in Tanzania. Often cited by policymakers, their work provided valuable descriptive analysis of the growth of the digital finance ecosystem, but relied less on econometric techniques to estimate its causal impact on the important financial sector indicators.

2.3.1 The Nigerian Empirical Landscape and Identification of the Research Gap

Early work by Mbutor and Uba (2013) provided an initial assessment of the CBN's financial inclusion drive, concluding that policies encouraging electronic banking were crucial for expanding access.

Oyelami et al., (2017) employed logistic regression on survey data to analyze the determinants of financial inclusion in Nigeria. They identified factors such as income, education, and, importantly, awareness of digital channels as key drivers. \

Other studies have examined the impact of digital finance on the banking sector itself. Nwani and Orij (2019) investigated the effect of electronic banking on the profitability of Nigerian commercial banks, where they found a positive relationship.

More recent research has begun to employ time-series methodologies. A study by Adeola and Evans (2020) used Autoregressive Distributed Lag (ARDL) model to examine the impact of mobile banking on financial inclusion in Nigeria, and they found a positive long-run relationship.

2.3.2 Synthesis of the Research Gap

This empirical literature reveals a clear and consistent pattern. Globally, initial evidence from Kenya and cross-country studies established the powerful impact of digital finance on financial inclusion and welfare. Subsequent research, particularly from Asia, has begun to provide direct evidence of its effect on credit markets and financial depth. Across Africa, the focus has remained predominantly on financial inclusion, savings, and usage, with limited studies into its macro-economic financial impact.

Within Nigeria, the existing empirical literatures have played a role in highlighting the success of digital finance in expanding financial access and improving efficiency. However, an important gap still remains. There is a scarcity of empirical research that employs econometric techniques to investigate the causal relationship between the key metrics of digital finance adoption, such as the value of digital payments and the density of agent networks, and the paramount indicator of financial depth in the form of domestic credit to the private sector as a percentage of GDP.

3.0 Research Methodology

To ensure a rigorous foundation, the methodology is rooted in Financial Intermediation Theory (Gurley & Shaw, 1960; Diamond, 1984) and Endogenous Growth Theory (King & Levine, 1993).

3.2 Research Design

This study adopts a quantitative research design using quarterly data to examine the relationship between digital finance and financial development in Nigeria over the period from Q1 2010 to Q4 2024.

3.3 Data Sources and Variables

Table 1: Summary of Variables, Data Sources, and Expected Signs

SN	VARIABLE	SOURCE	EXPECTED SIGN
1.	Financial Development (FD)	CBN Statistical Bulletin	Dependent
2.	Digital Finance (DF)	CBN e-Payment Statistics	+
3.	Broad Money Supply (M2)	CBN Statistical Bulletin	+
4.	Inflation Rate (INF)	CBN Statistical Bulletin	-
5.	Exchange Rate (EXR)	CBN Statistical Bulletin	+/-

3.4.0 Model Specification

3.4.1 Functional Relationship

Guided by financial intermediation theory and following empirical formulations in financial development literature (e.g., Ozturk & Acaravci, 2013; Eduke et al., 2025), the functional model for Objective One is specified as:

$$FD_t = f\left(DF_t, M2_t, \in F_t\right)$$

3.4.2 Linear Econometric Model

Linearizing Equation (1) yields:

$$FD_t = \beta_0 + \beta_1 DF_t + \beta_2 M2_t + \beta_3 \mathrm{IN}F_t + \mu_t$$

Where:

FD_t = Financial development (private sector credit / GDP) at time t

DF_t = Digital finance transaction value at time t

$M2_t$= Broad Money Supply relative to GDP at time t (Control variable for financial depth/liquidity)

INF_t = Consumer price index inflation rate at time t (control variable for macroeconomic stability)

β_0 = Intercept parameter

β_1, β_2, β_3 = Long-run structural parameters to be estimated

μ_t = Stochastic error term, assumed to be i.i.d. (0, σ2)

3.5.0 Method of Estimation

To estimate Equation (2), this study adopts the Autoregressive Distributed Lag (ARDL) bounds testing approach introduced by Pesaran, Shin, and Smith (2001).

3.5.1 Justification for Using the ARDL Approach

The choice of the ARDL technique over traditional co-integration methods (such as Johansen & Juselius, 1990) is justified based on four econometric considerations. It yields consistent, unbiased estimates and robust statistical inferences in small or finite sample sizes such as quarterly observations over 15 years, N=60.

