

E-Banking and Financial Development in Nigeria

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Abstract- *Despite the rapid expansion of electronic banking (e-banking) channels in Nigeria, financial development remains shallow and uneven, raising concerns about the effectiveness of digital financial innovations. This study examines the effect of electronic banking on financial development in Nigeria over the period 1999–2024, using the International Monetary Fund’s Financial Development Index (FDI), which captures financial depth, access, efficiency, and stability. Principal Component Analysis (PCA) was employed to construct composite indices, while the Auto-Regressive Distributed Lag (ARDL) model is used to estimate short- and long-run relationships. The results show that ATM and Internet Banking exert positive and statistically significant effects on financial development in both the short and long run, indicating improved financial access, inclusion, and transactional efficiency. Specifically, a 1% increase in ATM and INB usage raises financial development by approximately 6% and 3% in the short run. In contrast, POS transactions and GDP growth exhibit negative and significant effects, reflecting infrastructural inefficiencies and growth driven by non-financial sectors. Mobile banking, interest rate, and exchange rate effects remain weak or insignificant. The study concludes that e-banking is a key driver of financial development in Nigeria, but its impact is constrained by infrastructural, technological, and regulatory challenges. The study recommended an increased investment in digital infrastructure, enhanced financial literacy, and stronger regulatory and cybersecurity frameworks.*

Keywords: *E-banking, Financial Development, ARDL, Financial Inclusion, Financial Development Index.*

I. INTRODUCTION

The emergence and diffusion of electronic banking (e-banking) represent a pivotal transformation in the financial architecture of many developing economies. The rapid expansion of electronic banking channels has transformed the delivery of financial services, with technologies such as automated teller machines (ATMs), point-of-sale (POS) devices, internet banking, mobile banking applications, and web-based

payment platforms increasingly complementing traditional branch-based transactions (Madzire & Ncube, 2021; Onabanjo et al., 2022). In the context of Nigeria, such mechanisms have emerged against a backdrop of large unbanked populations, substantial cash-dependence in everyday transactions, and ongoing efforts to deepen financial inclusion and promote efficient intermediation.

In Nigeria, the transition toward digital financial services has been catalysed by multiple factors. These include the regulatory push by the Central Bank of Nigeria (CBN) through its cash-less economy policy, mobile money guidelines, and payment system modernisation. The CBN’s interventions aim to reduce reliance on physical cash, enhance payment system efficiency, and broaden access to formal financial services, thus laying the groundwork for a link between e-banking adoption and broader financial development (CBN, 2024; Oluwatayo, 2017). The growth of Nigeria’s fintech ecosystem, characterised by the proliferation of POS terminals, mobile money platforms, internet banking uptake and a rising number of ATMs and digital accounts, further underpins this shift (Iwedi, 2024; Okoro et al., 2023).

Financial development refers to the extent to which a country’s financial institutions and markets effectively mobilise savings, facilitate transactions, allocate credit, manage risks, and support productive investment. It encompasses key dimensions such as financial depth, access, efficiency, and stability, which determine the capacity of the financial system to provide affordable and reliable financial services to households and businesses (Čihák et al., 2012). A developed financial system can promote economic growth by improving resource allocation, reducing transaction and information costs, encouraging investment, supporting innovation, and enhancing access to credit (Levine, 2005). In Nigeria, financial development is particularly important given the need

to expand access to financial services, strengthen financial intermediation, and improve the efficiency of the banking system. The increasing adoption of electronic banking channels, including ATMs, POS terminals, internet banking, and mobile banking, can contribute to these objectives by reducing transaction costs, widening access, and improving the efficiency of financial services (World Bank, 2016).

Theoretically, e-banking can influence financial development through several channels. First, by lowering transaction costs and reducing physical barriers to banking services, e-banking can expand deposit mobilisation and savings (thereby increasing the deposit-to-GDP ratio). Second, enhanced digital payment infrastructure can accelerate payment system efficiency, reduce settlement times, and improve the velocity of money critical components of financial deepening. Third, as digital channels proliferate, banks may extend credit more broadly (private sector credit/GDP) and thereby improve financial intermediation. Ultimately, expanded inclusion through digital financial channels enhances both the breadth and depth of financial services, thereby strengthening financial stability and promoting inclusive economic growth (Oluwatayo, 2017; Okoro et al., 2023).

