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FINTECH-DRIVEN PAYMENT SYSTEMS AND ACCESS TO FINANCIAL SERVICES IN NIGERIA

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ABSTRACT

The study aimed at investigating the effect of FinTech-powered payment systems on financial services provision in Nigeria between the years 2000 and 2025 with particular emphasis on mobile banking, ATM transactions, and web-pays as the major digital banking systems. The need for conducting the study was prompted by Nigeria's continuous inadequacy in providing financial services to its populace where the existing financial inclusion ratio is only 64.1% against the set Central Bank of Nigeria (CBN) objective of 98% by the year 2024. This project relied on the Technology Acceptance Model, Diffusion of Innovations theory, and Financial Intermediation theory. They used a time series method for research and got their secondary data from CBNSB and WDI databases. The main estimation method was ARDL (Bounds Test Approach). Before and after the main estimation, they ran some tests too - stuff like the Augmented Dickey Fuller unit root test, Breusch-Godfrey serial correlation LM test, Breusch Pagan-Godfrey heteroscedasticity test, and Ramsey RESET. Their bounds test showed that there's a cointegration relationship between variables in the long run. Over time, using ATMs had a strong, positive effect on financial inclusion, with a beta of 0.764 and $p < 0.0000$. Web payments also made a positive difference with a beta of 0.233 and $p = 0.0006$. Surprisingly, mobile banking turned out to have a negative impact, though. It had a beta of 0.178 and a p of 0.0072. So, it seems that while most technologies have increased financial inclusion, mobile banking actually decreased it, at least according to this study. This is due to the structural issues of digital illiteracy, cyber security threats, and poor infrastructure. In conclusion, the findings demonstrate that even though digital banking has an impact on financial inclusion in Nigeria, targeted measures are necessary.

KEYWORDS: FinTech, mobile banking, ATM adoption, web-pay transactions, financial inclusion, ARDL, Nigeria.

1. INTRODUCTION

Indeed, the interface between digital banking and financial inclusion has become one of the most important fields of study within the modern discipline of financial economics. In today's world, policymakers, development finance agencies, and academic researchers have realized that digital financial innovations such as mobile banking, ATM systems, online payments, and other fintech applications may offer tremendous possibilities for expanding access to financial services among traditionally excluded groups. As reported by the Global Findex Database 2025 of the World Bank, 79% of adults in the world population currently have financial accounts, representing a significant increase from 62% in 2014, largely due to the fast spread of digital and mobile technologies. However, about 1.6 billion adults around the world are still not connected with the formal financial sector (Accion, 2025).

Given that Nigeria is the biggest economy and most populous nation on the continent, with over 220 million people and a median age of 18.1 years, its importance in these deliberations cannot be understated. It must be recalled that in 2012, the CBN rolled out the NFIS for which it established an ambitious target of reaching 80 percent inclusion by 2020 and 98 percent by 2024. However, statistics obtained from the EFInA Survey indicate that currently, the inclusion rate has only reached 64.1 percent. It should be noted that this is a massive deficit and one with serious developmental implications (Arewa, 2025). In this regard, the excluded groups include women, rural populations, the youth, and those living in Northern Nigeria. In this scenario, digital banking like mobile banking, ATMs, and web-based payments is seen as a way to bridge financial gaps. Plus, FinTech payment systems work better with a strong financial backbone, says Kalu, Lawal, Ukpere, and Anowor (2025). According to Davis's Technology Acceptance Model (1989), we should be able to explain how underserved folks take to new financial tech too. According to the model, perceived usefulness and perceived ease of use determine whether people would accept the technology. In the case of digital banking in Nigeria, TAM explains why USSD-based mobile banking services, which have low data requirements and high perceived convenience, have led to greater inclusion in the rural areas compared to web-pay platforms, which are more complex and require more data. Besides TAM, the Diffusion of Innovations Theory by Rogers (1962) helps explain how mobile banking, ATMs, and online payment services are being adopted unevenly and in stages throughout Nigeria's diverse population. The chart below (Figure 1) shows the trend of FinTech payment volumes via Nigeria's major digital payment channels from 2005 to 2023, capturing the explosive rise in mobile and web-pay payments and the flatness of ATM payments since about 2016:

Figure 1. FinTech payment channel volumes in Nigeria indexed growth trends (2005–2023)

Figure 1 shows two analytically significant trends. First, mobile banking is the most rapidly growing payment channel of the three owing to the increasing number of mobile phone subscribers within the country, which currently stands at 84%, coupled with the swift spread of USSD and mobile applications within the country on account of the CBN's PSV2020 and PSV2025 Payment System Vision frameworks. Second, while the trend of ATM usage grew rapidly until about 2016, its momentum seems to have stagnated since then, following the observation that mobile and POS payment methods have overtaken ATM usage amongst urban consumers (TC Insights, 2024). Web pay transactions, although significantly increasing in absolute terms and accounting for more than one trillion Naira worth in 2022, have mainly benefited high-income urban internet users.