3.5.2 ARDL Bounds Specification

The conditional ARDL framework is formulated as follows:

$$\Delta FD_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta FD_{t-i} + \sum_{i=0}^{q_1} \alpha_{2i} \Delta DF_{t-i} + \sum_{i=0}^{q_2} \alpha_{3i} \Delta M2_{t-i} + \sum_{i=0}^{q_3} \alpha_{4i} \Delta \mathrm{IN}F_{t-i} + \theta_1 FD_{t-1} + \theta_2 DF_{t-1} + \theta_3 M2_{t-1} + \theta_4 \mathrm{IN}F_{t-1} +$$

Where Δ represents the first-difference operator,

p, q_1, q_2, q_3 represent optimal lag lengths selected via the Akaike Information Criterion (AIC), α parameters capture short-run dynamics, and

θ parameters represent long-run multipliers.

3.6.2 ECM Specification

The restricted Error Correction Model is specified as:

$$\Delta FD_t = \alpha_0 + \sum_{i=1}^{p} \gamma_{1i} \Delta FD_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta DF_{t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta M2_{t-i} + \sum_{i=0}^{q_3} \gamma_{4i} \Delta \mathrm{IN}F_{t-i} + \lambda ECT_{t-1} + e_t$$

Where:

($ECT_{(t-1)}$) is the lagged residual derived from the long-run equilibrium equation.

λ is the speed-of-adjustment coefficient. λ must be statistically significant with a negative sign (-1 < λ < 0), confirming that short-run deviation from equilibrium is systematically corrected over subsequent periods.

3.7.2 Objective Two Model Specification

In order to address Objective Two evaluating the causal direction between digital finance and financial development, the Granger Causality model (Granger, 1969) is specified within a Vector Autoregression (VAR) framework as follows:

$$FD_t = \sum_{i=1}^{m} \alpha_i FD_{t-i} + \sum_{i=1}^{m} \beta_i DF_{t-i} + \mu_{1t}$$

$$DF_t = \sum_{i=1}^{m} \gamma_i DF_{t-i} + \sum_{i=1}^{m} \delta_i FD_{t-i} + \mu_{2t}$$

Where m is the optimal lag length, and μ_{1t}, μ_{2t} are mutually uncorrelated white-noise error terms.

Decision Rule

Unidirectional Causality (DF → FD): Null hypothesis $\sum \beta_i = 0$ is rejected, but $\sum \delta_i = 0$ is not rejected.

Unidirectional Causality (FD → DF): Null hypothesis $\sum \delta_i = 0$ is rejected, but $\sum \beta_i = 0$ is not rejected.

Bidirectional Causality (DF ↔ FD): Both null hypotheses ($\sum \beta_i = 0$ and $\sum \delta_i = 0$) are rejected.

Independence / Neutrality (DF ↛ FD): Neither null hypothesis is rejected.

4.0 Results

Table 2: Descriptive Statistics and Pairwise Correlations

	FD	DF	M2	INF
Mean	129.9417	388.1427	141.2965	15.03817
Median	133.4750	126.5200	144.8550	12.7850
Max	172.0000	1392.090	179.4900	34.1900
Min	94.8900	7.6400	101.1400	7.8000
Std. Dev.	26.4516	451.0252	19.7307	6.7780
Skewness	0.0014	1.0951	-0.0368	1.4648
Kurtosis	1.3455	2.4883	1.8293	4.5874
Observations	60	60	60	60
FD	1.0000			
DF	-0.6435	1.0000		
M2	0.8647	-0.3722	1.0000	
INF	-0.4737	0.5949	-0.0954	1.0000

Source: Author Computation (2026)

The correlation matrix reveals FD is strongly and positively correlated with M2 (0.8647), suggesting that an increase in money supply is associated with improved financial development.

4.2 Econometric Interpretation

Table 3: Unit Root Tests with Trend and Intercept Specification

Variable	ADF				PP			
	Level	Prob	Diff	Prob	Level	Prob	Diff	Prob
FD	-1.5947	0.7833	-6.4721	0.0000***	-1.7208	0.7296	-6.8185	0.0000***
DF	-2.2304	0.9162	-6.5142	0.0000***	-2.1318	0.5177	-7.8191	0.0000***
M2	-1.1196	0.3154	-7.4073	0.0000***	-1.7476	0.7172	-13.5132	0.0000***
INF	-1.3449	0.8664	-5.7796	0.0001***	-0.6012	0.9752	-5.7891	0.0001***

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author Computation (2026)

Table 3 indicates that both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests confirm that all variables become stationary after first differencing, implying that they are integrated of order one, I(1).