Empirical studies in Nigeria and other developing economies yield mixed but increasingly positive evidence regarding the relationship between e-banking and indicators of financial development. For instance, Alwell & Oladosu (2022) found that mobile payments, web-based payments and ATMs had a positive and significant effect on deposit penetration in Nigerian deposit-money banks. Similarly, Iwedi (2024) reported that digital finance infrastructure (including ATMs, POS, and web banking) correlates positively with growth in commercial banking firms in Nigeria. On the other hand, while some studies link e-banking to improved bank productivity (Fatade et al., 2025) or higher deposit mobilisation (Osakwe et al., 2024), others note that e-banking alone may not guarantee improved bank intermediation or broader economic growth indicating the importance of complementary factors such as infrastructure quality, regulatory environment, human capital and consumer trust (Igbinovia & Shittu, 2024; Onabanjo et al., 2022).

Against this background, the present study examines the effect of e-banking on financial development in Nigeria. Unlike previous studies that have largely concentrated on specific measures of banking performance, such as profitability, net interest margin, and deposit growth, this study adopts a broader measure of financial development using the IMF Financial Development Index (FDI). The index provides a comprehensive assessment of financial development by capturing key dimensions, including financial depth, access, efficiency, and stability, thereby providing a more holistic measure of the development of the financial system. Specifically, the study investigates the effects of major e-banking channels automated teller machines (ATMs), point-of-sale (POS) transactions, internet banking, and mobile banking on financial development in Nigeria over time, while controlling for important macroeconomic factors, namely GDP growth, interest rate, and exchange rate. This approach provides a broader empirical assessment of whether the expansion of electronic banking has translated into improvements in the overall development and functioning of Nigeria's financial system.

This study addresses three key gaps in the literature. First, it expands the outcome space beyond individual bank performance to include system-wide financial development metrics. Second, it places Nigeria's recent digitalisation trajectory (including data up to 2024) at the centre, thereby allowing for an updated assessment rather than relying on older datasets. Third, by controlling for structural breaks and applying appropriate time-series econometric methods, the study aims to provide robust inference on both short-run and long-run effects. Policymakers, banks, fintechs and development partners thus stand to benefit from insights into whether and how e-banking contributes to sustainable financial sector advancement in Nigeria.

The remainder of the paper is structured as follows: Section 2 reviews the literature and develops the conceptual framework; Section 3 describes the data, variables and econometric methodology; Section 4 presents the empirical results; Section 5 discusses

policy implications, limitations and suggestions for future research; and Section 6 concludes.

II. CONCEPTUAL CLARIFICATIONS

2.1 E-banking

Electronic banking (e-banking) refers to the conduct of banking transactions through electronic channels such as computer systems, mobile communication devices, Automated Teller Machines (ATMs), and internet-based platforms. In Nigeria, the evolution of e-banking gained momentum following the deregulation of the banking sector in 1986, which introduced computerisation and improved service delivery. This development was further strengthened by the Central Bank of Nigeria's issuance of electronic banking guidelines in August 2003 to enhance the efficiency and regulation of electronic banking operations (Oluwagbemi et al., 2011).

According to Oluyemi (2001), e-banking is the totality of the deployment of modern information technology and communication systems to record financial transactions and deliver financial services to customers. It is therefore the provision of bank services by financial institutions to their customers through electronic devices. Oluyemi (2001) listed some electronic banking services including automated teller machines (ATM), card systems, internet and online banking, virtual banking and telephone banking. Hertzum, Juul, Jørgensen and Nørgaard (2004) defined as banking operations conducted over the World Wide Web. It involves individual and corporate clients and includes bank transfers, payments and settlements, documentary collections and credits, corporate and household lending, business cards and some orders.

According to Abdul, Rahman, & Uddin, (2007), electronic banking information architecture is modelled as client-server architecture. A client operating through a PC linked to the Internet opens the special E-Banking site of his bank and then, using a set of special secure numbers gets access to his bank accounts and can consult them, as well as to make all necessary payments and transfers from his accounts.

2.2 Financial Development

Financial development typically comprises institutions, intermediaries and markets, with both private market actors such as commercial banks, hedge funds and institutional investors, and public institutions such as governments and central banks, which allow the transactions of financial capital, such as money and credit, between savers and investors (Hudson, 2014). While there is no single universal definition of financial development, it broadly refers to the establishment and expansion of various financial intermediaries, institutions and markets, such as banks and stock markets.