The differences between the trends mentioned above have clear implications for financial inclusion. Although Nigeria's mobile phone system creates conditions for a potential large-scale involvement in digital financial activities, according to the EFInA Survey, the inclusion ratio stagnates at the level of 64.1%, which is far from reaching the 98% level set out in CBN's plans for 2024. The discrepancy above shows that technology dissemination and financial inclusion are two different processes, because the presence of structural impediments such as low digital literacy rates, unstable infrastructures, low cybersecurity levels, and unequal incomes exists between them. It is important to note that there are no research studies that cover the impact of all three digital channels of communication on the financial inclusion in Nigeria during the period of 2000-2025.

2. REVIEW OF RELATED LITERATURE

2.1 Conceptual Framework

The design of the current study conceptualizes the use of the digital banking channels of mobile banking, the use of ATMs, and web-pay payments as the independent variables that have varying influences on financial inclusion which is the dependent variable and is operationalized in terms of the percentage of adults banked, deposit to GDP ratio, and formal financial service access. The influence of these digital banking channels on financial inclusion is conceptualized as being mediated by technology acceptance model's cognitive antecedents while the moderating elements include the following:

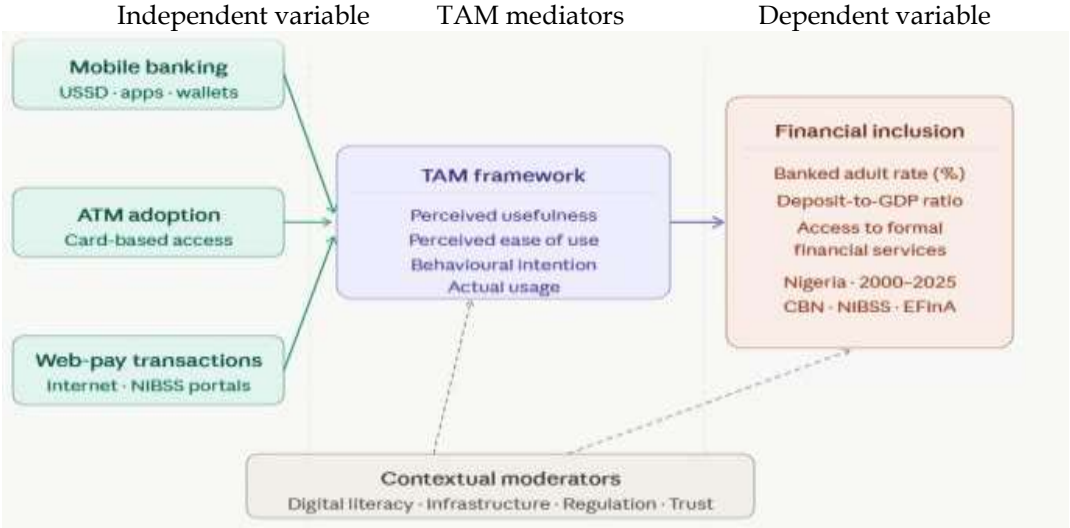

Figure 2. Conceptual framework FinTech payment channels and financial inclusion in Nigeria
Author's construction (2026).

As seen from Figure 2 below, the model views the cognitive constructs of TAM as the intervening variable between the deployment of digital channels and financial participation. It should be noted that while contextual factors may influence adoption, they play an intermediary role in translating behavioral intention into financial inclusion.

2.2 Theoretical Literature Review

2.2.1 Technology Acceptance Model (Davis, 1989)

The Technology Acceptance Model (TAM), first proposed in 1989 by Fred Davis in his MIT doctorate thesis, forms the fundamental theoretical basis for this research. TAM suggests that two cognitive beliefs, Perceived Usefulness (PU) and Perceived Ease of Use (PEU), jointly determine an individual's attitude towards a technological tool, and in turn, predict behavioral intentions to adopt the technology. For the present study of digital banking, TAM provides insights into how mobile USSD banking is more inclusive in rural Nigeria than web-based pay services. While USSD banking has a higher PEU among lower-income rural individuals with low literacy levels who have access to basic mobile devices, web-based banking is considered PU by richer, educated people living in cities with greater confidence in digital technologies.

There have been many studies on Nigerian fintechs in which TAM has been extended by including other antecedents to perceived ease of use such as those related to security trust, regulatory confidence, and infrastructure reliability due to structural conditions that are unique to developing countries (Nkwo et al., 2025; Ekong & Ekong, 2025). The main weakness of the TAM framework, however, lies in its individual-cognitive perspective, where intention is taken to

be highly predictive of behavior without considering the effect of financial and physical barriers such as lack of income, distance from service points, and social networks that frequently negate intentions of adoption in Nigeria. Still, TAM is the most tested framework for explaining digital banking adoption among the empirical literature of Nigeria.

2.2.2 Diffusion of Innovations Theory

The Diffusion of Innovations Theory by Rogers provides a macro level approach that complements TAM's micro-level cognitive perspective. This theory suggests that innovations diffuse in social systems through an S-shaped adoption rate, depending on five features of the innovation: relative advantage, compatibility, complexity, trialability, and observability. Applying the DOI theory to the adoption rates of digital banking services in Nigeria, one can see how the theory is illustrated through the various adoption rates depicted in Figure 1. First, the rapid diffusion rate of mobile banking can be attributed to its relative advantage compared to bank branches (less expensive and more convenient), its compatibility with the mobile phones already in use, and the ease with which customers can experiment with the services using the USSD codes that do not need a smartphone and internet access. The rapid adoption rate of ATMs and its subsequent flattening is due to their incompatibility with the habits of most consumers, as well as problems with power supply and fraud cases that affected its observability by Ogbu, Silk Ugwu. (2024).