Table 4: Lag Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	00000127	36.9174	37.0703	36.9756
1	393.1822	38692180	28.8199	29.5848*	29.1112
2	34.5432	32018018	28.6175	29.9941	29.1417
3	11.0489	46557288	28.9588	30.9473	29.7161
4	23.6418	45976877	28.8824	31.4828	29.8727
5	13.7162	60579862	29.0495	32.2616	30.2727
6	21.7681	57177034	28.8187	32.6428	30.2749
7	14.4764	70955319	28.7694	33.2053	30.4586
8	18.5509	67601024	28.3181	33.3659	30.2403
9	27.8295	28056428	26.8174	32.4769	28.9726
10	35.3646*	2873479.*	23.5280*	29.7994	25.9162*

*Note: * indicates lag order selected by the criterion; NA: Not applicable; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion*

Source: Author Computation (2026)

Table 4 shows that the Akaike Information Criterion (AIC) attains its lowest value of 23.5280 at lag 10, indicating that this lag length provides the best model fit among the alternatives.

Table 5: ARDL Bounds Test for Cointegration

Test Statistic	Value	k
F-statistic	9.6677	3
Critical Value Bounds		

Test Statistic	Value	k
Significance	I0 Bound	I1 Bound
10%	3.47	4.45
5%	4.01	5.07
1%	5.17	6.36

Source: Author Computation (2026)

Table 5 presents the results of the ARDL bounds test for cointegration, which examines whether a long-run relationship exists among the variables in the model. These results provide strong evidence of cointegration among the variables, indicating that Financial Development (FD), Digital Finance (DF), Money Supply (M2), and Inflation (INF) maintain a stable long-run equilibrium relationship over the study period.

Objective One: To examine the empirical effect of digital finance on financial depth in Nigeria

Table 6:Long Run Estimates (Dependent Variable: FD)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DF	0.0002	0.0030	0.0695	0.9468
M2	0.9487	0.0835	11.3608	0.0000***
INF	-0.5138	0.1013	-5.0718	0.0023***

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author Computation (2026)

The long-run estimates in Table 6 show the relationship between Financial Development (FD) and its determinants over the study period.

Table 7: Short Run Estimates (Dependent Variable: D(FD))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	112.4947	15.1061	7.4469	0.0003***
@TREND	-2.8915	0.3840	-7.5291	0.0003***
D(FD(-1))	2.6259	0.3539	7.4198	0.0003***
D(DF)	-0.0056	0.0022	-2.5099	0.0459**
D(M2)	0.5387	0.0789	6.8276	0.0005**
D(INF)	-1.8519	0.5037	-3.6767	0.0104***
CointEq(-1)*	-0.8085	0.6314	-7.6162	0.0003***
R-squared: 0.9902 Durbin-Watson statistics: 2.1538 Prob(F-statistic): 0.0000 Adjusted R-squared: 0.9467 F-statistic: 22.7454Selected Model: ARDL(10, 10, 9, 10)				

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author Computation (2026)

The short-run estimates in Table 7 provide a detailed understanding of the immediate effects of the explanatory variables on changes in financial development (D(FD)) in Nigeria.