Financial development refers to the improvement of financial functions, which facilitates efficient capital allocation, mobilisation of savings, risk management, corporate governance and firm monitoring (Levine, 1995). In his work, Levine (1997) defined financial development as the ability of a financial system being able to perform better with respect to producing information, allocating capital, monitoring investments, exerting corporate governance, ameliorating risks, mobilizing and pooling savings, and easing the exchange of goods and services. Rajan and Zingales (2003) defined financial development as how easy it is to raise finance without prior connections or wealth and the ease with which any entrepreneur or company with a sound project can obtain finance, and the confidence with which investors anticipate an adequate return.

Galor and Zeira (1993) suggested that financial development occurs when financial constraints and credit market imperfections, such as information asymmetries, contract enforcement and transaction costs, are reduced. According to Stiglitz and Weiss (1983), financial development can be defined as the development of the size, efficiency and stability of financial markets along with increased access to the financial markets that can have multiple economic advantages. Further, financial systems assist in trading, diversification, hedging and risk amelioration, apart from facilitating transactions of goods and services. Also, capital accumulation and technological innovation are the paraphernalia between financial development and growth.

2.3 Theoretical Review and Theoretical Framework

The literature links e-banking to financial development through standard financial intermediation and technology-adoption theories. Financial intermediation theory predicts that innovations which lower transaction costs and informational frictions (e.g., digital payments, online account management) should increase deposit mobilisation, lower intermediation margins and enable more efficient credit allocation (Madzire & Ncube, 2021). Technology adoption frameworks (TAM, diffusion of innovation) explain heterogeneity in consumer uptake across demographics and geographies, which in turn conditions how digital channels affect aggregate financial outcomes (Onabanjo et al., 2022). Together these frameworks motivate measuring both supply-side (payment rails, bank digital capacity) and demand-side (consumer adoption, trust) factors when assessing impacts on financial depth, access and efficiency.

The study adopts the Innovation Theory of Unemployment as the Theoretical Framework for the study. The theory argues that if the demand for laborers decreases because of a technology change (innovation is labor saving, in the sense that at any wage, the demand for workers decreases) then unemployment increases. Keynes postulations on technological innovation created the awareness of the discovery of machineries that accelerate and enhances productivity, however, might result in detrimental effect on the labour force. Therefore, given the introduction of electronic banking channels like point-of-sale services, mobile banking, internet banking, and other forms of technology that are adopted for intra and interbank service, the adoption of these channels has the possibility of reducing the number of manual labour forces that might be needed.

2.4 Empirical Review

Wachukwu (2025), examined the effect of banking innovations on unemployment and economic growth using annual time-series data covering 2009–2023. The study employed the Augmented Dickey-Fuller (ADF) unit-root test, Johansen cointegration test, and

Error Correction Model (ECM) to examine both the short-run and long-run relationships among the variables. The findings revealed that electronic banking innovations, particularly point-of-sale (POS) transactions, mobile banking, automated teller machine (ATM) transactions, and Bank Verification Number (BVN) registrations, exerted positive and significant effects on real GDP growth in both the short and long run. Mobile banking and BVN registration recorded particularly strong short-run effects, providing support for the financial innovation-led growth hypothesis in Nigeria. The study recommended that policymakers and financial institutions should promote digital banking infrastructure, improve the reliability of electronic payment systems, and strengthen policies that encourage the adoption of financial innovations. However, the study has an important limitation in relation to the present study. Its principal outcome variable was economic growth rather than financial development. Although the study demonstrates that banking innovation can stimulate economic activity, it does not directly establish whether e-banking improves the depth, access, efficiency, and stability of Nigeria's financial system.

Idanyingi and Egileoniso (2025) investigated the relationship between electronic payment systems and economic development over the period 2009–2023. The researchers employed the Autoregressive Distributed Lag (ARDL) model to examine both short-run and long-run relationships between payment-system variables and economic development, measured using per capita income. The findings indicated that ATM, electronic funds transfer (EFT), and mobile payment transactions had positive but statistically insignificant effects on per capita income in the short run, whereas POS transactions exerted a significant negative effect. In the long run, the electronic payment variables remained statistically insignificant, suggesting that the increasing availability of electronic payment channels had not necessarily translated into proportional improvements in economic development. The study recommended improved payment-system infrastructure, greater public awareness, enhanced security, and policies aimed at increasing the effective utilisation of electronic payment technologies. The major limitation

of the study is its use of per capita income as the measure of economic development. Per capita income captures changes in economic welfare but does not comprehensively measure financial-system development. Consequently, the study does not establish whether electronic payment systems improve financial depth, access, efficiency, or stability.