2.2.3 Financial Intermediation Theory

The Financial Intermediation Theory serves as the underlying macroeconomic framework for explaining the role of digital banking channels in financial inclusion. The pioneering theories on financial intermediation proposed by Gurley & Shaw argued that financial intermediaries reduce information asymmetry, reduce transaction cost and move savings towards productive investments which is further enhanced if the digital channels make intermediation available to populations who are not banked. In Nigeria, each channel serves as its own intermediation channel whereby the mobile banking channel moves deposits by opening accounts through USSD technology and facilitating money transfer; the use of ATM channel has in the past facilitated deposit mobilisation by making it easier to get cash out of liquidity constraints of branches; web-pay facilitates transactions with larger value by individuals or businesses or from governments to people that integrate informal players in intermediated channels. Indeed, empirical works using the theory demonstrate the positive impact of expansion of digital banking channel on deposit-to-GDP ratio, a critical measure of financial deepening, though the impacts differ significantly across channels and incomes (Adeniyi et al., 2024; Uzor et al., 2023).

2.3 Conceptual Literature Review

2.3.1 Financial Inclusion in Nigeria

Financial inclusion is generally defined as the number of individuals and firms that have access to and can make use of relatively affordable, accessible, and reliable financial services via formal or semi-formal organizations. The rate of financial exclusion in Nigeria has been estimated to be about 46.3% in 2010, but subsequent policy changes in the different versions of NFIS have ensured that this percentage decreases, yet the latest statistics from EFInA (2025) reveal that the rate of financial inclusion today stands at 64.1%, which leaves out some 35.9% of adults in Nigeria.

2.3.2 Digital Banking in Nigeria

Digital banking involves the use of digital mediums to provide banking services in the form of mobile apps, USSD services, ATM services, agency banking, and web pay platforms. The Nigerian digital banking system has grown over time to become an intricate network consisting of mobile money, point-of-sale services, biometric identification, and APIs connecting fintech companies. Each medium takes its place on the inclusivity scale where USSD services on mobile phones target poor, rural customers requiring little to no data, while ATMs provided the initial access to electronic banking to the hitherto unbanked population, and the web pay services target wealthy urban business people.

2.4 Empirical Literature Review

The empirical scholarship on digital banking and financial inclusion in Nigeria is substantial. The chart below (Figure 3) maps the reported effect directions of reviewed studies across the three channel types, providing a visual synthesis of the evidence base:

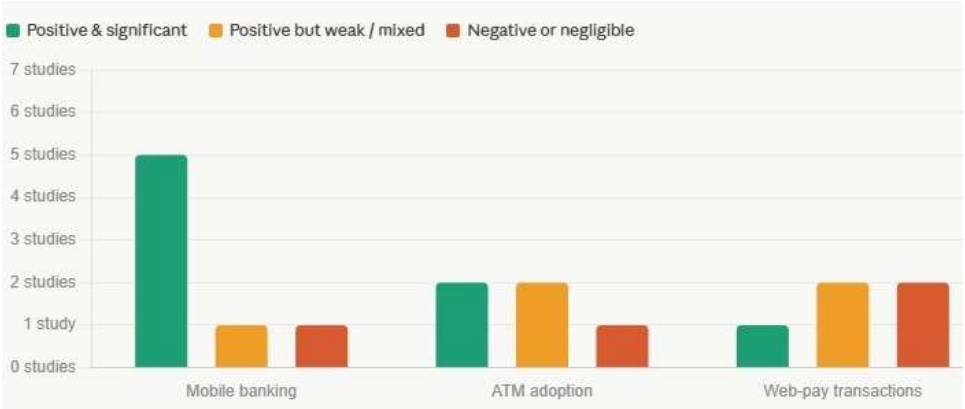

Figure 3. Empirical evidence maps direction of channel effects on financial inclusion (selected Nigerian studies)

Based on: Oke & (2023); Adeniyi et al. (2024); Jegede (2025); Ekong & Ekong (2025); Uzor et al. (2023); Ogbu & ogbu (2024); Davids West et al. (2025)

This is best captured in Figure 3 below. In the individual articles, the findings are summarised as follows.

In their study employing robust regression from 2009 to 2023, Oke and Oke (2023) establish that the adoption of ATM and internet banking technologies has significant positive impacts on financial inclusion, with mobile banking demonstrating only a non-statistically significant positive influence. This finding stands in contrast to most of the literature reviewed, possibly because of the specific proxy variables used. Adeniyi, Oke, and Ogunbameru (2024), using cointegration and error correction methods between 2000 and 2022, demonstrate that agency banking and USSD services have significant positive impacts on financial inclusion, with internet banking having limited impact, due mainly to high data costs and low levels of digital literacy. In his study employing panel OLS regression between 2009 and 2023, Jegede (2025) demonstrates that mobile banking and USSD services have significant positive impacts on rural deposits, which are commonly considered proxies for financial inclusion, while e-wallet platforms exhibit negligible or even negative impacts due to trust issues. Furthermore, Ekong and Ekong (2025) using ARDL bounds testing for the period 2008-2022 have shown the positive effects of mobile banking to be significant, however, fraud cases and uncertainties around regulation have been found to reduce the effectiveness of these inclusion effects. Additionally, Uzor et al. (2023) using ARDL for the period 2004-2020 have established that Internet access and digital banking use lead to financial inclusion, while Ogbu and Ogbu (2024) using multiple regression have found that digital banking inclusion has a more significant effect on bank account ownership among urban and high-income individuals indicating the role of customer segments in the lesser efficacy of web-pay in terms of inclusion. Finally, Davids West et al. (2025) using a mixed-method approach for the period 2000-2024 have shown mobile banking, agency banking and USSD payments to be positively significant for financial inclusion while stressing cybersecurity and infrastructure issues.