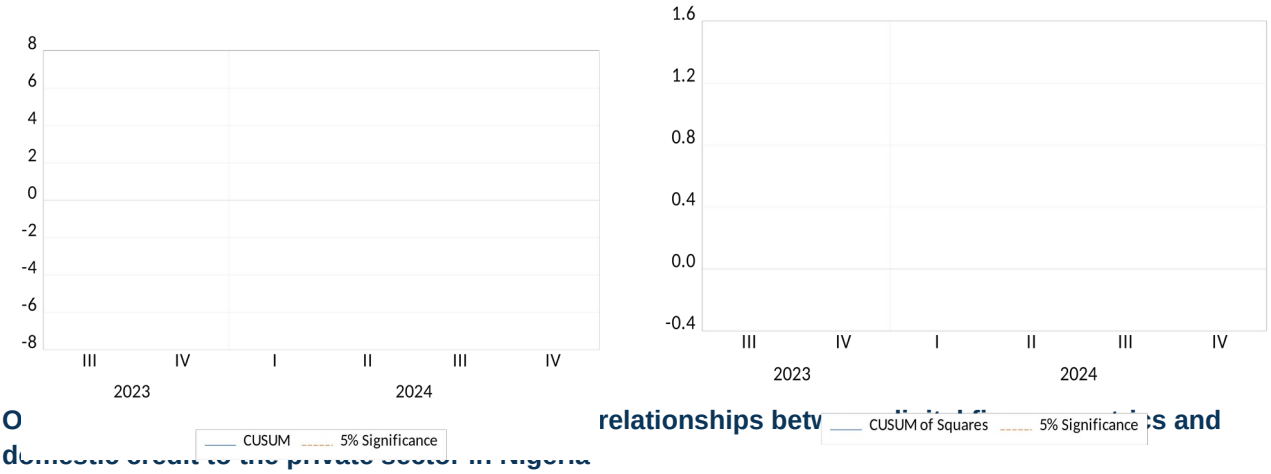
4.3 Post Estimation Test

Table 8: Normality, Serial Correlation, Heteroskedasticity and Model Specification Tests

Test	F-statistics	Probability	Decision
Jarque-Bera Normality	1.9571	0.3759	Normally distributed
Breusch-Godfrey Serial Correlation LM	1.2705	0.3740	No serial correlation
Breusch-Pagan-Godfrey Heteroskedasticity	1.0308	0.5432	No heteroskedasticity
Ramsey RESET	0.0259	0.8784	Model is correctly specified

Source:Author Computation (2026)

Figure 1: Model Stability Test CUSUM and CUSUM of Square



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Table 9: Pairwise Granger Causality Test Results

Hypothesis	F-Statistic	Prob.	Decision
DF does not Granger Cause FD FD does not Granger Cause DF	0.0686 4.0883	0.9338 0.0223**	One-way causality
M2 does not Granger Cause FD FD does not Granger Cause M2	0.4519 0.7581	0.6388 0.4736	No causality
INF does not Granger Cause FD FD does not Granger Cause INF	0.4653 1.6425	0.6305 0.2032	No causality
M2 does not Granger Cause DF DF does not Granger Cause M2	6.0893 0.0518	0.0042*** 0.9496	One-way causality
INF does not Granger Cause DF DF does not Granger Cause INF	1.7771 3.8476	0.1791 0.0275**	One-way causality
INF does not Granger Cause M2 M2 does not Granger Cause INF	1.2819 1.1882	0.2860 0.3128	No causality

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author Computation (2026)

The Pairwise Granger Causality results in Table 9 provide evidence on the direction of relationships between Digital Finance (DF) and Financial Development (FD) in Nigeria in line with Objective Two. The results indicate a unidirectional causality running from Financial Development (FD) to Digital Finance (DF) at the 5% level of significance (p = 0.0223), leading to the rejection of the null hypothesis that FD does not Granger cause DF.

4.4 Robustness Check

Table 10:Fully Modified and Dynamic OLS Results (Dependent Variable: FD)

Variable	FMOLS				DOLS			
	Coefficient	Std. Error	t-Statistic	Prob.	Coefficient	Std. Error	t-Statistic	Prob.
DF	-0.0102	0.0052	-1.9529	0.0560*	-0.0143	0.0069	-2.0597	0.0455**
M2	0.9356	0.1662	5.6293	0.0000***	1.0280	0.2330	4.4114	0.0001***
INF	-0.8064	0.5205	-1.5493	0.1271	-0.5831	0.6107	-0.9547	0.3450
C	21.5242	24.9990	0.8610	0.3930	3.3266	37.9600	0.0876	0.9306
@TREND	-0.2557	0.3004	-0.8514	0.3983	-0.1434	0.3974	-0.3607	0.7201
R-squared		0.9257				0.9476		
Adjusted R-squared		0.9201				0.9317		

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Source: Author Computation (2026)

4.5 Discussion of the Major findings

Objective One: To examine the empirical effect of digital finance on financial depth in Nigeria

The empirical results from both the long-run and short-run analyses indicate that digital finance (DF) does not yet exert a significant positive effect on financial depth in Nigeria. In the long run, DF shows a positive but statistically insignificant relationship with domestic credit to the private sector, implying that the expansion of digital financial platforms has not translated into meaningful credit growth within the Nigerian financial system.

The short-run results further show that DF has a negative and significant effect on financial depth, and that while monetary factors such as liquidity strongly drive financial depth, digital finance remain underdeveloped in their role as a credit-enhancing mechanism within Nigeria's financial system.

In contrast, Money Supply (M2) demonstrates a strong positive and statistically significant effect on financial development (0.9487, $p < 0.01$). This indicates that increases in liquidity substantially enhance financial depth by expanding the availability of credit to the private sector.