Chidum (2024) examined the relationship between financial development, trade performance, unemployment, and economic growth in Nigeria over the period 1985–2021. The study utilised the Autoregressive Distributed Lag (ARDL) approach to establish both the short-run and long-run relationships among the variables. The findings indicated that financial development and government expenditure had positive and statistically significant effects on GDP in the long run. The results suggest that improvements in the financial system, together with supportive government expenditure, can enhance economic performance by improving financial intermediation and resource allocation. Based on these findings, the study recommended strengthening financial institutions, improving access to financial services, and implementing supportive fiscal policies to promote economic growth. Nevertheless, the study does not directly investigate the role of e-banking in financial development. Its focus is principally on the relationship between financial development and broader macroeconomic outcomes, leaving unanswered the question of whether technological innovations in banking such as ATM, POS, internet banking, and mobile banking are responsible for improvements in Nigeria's financial system.

Isiaka (2024) examined different indicators of financial development, including financial system deposits relative to GDP, private-sector credit, liquidity, efficiency, and stability. The findings showed that financial system deposits relative to GDP significantly reduced unemployment in both the short and long run, while other indicators of financial development, including private-sector credit, liquidity, efficiency, and stability, mainly exerted short-run effects. The study concluded that although financial development contributes to employment creation, weaknesses in Nigeria's financial system continue to constrain its broader developmental

impact. It recommended deeper financial-sector reforms, improved credit allocation, enhanced financial intermediation, and policies aimed at strengthening the efficiency and stability of financial institutions. The limitation of this study is that it treats financial development primarily as an explanatory factor for unemployment rather than investigating the factors that drive financial development itself. In particular, the study does not consider e-banking as a technological determinant of financial development.

Ogbaro et al. (2023) examined the interaction between remittances, financial development, and economic growth using annual data covering 1981–2021. The study employed the Fully Modified Ordinary Least Squares (FMOLS) technique to estimate the long-run relationships among the variables. The findings revealed that remittances alone had a negative but statistically insignificant effect on economic growth. However, when remittances interacted with financial development, their effect on economic growth became positive and statistically significant. This finding suggests that the level of financial development determines the extent to which remittances can be transformed into productive investment and contribute to economic growth. The study recommended strengthening financial institutions and improving financial intermediation mechanisms to ensure that remittance inflows are efficiently channelled into productive economic activities. Despite its relevance to financial development, the study does not examine the technological transformation of banking services as a determinant of financial development. Its emphasis on remittances and economic growth means that the role of specific e-banking channels remains unexplored. Moreover, the study does not separately examine ATM, POS, internet banking, and mobile banking, making it difficult to determine which electronic banking channels contribute most to financial-system development. This represents another gap that the present study intends to fill.

Naimoğlu (2023) assessed the impact of financial sector development on unemployment across eight upper-middle-income countries using panel data and CCEMG and AMG estimators. The study found that increased broad money supply raised unemployment, whereas domestic credit to the private sector

significantly reduced unemployment, indicating that credit access is a key channel through which financial development improves labor market outcomes.

Ebimobowei et al. (2023) evaluated the effect of digital financial services on Nigeria's financial sector growth from 2006–2021 using a VECM approach. The results showed that POS services and web banking had significant positive effects on GDP, while ATM and mobile banking had positive but insignificant effects. The study concluded that digital financial services contribute to economic growth, though their impact varies across channels.

Chidum (2024) demonstrates that financial deepening and government expenditure exert a positive and significant long-run effect on real GDP, reinforcing the argument that a well-functioning financial system supports growth when complemented by sound trade and fiscal policies. Similarly, Akintola, Oji-Okoro, and Itodo (2023) show that financial deepening, banking system liquidity, and capital market performance enhance long-run output growth, although exchange rate instability undermines these gains. These studies emphasize the importance of macroeconomic stability and sectoral depth in translating financial development into growth outcomes.

Beyond growth, several studies examine the labor market implications of financial development, with mixed findings. Isiaka (2024) finds that only financial system deposits significantly reduce unemployment in both the short and long run, while other financial indicators exert only temporary effects, suggesting structural weaknesses in Nigeria's financial system. In contrast, Tabansi, Ogonna, and Chukwunonso (2023) report no long-run relationship between financial inclusion and unemployment, though a significant short-run effect exists. These results imply that while financial development can alleviate unemployment, its long-term effectiveness depends on the depth, efficiency, and inclusiveness of the financial sector.