2.5 Literature Gap

Despite the richness of the literature on the topic, there are several crucial issues that have not been addressed by the extant body of literature. First, previous research has approached digital banking as an aggregate phenomenon, ignoring its individual components and their possible complementary effects on each other. Second, most empirical studies used short panel or cross-sectional data, overlooking the dynamic nature of the process illustrated in Figure 1. Finally, the TAM model and innovation diffusion theory were seldom formally incorporated into empirical models despite their theoretical relevance. The current paper bridges all three gaps with an individualized, dynamic, and theoretically sound empirical approach towards exploring how specific payment channels have impacted financial inclusion in Nigeria from 2000 to 2025.

3. METHODOLOGY

The study used secondary data due to the easy access to reliable and consistent info on the key variables. These data are perfect since they offer the historical records needed to analyze how digital banking relates to financial inclusion in Nigeria over time. Mainly, the data came from the Central Bank of Nigeria Statistical Bulletin in 2025 and the World Bank's World Development Indicators database. These sources are widely recognized as credible and dependable for financial and macroeconomic data. The CBN Statistical Bulletin provides comprehensive

national financial statistics with a high level of consistency, while the WDI database offers reliable and internationally comparable data suitable for empirical analysis.

This study utilized time-series data to examine the effect of the independent variables on the dependent variable, with the aim of analyzing the relationship between digital banking and financial inclusion in Nigeria. The use of time-series data enabled the study to assess changes and trends in mobile banking, ATM adoption, web-pay transactions, and the level of financial inclusion over the period 2000–2025.

The model specified above was adapted to reflect the time-series nature of this study, which is country-specific, and to allow for the inclusion of additional explanatory variables. Accordingly, the general model for the study is presented in its time-series form as shown below:

$$FINCL_{t,=}\ \delta_o + \delta_1 MBNK_{t-1} + \delta_2 ATM_{t-1} + \delta_3 WEBPAY + \mu_t$$

All the variables are defined in equation 2 nevertheless the coefficients and other notations are explained below:

δ_o = constant or the intercept
δ_o - δ_3 = coefficients of the parameters or explanatory variables
μ_t = the residual or error term

All the variables are as defined above. The general model is uncoupled to show the respective models for testing the three (3) formulated hypotheses as presented below:

$$FINCL_t = \delta_o + \sum_{t=1}^{k} \delta_1 FINCL_{t-1} + \sum_{t=1}^{k} \delta_2 MBNK_{t-1} + \sum_{t=1}^{k} \delta_3 ATM_{t-1} + \sum_{t=1}^{k} \delta_4 WEBPAY_{t-1} + \vartheta_1 FINCL_{t-1} + \vartheta_2 MBNK_{t-1} + \vartheta_3 ATM_{t-1} + \vartheta_4 WEBPAY_{t-1} + \mu_t$$

δ_o = constant or the intercept
δ_o - δ_3 = coefficients of the short-run parameters or explanatory variables
ϑ_1 - ϑ_3 = coefficients of the short-run parameters or explanatory variables
μ_{it} = the residual or error term

The variables are appropriately described in table 1.

Table 1: Variables Measurement and Description

Symbol	Definition	Variable	Measurement	Literature Justification	Expected Signs
FINCL	Financial Inclusion	DV	Financial inclusion is measured by the extent to which individuals and businesses have access to and make use of formal financial services.	WDI	NA
MBNK	Mobile Banking	IV	Mobile banking is measured by the volume or value of financial transactions conducted through mobile devices such as phones and tablets within a given period.	CBN	**+**
ATM	ATM Adoption	IV	ATM adoption is measured by the number of Automated Teller Machines (ATMs) deployed and actively used within the banking system over a given period.	CBN	**+**
WEBPAY	Web-Pay Transactions	IV	Web-pay transactions are measured by the volume or value of payments and financial transactions carried out through internet-based payment platforms within a given period.	CBN	**+**

Source: Researcher 2026.

This study used the Autoregressive Distributed Lag (ARDL) model, specifically the bounds testing approach, to look at both short-term and long-term connections between digital banking and financial inclusion in Nigeria. The ARDL technique was chosen for its flexibility in dealing with variables that are integrated at different orders. We used E-Views 10 for the empirical analysis.

To ensure the reliability and validity of the findings, a number of preliminary tests suitable for time-series were carried out to examine the statistical properties of the variables. These tests were necessary to confirm the appropriateness of the estimation technique adopted for the study. Consequently, both pre-estimation and post-estimation diagnostic tests were conducted, as discussed in the subsequent sections.