Inflation (INF) is found to have a negative and statistically significant effect on financial development (−0.5138, $p < 0.01$), indicating that rising price levels hinder financial depth in Nigeria. High inflation reduces the real value of financial assets, discourages savings, and increases uncertainty in lending, thereby constraining credit to the private sector.

The short-run ARDL results in Table 7 reveal important dynamics in the relationship between Digital Finance (DF) and financial depth in Nigeria. The lagged dependent variable is positive and highly significant, indicating strong persistence in financial development. While the coefficient of DF is negative and statistically significant, suggesting that, in the short run, increases in digital finance slightly reduce financial depth. This implies that digital finance in Nigeria is not yet effectively channelled toward credit expansion but is largely concentrated on payments and transactional services, and that while monetary expansion supports short-run financial depth in Nigeria, the current structure of digital finance and macroeconomic instability particularly inflation limit their effectiveness in promoting sustainable financial deepening.

Objective Two: To analyze the nature of causal relationship between digital finance and financial depth in Nigeria.

The findings reveal a unidirectional causality running from financial development to digital finance at the 5% level of significance, which implies that improvements in domestic credit to the private sector stimulate the expansion of digital finance rather than the reverse.

In addition, the results reveal a strong unidirectional causality from digital finance to money supply at the 1% level, indicating that the expansion of digital finance significantly influences liquidity conditions in the economy.

The causality results indicate that while financial development drives digital finance in Nigeria, DF has limited feedback effects on financial depth but plays a significant role in influencing broader macroeconomic variables such as money supply and inflation.

However, the negative DF - FD relationship contradicts other empirical evidence. For instance, Aker and Mbiti (2010) argue that mobile financial services can enhance financial sector efficiency and promote broader financial development by lowering transaction costs and improving market participation. This implies that Nigeria’s experience may reflect structural constraints such as weak credit infrastructure, low digital lending penetration, and regulatory gaps that limit the transformation of digital finance into credit expansion.

5.0 Summary, Conclusion and Recommendations

5.1 Summary of the Major Findings

The empirical investigation on the effect of digital finance on financial depth in Nigeria provides evidence across the long-run, short-run, causality, and robustness analyses, revealing a mixed and structurally constrained relationship. In both the long-run ARDL and robustness estimations (FMOLS and DOLS), Digital finance (DF) consistently exhibit a negative relationship with financial development, which is statistically significant in some cases and insignificant in others. This indicates that, despite the rapid expansion of digital financial platforms in Nigeria, they have not yet translated into meaningful growth in domestic credit to the private sector. Instead, DFS appears to be largely concentrated on payment and transfer services rather than credit intermediation.

In the short-run dynamics, DF maintains a negative and statistically insignificant effect on financial development, further reinforcing the long-run evidence that digital finance has not yet become effective channels for credit expansion in Nigeria. Money supply continues to exert a positive and significant influence, while inflation reduces financial depth, indicating that monetary conditions play a more immediate role in shaping financial outcomes than digital finance innovations.

5.2 Conclusion

This study concludes that digital finance s not yet significantly contributed to financial depth in Nigeria, as evidenced by their weak and mostly negative relationship with domestic credit to the private sector across the long-run, short-run, and robustness estimations. The results consistently show that DF remains largely transaction-oriented, focusing on payments and financial inclusion rather than credit intermediation and financial deepening. The financial system continues to rely more on traditional monetary factors, particularly liquidity conditions, in driving financial development.

5.3 Recommendations

The following recommendations are made in line with the stated objectives:

i. The Central Bank of Nigeria (CBN) and regulatory bodies should create incentives for commercial banks and FinTech operators to integrate retail e-payment transaction histories into a centralized credit registry, as adding such alternative data into credit-scoring systems will allow e-payments to play an active role in enhancing the allocation of credit to SMEs.
ii. Regulators should shift policy focus from basic financial inclusion toward encouraging digital credit platforms.
iii. Monetary authorities should maintain price stability alongside monetary growth in order to preserve real values of credit and encourage intermediary long-term lending.
iv. The CBN and other financial authorities should also encourage interoperability between traditional banks and fintech operators to improve efficiency in credit delivery.
v. Financial literacy programs should be intensified to increase the ease with which users and firms can access and utilize digital credit services effectively.
vi. Lastly, continuous monitoring and regulation of digital financial platforms is necessary to ensure that they contribute to sustainable credit expansion and financial deepening in Nigeria.

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