Iwedi (2023) examined the effect of digital banking technology on financial inclusion in Nigeria using quarterly time-series data from 2009-2021. The study applied Granger causality techniques and found that

the digital banking model (including ATM, POS, web and mobile banking) had a significant positive impact on financial inclusion. It concluded that digital banking is a critical driver of increased access to financial services, recommending expanded internet and mobile infrastructure to deepen inclusion (Iwedi, 2023).

Oluwatayo, (2017) examined electronic banking services as determinants of household financial inclusion using secondary data and found that ATM, mobile and internet banking offered convenience and increased financial participation but were constrained by infrastructure and ICT limitations. The study concluded that enhancing ICT access and reducing operational barriers would improve financial inclusion outcomes.

Okoro, et al., (2023) investigated the dynamics of digitalisation on Nigerian financial system performance using dynamic OLS. Results showed that web and instant payment systems positively impacted capital adequacy and liquidity ratios, concluding that digitalisation enhances financial system robustness, recommending greater digital infrastructure investments.

Despite these extensive contributions, several gaps remain. First, existing Nigerian studies largely rely on single or limited indicators of financial development or innovation, failing to capture its multidimensional nature. Second, findings on the growth and employment effects of digital financial services are mixed, suggesting that infrastructure quality, efficiency, and regulatory frameworks may condition outcomes. Third, few studies integrate financial development, financial innovation, and macroeconomic outcomes within a unified empirical framework using comprehensive indices and recent data. These gaps underscore the need for further empirical analysis employing multidimensional measures of financial development and robust econometric techniques to better capture both short- and long-run dynamics in Nigeria.

III. METHODOLOGY

A time series data is used in this study, data cover the period between 1999 and 2024. Data on the electronic banking system (measured by the aggregate annual volume of ATM, POS, internet banking and mobile–phone banking transactions), financial development indicators measured by IMF financial development index (the depth, access, efficiency, and stability of

financial systems) and the control variables (inflation, interest rate, exchange rate and GDP) sourced from CBN Statistical Bulletin whereas data on unemployment rate are sourced from National Bureau of Statistics, Nigeria.

Table 3.1: Description of variables

Variables	Unit of Measurement	Sources
Financial Development Index (FDI)	Composite index (standardised score, 0–1 scale)	IMF (2025)
Internet Banking Transactions	Percentage of total transactions (%)	CBN (2025)
Mobile Phone Banking Transactions	Percentage of total transactions (%)	CBN (2025)
ATM Transactions	Value of transactions (₦ billion)	CBN (2025)
POS Transactions	Value of transactions (₦ billion)	CBN (2025)
Interest Rate	Percentage (%)	CBN (2025)
Exchange Rate	Naira per US Dollar (₦/USD)	CBN (2025)
GDP Growth Rate	Annual percentage growth rate (%)	CBN (2025)

3.1 Model Specification

The variables for electronic banking are based on the study conducted by Napoleon, Princess and Linda (2022). Following the approach used in Cihak (2012), financial development variables selected from the major two components of financial system (financial institutions and financial market). The development and efficiency of the financial institutions represented by financial development index (FDI) develop by IMF. Also, Financial Development (FDI) and Electronic Banking (EBI) Indices respectively

generated from Financial Development and Banking Variables using principal component analysis.

To achieve the objective, financial development is the dependent variable, while Electronic Banking (EBI) variables are used as explanatory variables. Explicit specification of the functional form of the model is stated in equation 3.1

$$FDI = F(ATM, POS, INB, MPB, ITR, EXR, GDP) \quad 3.1$$

$$FDIt = \beta_0 + \beta_1 ATM_t + \beta_2 POS_t + \beta_3 INB_t + \beta_4 MPB_t + \beta_5 ITR_t + \beta_6 EXR_t + \beta_7 GDP_t + \mu_t \quad 3.1$$

Where: ATM = Automated Teller Machine, POS = Point of Sale, INB = Internet Banking, MPB = Mobile–Phone Banking, FDI = Financial Development Index, ITR = Interest rate, EXR = Exchange rate, GDP = Gross Domestic Product Growth rate. Approri Expectation: $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$, $\beta_5 > 0$, $\beta_6 > 0$, $\beta_7 > 0$. Since the variables in the model are integrated of the mixture of order zero and one, the Auto-regressive Distributed Lag (ARDL) is adopted with ARDL Bound Test to use to test the

nature of the long-run relationship between the dependent and independent variables.