Pre-estimation tests are essential statistical diagnostics carried out prior to the main estimation or analysis of a study. They are necessary to ensure that the data are consistent with the underlying assumptions of the chosen model and to identify potential issues that could undermine the validity of the findings.

Descriptive statistics were used to describe the datasets. These measures include the mean and median, which reflect central tendency; the standard deviation and variance, which indicate the degree of dispersion; and the minimum and maximum values, which define the range of the data. In addition, skewness and kurtosis are employed to examine the shape of the distribution, showing the extent of asymmetry and the level of peakedness or flatness. Correlation analysis was also used to show the linear relationship among the investigated variables. The unit root test is employed to assess the stationarity properties of the data, specifically to determine the presence of a unit root and the order of integration of the variables. Time-series variables are expected to be stationary either at level, I(0), or after differencing, such as I(1) or I(2). The results of the unit root test therefore inform the suitability of various estimation approaches, including simple regression, the Autoregressive Distributed Lag (ARDL) model.

The main estimation technique adopted in this study is the Autoregressive Distributed Lag (ARDL) model. This approach was selected due to its suitability for handling variables with mixed orders of integration and its ability to estimate both short-run and long-run relationships simultaneously. Furthermore, the ARDL model is flexible in accommodating variable heterogeneity and is relatively robust in addressing potential endogeneity issues. To ensure the reliability and validity of the estimates, a range of diagnostic and stability tests were conducted. Model stability was assessed using the Ramsey RESET test and the CUSUM test. The Breusch–Pagan–Godfrey (BPG) test was employed to examine the presence of heteroscedasticity in the residuals, while the Breusch–Godfrey Lagrange Multiplier (BG LM) test was used to detect higher-order autocorrelation in the model.

4. RESULTS

For this study, the data was shared in two stages. first, we got the raw figures from the Central Bank of Nigeria Statistical Bulletin and the World Bank World Development Indicators (WDI) database, then we moved on. To ensure uniformity in scale and reduce the problem of large variations in the magnitude of the variables, the data were transformed into their logarithmic form.

Table 2 presents the descriptive statistics of the study variables, including the minimum and maximum values, mean, and standard deviation. The table also reports measures of normality such as skewness, which indicates the degree of asymmetry in the distribution of the variables, and kurtosis, which reflects the degree of peakedness or flatness of the distribution. In addition, the Jarque–Bera statistic is employed to test for normality by comparing the skewness and kurtosis values of the series with those expected under a normal distribution.

Table 2. Summary of Descriptive Statistics

	FINCL	MBNK	ATM	WEBPAY
Mean	42.96154	18.57423	15.27077	240.1435
Median	43.00000	1.850000	15.00000	3.750000
Maximum	72.00000	95.00000	32.50000	1400.000
Minimum	20.00000	0.000000	0.100000	0.000000
Std. Dev.	17.12888	29.18899	13.70292	433.0531
Skewness	0.204638	1.515379	0.025252	1.624980
Kurtosis	1.680724	3.945782	1.194164	4.126266

Obs	26	26	26	26

The mean value of Financial Inclusion (FINCL) is 42.96154, maximum and minimum values of 72.00000 and 20.00000 respectively shows that the variables had higher Financial Inclusion (FINCL) levels during the study period. The standard deviation of 17.12888 also kind of tells us that the Financial Inclusion (FINCL) indicator does not stay right at the mean it instead varies by 17.12888. Looking at it another way, Financial Inclusion (FINCL) shows a positive Skewness value of 0.204638, so the data tilts a bit. As for Kurtosis, it has a positive value of 1.680724, and this suggests the distribution is leptokurtic (that peaked curve). In other words, it implies that there are higher values relative to the sample mean for this variable, not exactly lower ones. The mean value of Mobile Banking (MBNK) is 18.57423, maximum and minimum values of 95.00000 and 0.00000 respectively shows that the variables had higher Mobile Banking (MBNK) levels during the study period. The standard deviation of 29.18899 also indicates that the Mobile Banking (MBNK) indicator deviates from the mean by 29.18899. Mobile Banking (MBNK) has a positive Skewness value of 1.515379, it actually leans to the right a bit. The Kurtosis is also positive at 3.945782 and that suggests the distribution is leptokurtic (a peaked-curve type), meaning there are more cases with values clustered higher than the sample mean for this variable. For ATM Adoption (ATM) the mean value comes out to 15.27077, and with maximum and minimum values of 32.50000 and 0.100000 respectively, it shows the study period had higher ATM Adoption (ATM) levels overall. The standard deviation of 13.70292 also indicates that the ATM Adoption (ATM) indicator deviates from the mean by 13.70292. ATM Adoption (ATM) has a positive Skewness value of 0.025252. The Kurtosis has a positive value of 1.194164 which implies that the distribution is leptokurtic (peaked-curve) indicating that they are higher value that the sample mean for this variable. The mean value of Web-Pay Transactions (WEBPAY) is 240.1435, maximum and minimum values of 1400.000 and 0.00000 respectively shows that the variables had higher Web-Pay Transactions (WEBPAY) levels during the study period. The standard deviation is 433.0531, meaning WEBPAY values differ from the mean by that amount on average. Plus, WEBPAY's skewness is 1.624980, showing a positive skew. And the kurtosis is 4.126266 since it's positive, the distribution is leptokurtic, implying more data points pile up above the mean.

The correlation coefficient is concerned with the linear relationship between dependent and independent variables and also between the independent variables themselves. This is presented in Table 3 below:

Table 3. Summary of Correlation Matrix

Correlation				
t-Statistic				
Probability	FINCL	ATM	MBNK	WEBPAY
FINCL	1			

ATM	0.951976	1		
	15.2323	-----		
	0	-----		
MBNK	0.85186	0.707035	1	
	7.967726	4.897989	-----	
	0	0.0001	-----	
WEBPAY	0.799003	0.629928	0.991303	1
	6.509441	3.973458	36.90169	-----
	0	0.0006	0	-----

The "R" for Mobile Banking (MBNK) and Financial Inclusion in Nigeria (FINCL) is 0.85, with a t-stat of 7.97, way above 2.5. Plus, the associated p-value is 0.0000. So, we see a strong positive and significant linear relationship between MBNK and FINCL. We accept the null hypothesis and reject the alternative one.

When it comes to ATM Adoption (ATM) and FINCL, their "R" is 0.95 and the t-stat hits 15.23, again higher than 2.5. The related p-value is also 0.0000. This means there's another solid link - a positive and significant linear association - between ATM adoption and financial inclusion in Nigeria. Like before, we accept the null hypothesis here too. As for Web-Pay Transaction (WEBPAY) and Financial Inclusion in Nigeria (FINCL) the correlation "R" is (0.80) and the t-stat (6.51) which is higher than 2.5 and with an associate p-value of 0.0000 it therefore concludes that Web-Pay Transactions (WEBPAY) and Financial Inclusion in Nigeria (FINCL) shows a positive and significant linear association. By this, we accept the null hypotheses and reject the alternate hypotheses.

The stationarity properties of the investigated series are presented.

Table 4. Summary of Unit Root Results (ADF Test)

Variables	t-statistics	Critical Values @5%	Order of Integration	Prob.	Remarks
FINCL	-5.334866	-3.622033	I(1)	0.0056	Stationary
MBNK	-6.586302	-3.658446	I0)	0.0002	Stationary
ATM	-4.164235	-3.632896	I(1)	0.0176	Stationary
WEBPAY	-2.805264	-1.959071	I(0)	0.0075	Stationary

Table 4 shows the setup clearly. The first column lists the variables, the second gives t-statistics, and the third shows critical values at the 5% significance level. The fourth column tells us about the order of integration that means level or first difference. The fifth column has probability values, and the last one offers remarks, so everything is well explained. The results indicate that the variables are integrated at both level and first difference, reflecting a combination of I(0) and I(1) series. On the basis of this finding, the Autoregressive Distributed Lag (ARDL) model is adopted as the appropriate estimation technique for testing the study's hypotheses.

Table 5. Summary of ARDL Estimates

Variable	**Coefficient**	**Std. Error**	**T-Statistic**	**Prob.***
Short-run Estimate				
LOG_MBNK	-0.021615	0.051344	-0.420975	0.6785
LOG_ATM	0.092858	0.224651	0.413344	0.684
LOG_WEBPAY	-0.002826	0.003485	-0.810789	0.4275
C	0.01214	0.01413	0.859154	0.401
Long-run Estimate				
LOG_MBNK	0.177838	0.059032	-3.012547	0.0072
LOG_ATM	0.764005	0.10874	7.025982	0
LOG_WEBPAY	0.23277	0.056696	4.105554	0.0006
Asymptotic:				
Bounds Test			n=1000	
F-statistic	37.7116	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
DIAGNOSTIC TESTS				
BG_ LM Test	F-statistic	0.073463	Prob. F (2,11)	0.9295
	Obs*R-squared	0.214217	Prob. Chi-Square (2)	0.8984

BPG – HET Test	F-statistic	0.73073	Prob. F(7, 16)	0.6092
	Obs*R-squared	4.032074	Prob. Chi-Square(7)	0.5448
Ramsey Reset Test	T-Statistic 1.059432 Prob. 0.3034			
	F-Statistic 1.122397 Prob. 0.3034			

The results for the Bounds test in Table 5 above reveals that there is a long run relationship among the variables. This is because the F-statistics value (37.71160) is greater than upper Bounds critical values at 4% level of significant, and thus the null hypothesis of no cointegration is rejected.

We conduct a test for Autocorrelation (or serial correlation) to see if our variables' error terms are correlated, like what Table 5 shows. According to Table 5, the Breusch-Godfrey Serial Correlation LM test has an F-statistics of 0.07 and a Chi-square value of 0.93. With no serial correlation as our null hypothesis, we can't reject it because both stats 0.21 for F and 0.90 for Chi-square are higher than the 5% significance level. So, there's no serial autocorrelation here.

To check for heteroskedasticity, we see if data is homoskedastic or not. This means looking at whether a variable's variability is the same or changes based on another predicting variable. Our findings show an F-statistic of 0.73 and an observed R-square prob value of 0.61, which are both above the 5% level of significance. So, we can't reject the idea of no heteroskedasticity. Simply put, our data looks homoscedastic for analysis purposes.