3.2 Justification of Variable

The choice of variables in this study is guided by both theoretical foundations and empirical evidence from the financial development and digital banking literature. Electronic banking variables Automated Teller Machines (ATM), Point of Sale (POS), Internet Banking (INB), and Mobile Phone Banking (MPB) are included based on the framework of Napoleon,

Princess, and Linda (2022), who emphasize the role of technology-driven payment systems in enhancing financial intermediation, access, and efficiency. These variables capture the depth, accessibility, and usage of digital financial services, which are critical channels through which financial inclusion and system efficiency are improved in modern economies.

Financial Development Index (FDI), developed by the International Monetary Fund (IMF), is employed as the dependent variable to provide a comprehensive and multidimensional measure of financial development, incorporating financial depth, access, efficiency, and stability. This approach follows Cihák et al. (2012), who argue that composite indices offer a more accurate representation of financial system performance than single indicators such as credit or money supply. The use of FDI allows the study to move beyond narrow bank-based measures and capture the broader structure of Nigeria's financial system.

3.3 Estimation Technique

To reduce dimensionality and avoid multicollinearity among correlated indicators, Principal Component Analysis (PCA) is used to generate composite indices for both Financial Development (FDI) and Electronic Banking (EBI). PCA is appropriate as it extracts the most relevant information from multiple indicators while retaining maximum variance, thereby improving estimation efficiency and interpretability.

Given that the variables are integrated of mixed order, $I(0)$ and $I(1)$, the Autoregressive Distributed Lag (ARDL) modeling approach is adopted. The ARDL technique is suitable in such situations because it does not require all variables to be integrated of the same order and performs well with small or moderate sample sizes. The ARDL Bounds Testing approach is further employed to examine the existence of a long-run equilibrium relationship between financial development and electronic banking variables.

Moreover, the ARDL framework allows for the simultaneous estimation of short-run dynamics and long-run coefficients, providing richer insights into how electronic banking innovations influence financial development over time. The inclusion of lagged dependent variables also captures adjustment dynamics, enabling the model to reflect how deviations from long-run equilibrium are corrected.

Based on theoretical expectations and prior empirical findings, the coefficients of electronic banking variables and macroeconomic controls are expected to be positive ($\beta_1 - \beta_7 > 0$), reflecting their anticipated role in enhancing financial access, efficiency, inclusion, and system stability.

IV. DATA PRESENTATION

Table 4.1: Result of the Descriptive Statistics

	FDI	ATM	POS	INB	MPB	INT	EXR	GDP
Mean	0.870402	12.62905	6.886382	1.296104	5.857025	3.707406	80.05740	2.876753
Median	0.825456	11.89939	7.083052	1.098844	4.058897	3.107068	71.08031	3.135749
Maximum	2.578546	27.85800	9.486627	3.750862	15.041229	11.178328	3.5070	6.973681
Minimum	-0.095950	8.245559	3.104438	0.007696	2.760729	1.938522	37.17148	-2.179304
Std. Dev.	0.536193	4.000468	1.738415	0.956332	3.711730	1.595352	55.93166	2.316544
Probability	0.134004	0.000000	0.123053	0.062551	0.000003	0.000000	0.000000	0.247863
Observations	64	64	64	64	64	64	64	64

The descriptive statistics revealed that the central Tendency (Mean and Median) in the table above shows that the mean value of FDI (0.87) indicates that, on average, financial development index inflows

account for about 0.87% of GDP during the study period, with a median of 0.83%, suggesting that the distribution is fairly symmetric around its central value.

Additionally, in line with the electronic banking indicators, the mean value of ATM usage (12.63) are higher than that of POS transactions (6.89), suggesting that automated teller machine usage remains a dominant channel for electronic transactions in Nigeria. Internet banking (INB) has a mean of 1.30, while mobile payments (MPM) record an average of 5.86, indicating increasing adoption of mobile-based financial services. The average interest rate (INT) is 3.71, while the mean exchange rate (EXR) stands at ₦80.06 per US dollar, with considerable variation over the years. The average GDP growth rate (2.88%) reflects a moderate but positive economic performance across the observed period.

The standard deviations show the degree of variability among the series. Exchange rate (EXR) exhibits the highest volatility (55.93), indicating significant fluctuations in Nigeria's currency value over the

sample period. This is consistent with episodes of devaluation and exchange rate reforms in the Nigerian economy. In contrast, GDP (2.32) and FDI (0.54) display relatively lower dispersion, suggesting moderate stability in output growth and foreign investment inflows during the period under review.