Table 5 shows the results of the Ramsey RESET test, which is a keyway to check if the estimated ARDL model might be missing something. This test looks to see if the linear form correctly represents the link between the dependent variable and the other factors. It checks if we've left out any important nonlinear parts. Specifically, the test decides if adding squared fitted values, or higher-order terms, would make the model better by contrasting the simple version with a more complex one. The results show a t-statistic of 1.06 and an F-statistic of 1.12, with corresponding probability values of 0.30, which are higher than the conventional 5% level of significance. This outcome indicates that the additional nonlinear terms do not significantly enhance the explanatory power of the model. Consequently, the null hypothesis of correct model specification cannot be rejected, suggesting that the model is properly specified and that there is no evidence of omitted nonlinear relationships.

The study discovered that over time, mobile banking actually has a negative effect on financial inclusion in Nigeria by -3.01, which is significant (0.0072). This means a rise in mobile banking leads to more people having access to financial services in Nigeria. While mobile banking can promote financial inclusion by making it easier for folks to use financial services through their phones, the research shows this isn't happening in the long term. The introduction of mobile banking has improved the efficiency, convenience, and speed of financial transactions, thereby reducing the need for customers to visit traditional banking halls before carrying out basic banking activities. Through mobile banking platforms, users can transfer funds, pay bills, save money, and conduct other financial transactions at any time and from any location. This innovation has contributed to the modernization of the financial system and has helped in extending financial services to previously unbanked and underbanked populations, especially in developing economies such as Nigeria. In addition, mobile banking is considered a safe and convenient channel for financial transactions because it reduces transaction costs, saves time, and improves accessibility to banking services. The increasing adoption of smartphones and mobile technology has further enhanced the relevance of mobile banking as a tool for achieving broader financial inclusion. It also supports the cashless policy initiative of the government and encourages greater participation in the formal financial system.

The study discovered that, in the long run, increased ATM adoption positively and significantly boosts financial inclusion in Nigeria, with a score of 7.03 (p = 0.0000). So, a rise in ATM usage leads to more financial inclusion in the country. ATM adoption is another important digital banking innovation that has significantly improved the delivery of financial services and enhanced convenience for banking users. The deployment and use of Automated Teller Machines (ATMs) have reduced the stress associated with carrying physical cash and visiting banking halls for routine financial transactions. Through ATM facilities, customers can conveniently withdraw cash, transfer funds, check account balances, and perform other banking operations at any time of the day without direct interaction with bank staff. This has contributed greatly to improving the efficiency and accessibility of banking services in Nigeria.

Furthermore, ATM adoption facilitates financial transactions in a safer and more secure manner by reducing the risks associated with holding large amounts of cash. It also helps in minimizing long queues in banks, reducing transaction time, and promoting the cashless policy introduced by the government and monetary authorities. The widespread availability of ATMs across urban centres and gradually in semi-urban areas has enhanced access to formal financial services and encouraged more individuals to participate in the banking system. As a result, ATM technology has become an important tool for expanding financial inclusion and strengthening financial intermediation within the economy. This finding is in line with the a-prior expectations of this study. The findings of this study is consistent with the findings of Jegede (2025), Oke and Oke (2023), Ali and Emenike (2025), and Davids et al. (2025).

The study revealed that web-pay transactions positively affect financial inclusion in Nigeria, with a score of 4.11, and it's highly significant to 0.0006. This means that a rise in web-pay usage should lead to higher financial inclusion. These transactions are key in the world of digital payments, pushed by fintech growth and efforts to make banking accessible to more people. Web-pay platforms enable individuals and businesses to carry out financial transactions electronically through internet-based channels at the comfort of their homes, offices, or any location with internet access. Through web-pay systems, users can conveniently make domestic and international payments, transfer funds, purchase goods and services online, and settle financial obligations without the need for physical cash transactions or direct visits to banking halls. This innovation has significantly improved the efficiency, speed, and convenience of financial transactions in Nigeria. In addition, web-pay transactions support the development of a cashless economy by promoting electronic payments and reducing overreliance on traditional banking methods. The growth of internet banking and online payment platforms has enhanced financial accessibility for businesses, entrepreneurs, students, and individuals engaged in e-commerce and digital economic activities. Web-pay systems also contribute to reducing transaction costs, improving transparency, and facilitating easier participation in both local and global financial markets. As internet penetration and digital transactions on financial inclusion within a single framework. Furthermore, the study revealed that while ATM adoption and web-pay transactions positively enhance financial inclusion, mobile banking exerts a negative long-run effect, thereby offering a new perspective on the challenges limiting the effectiveness of mobile banking in Nigeria.

Future studies should examine the main impact of digital banking on financial inclusion using primary data to capture users' perceptions, trust, digital literacy, and behavioural factors

literacy continue to expand, web-pay transactions have become an increasingly important channel for broadening financial inclusion in Nigeria. This finding is in line with the a-prior expectations of this study. The findings of this study is consistent with the findings of Patrick (2023) and Iwedi et al. (2023).