4.1 Unit Root Analysis and Interpretation of Result

The result in Table 4.2 is from ADF and Phillips-Perron (PP) test; it is used to examine the unit root of the variables. The unit root test or stationarity test is use to ascertain whether or not the variables in the study are stationary or not from 2009-2024. Therefore, using both the Augmented Dickey-Fuller (ADF) and Phillips-Perron test (PP), electronic banking indicators such as ATM, POS transactions, Internet banking (INB), mobile payments (MPB), with the findings shown in Table 4.2.

Table 4.2: Unit Root Test

Variables	ADF	5% Critical Level	Order of Integration
Dln(FDI)	-4.860416	-3.447383	I (1)
Dln(POS)	-5.651307	-3.447383	I(1)
Dln(INB)	-7.052838	-2.253402	I (1)
Dln(ATM)	-4.032432	-3.443202	I (1)
Dln(EXR)	-6.362838	-1.702304	I (1)
LnMPB	-3.207213	-2.881123	I (0)
Dln(ITR)	-6.093772	-2.753343	I (1)
DGDP	-7.641435	-2.881685	I (1)
Variables	PP	5% Critical Level	Order of Integration
Dln(FDI)	-2.880722	-12.24873	I (1)
Dln(POS)	-2.880722	-33.92879	I(1)
Dln(INB)	-2.880722	-9.729538	I (1)
Dln(ATM)	-2.880722	-7.228751	I (1)
Dln(EXR)	-2.880722	-13.03386	I (1)
LnMPB	-4.334213	-3.763223	I (0)
Dln(ITR)	-2.881685	-7.641435	I (1)
DGDP	-2.980423	-5.780724	I (1)

The results of the ADF and PP test show that most of the variables have unit root at level and became stationary after first difference I(I) with the exception of Mobile phone banking (LnMPB) which is stationary at level. This is established by comparing the ADF and PP value with their respective critical value at 5% level

of significant, which shows that all the variable of the ADF and PP statistic value are greater than their respective critical value at 5% level. Judging by the order of integration I(0) and I(1) its suggest that there may be existence of long-run relationship between the variables. In order to use long run restrictions within

the ARDL framework, at least one of the variables in our system need to be stationary I(0) at level (King & Watson, 1997).

4.3 Bounds Test for Cointegration

The study conducted bounds test proposed by Pesaran et al. (2001) to confirm if a long-run relationship exists among the variables in the model. The results of the ARDL bounds test for the three models are shown in Table 4.3.

Table 4.3: ARDL Bounds Test for Cointegration

ARDL Bounds Test		Critical Value Bounds @ 5%	
F-Statistic		Lower Bound <u>I(0)</u>	Upper Bound <u>I(1)</u>
	10%	2.17	3.21
	5%	2.48	3.51
14.7	1%	2.73	3.9

The bounds test results for model demonstrate that all the variables co-move over time. The estimated F-statistic value of 14.7 is higher than the upper bound at 5% (3.51) and 1% (3.9), levels, indicating the existence of a cointegrating relationship between the variables.

In achieving the effect of e-banking on Financial Development in Nigeria.

The study evaluates the effect of e-banking dynamics (Automated Teller Machines (ATM), Point of Sale (POS), Internet Banking (INB), Mobile phone

Banking (MPB)) on financial development index (the depth, access, efficiency, and stability of financial systems) changes in Nigeria. The study evaluated both the long-run and short-run models. Table 4.4 displays the findings from the short and long-run models in Nigeria.

Table 4.4: Estimated Short and Long-run ARDL Result on the effect of E-banking on Financial Development in Nigeria

Short-run Analysis				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.226	0.125	1.812	0.07
FDI(-1)	-0.123*	0.054	-2.279	0.02
ATM	0.033**	0.011	2.859	0.00
POS	-0.042**	0.015	-2.828	0.00
INB	0.064**	0.030	2.106	0.04
MPM	-0.006**	0.005	-1.204	0.23
INT	-0.065**	0.041	-1.591	0.11
EXR	0.000**	0.001	0.332	0.74
GDP	-0.025**	0.011	-2.258	0.02
Long-run Analysis				
	Coefficient	Std. Error	t-Statistic	Prob.
ATM	0.274**	0.104	2.629	0.01
POS	-0.345**	0.155	-2.222	0.03
INB	0.521**	0.176	2.953	0.00

MPM	-0.052	0.047	-1.113	0.27
INT	-0.533	0.356	-1.494	0.14
EXR	0.002	0.008	0.319	0.75
GDP	-0.025**	0.011	-2.258	0.02
C	1.841**	1.079	1.705	0.09

*, ** and *** indicate significance at 10 percent, 5 percent and 1 percent levels. Standard errors are in brackets.

Source: Author's Computation Source E-Views 10

This study examined the impact of electronic banking on financial development in Nigeria using an ARDL framework and a comprehensive Financial Development Index (FDI). The findings provide nuanced evidence that digital banking innovations affect financial development unevenly, depending on the channel and the supporting institutional environment. The results show that Automated Teller Machines (ATM) and Internet Banking (INB) significantly enhance financial development in both the short and long run. This confirms that digital channels which directly improve access, reduce transaction costs, and facilitate liquidity circulation are effective in deepening financial intermediation. ATM expansion lowers physical access barriers to banking services, while internet banking promotes remote transactions, operational efficiency, and broader financial inclusion. These findings align with the financial innovation-led development hypothesis and reinforce the argument that technology-driven access points are critical for strengthening financial depth, efficiency, and stability in developing economies.

In contrast, Point of Sale (POS) transactions exert a negative and significant effect on financial development in both time horizons. This outcome suggests that increased transaction volume alone does not guarantee financial deepening. In Nigeria, persistent infrastructural challenges, network failures, high merchant charges, and limited system integration may undermine the efficiency gains expected from POS adoption. Rather than strengthening savings mobilization and credit allocation, POS expansion may merely facilitate consumption-oriented transactions with limited contribution to broader financial system development. Similarly, Mobile Phone Banking (MPB) shows a negative but statistically insignificant relationship with financial development. Although mobile banking is theoretically associated with financial inclusion, its

weak impact indicates that limited coverage, low transaction values, digital trust concerns, and uneven financial literacy continue to constrain its effectiveness in Nigeria. This suggests that mobile banking remains underutilized as a tool for meaningful financial deepening.

The macroeconomic control variables reveal further structural insights. GDP growth is found to negatively and significantly affect financial development, indicating a disconnect between economic expansion and financial system deepening. This implies that Nigeria's growth is largely driven by informal and non-financial sectors that do not immediately translate into improved financial access or intermediation. Interest rate and exchange rate effects remain statistically insignificant, suggesting that their influence on financial development is indirect or moderated by policy interventions and structural rigidities. The significant error correction mechanism confirms that financial development adjusts gradually toward long-run equilibrium, reflecting institutional inertia within the financial system. The high explanatory power of the model underscores the central role of electronic banking and macroeconomic conditions in shaping Nigeria's financial development trajectory.

The findings indicate that electronic banking can serve as a catalyst for financial development, but its effectiveness depends on infrastructure quality, regulatory efficiency, and user confidence. Policies should therefore prioritize strengthening ATM and internet banking infrastructure, improving POS system reliability, expanding mobile banking coverage, and enhancing financial literacy. Without these complementary reforms, digital financial innovations may fail to translate into sustainable and inclusive financial development.

V. CONCLUSION AND RECOMMENDATIONS

The study examined the effect of electronic banking channels on financial development in Nigeria using the ARDL estimation approach to capture both short- and long-run dynamics. The findings reveal that Automated Teller Machine (ATM) and Internet Banking (INB) significantly promote financial development in both the short and long run, highlighting their roles in enhancing financial access, efficiency, and inclusion. Conversely, Point of Sale (POS) transactions and GDP growth exhibit negative and significant short-run effects, implying inefficiencies in POS infrastructure and the dominance of non-financial sectors in economic activity. The results also show that the lagged financial development variable adjusts gradually to long-run equilibrium, while interest and exchange rates remain insignificant, indicating weak macroeconomic influence on financial development in the digital era.

In the long run, ATM and INB continue to drive financial deepening, whereas POS, mobile banking, and interest rate maintain weak or negative impacts. These findings suggest persistent challenges such as inadequate infrastructure, low digital literacy, and trust deficits that limit the full potential of e-banking in Nigeria. Nonetheless, the high explanatory power of the model (97%) underscores that well-managed digital innovations can serve as vital catalysts for financial inclusion and system modernization, supporting Nigeria's broader goals of achieving sustainable and inclusive economic growth.

Based on these results, the study recommends strengthening e-banking infrastructure particularly POS and mobile banking through investment in ICT and network stability. It also calls for enhanced financial literacy programs, improved cybersecurity frameworks, and greater interoperability between banks and fintechs to boost consumer confidence. Additionally, policymakers should support digital inclusion through targeted incentives, align macroeconomic policies with financial innovation objectives, and promote continuous research to track the evolving impact of e-banking on financial development.

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