5. SUMMARY AND CONCLUSION

The research looked at how digital banking affected financial inclusion in Nigeria from 2000 to 2025, focusing on mobile banking, ATMs, and web-pay transactions. It showed that ATM adoption and web-pay transactions had positive long-term impacts. These digital payment methods expanded access to financial services and boosted involvement in the formal financial system. On the flip side, the study discovered that mobile banking had a negative effect in the long run. So, while some digital banking tools helped, others didn't quite have the same positive impact.

The study therefore concludes that digital banking remains an important driver of financial inclusion in Nigeria, but its effectiveness depends largely on the quality of technological infrastructure, security of digital platforms, affordability of digital services, and the level of financial and digital literacy among users.

The study recommended that there is a need to intensify financial and digital literacy programmes, particularly in rural areas, to enhance users' confidence and ability to effectively utilize mobile banking services. Also, banks should also ensure regular maintenance of ATM facilities, stable network services and stronger security measures to minimize fraud, machine failures and transaction delays. In addition, government and financial service providers should continue to promote the development of internet-based payment systems through improved internet infrastructure, affordable data services and enhanced cyber security frameworks.

This study contributes to knowledge by providing updated empirical evidence on the relationship between digital banking and financial inclusion in Nigeria over the period 2000–2025 using the ARDL approach. The study specifically contributes to the existing literature by examining the individual effects of mobile banking, ATM adoption, and web-pay

influencing the adoption of digital financial services in Nigeria. Further research may also extend the scope by incorporating other digital banking channels such as POS transactions, USSD banking, and agency banking to provide a broader understanding of digital financial inclusion. In addition, future studies can employ panel data analysis or comparative studies across African countries to determine whether the relationship between digital banking and financial inclusion differs across economies and institutional environments.

REFERENCES

Accion. (2025). *The state of financial inclusion: Bridging the gap for 1.6 billion adults*. Accion International.

Adeniyi, O., Oke, D., & Ogunbameru, B. (2024). Agency banking, USSD channels and financial inclusion in Nigeria: A cointegration and error correction analysis, 2000–2022. *Journal of African Banking and Finance, 12*(3), 45–68.

Ali, M., & Emenike, K. O. (2025). Digital payment systems and financial inclusion: Evidence from Nigeria. *International Journal of Finance and Banking Studies, 14*(1), 22–39.

Arewa, A. (2025). Financial exclusion and the digital divide in Nigeria: Evidence from the EFInA access to financial services survey. *Nigerian Journal of Financial Research, 9*(2), 11–34.

Central Bank of Nigeria. (2025). *CBN annual statistical bulletin* (Vol. 36). Central Bank of Nigeria.

Davids West, E., Okafor, C., Nweze, P., & Adeyemi, T. (2025). Digital banking channels andfinancial inclusion in Nigeria, 2000–2024: A mixed-method analysis. *Journal of Development Finance, 18*(1), 78–104.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340.

Kalu, E.U., Lawal, F.C., Ukpere, W.I., & Anowor, O.F. (2025). Elasticity of Financial System Stability to Growth Shocks and Economic Policy Uncertainty in Sub-Saharan Africa. Veredas Do Direito, 22(6).

Ekong, U. M., & Ekong, C. N. (2025). Mobile banking, fraud incidents, and financial inclusion in Nigeria: An ARDL bounds testing approach, 2008–2022. *African Journal of Economic Policy, 32*(1), 56–79.

Enhancing Financial Innovation and Access. (2025). *Access to financial services in Nigeria: 2025 survey report*. EFInA.

Gurley, J. G., & Shaw, E. S. (1960). *Money in a theory of finance*. Brookings Institution.

Iwedi, M., Barisua, F. N., & Nwite, S. C. (2023). Internet banking and financial inclusion in Nigeria. *International Journal of Banking and Finance Research, 9*(2), 14–28.

Jegede, C. A. (2025). Mobile banking, USSD transactions, and rural deposit mobilisation in Nigeria: Panel OLS evidence, 2009–2023. *Nigerian Journal of Rural Economics and Finance, 7*(1), 33–55.

Nkwo, M., Orji, A., & Uzodinma, C. (2025). Trust, security perception, and digital banking adoption in Nigeria: An extended TAM analysis. *Journal of Information Technology and Development, 21*(2), 88–112.

Nnaomah, U. I., Adeyemi, R., Okafor, P., & Eze, C. (2024). Digital literacy, infrastructure constraints, and fintech adoption among rural Nigerians. *African Development Review, 36*(3), 201–218.

Ogbu, Silk Ugwu. (2024). Business Ethics in Africa, Volume I: Values, Profits and Responsibility, 1, pp. 167 - 188, DOI: 10.1007/978-3-031-64427-6_10.

Ogbu, O., & Ogbu, E. (2024). Digital banking and bank account ownership in Nigeria: Evidence from multiple regression analysis. *Journal of Financial Systems and Development, 11*(4), 67–89.

Oke, B., & Oke, M. (2023). ATM adoption, internet banking, and financial inclusion in Nigeria: Robust regression evidence, 2009–2023. *Economic and Financial Review, 61*(2), 44–67.

Okoh, J. I., Nweze, C. L., & Eze, O. R. (2023). Digital payment volumes, economic development, and financia1 deepening in Nigeria. *Journal of Financial Regulation and Compliance, 31*(3), 310–328.

Okoyeuzu, C.R., Kalu, E.U., & Ukpere, W.I. (2019). Evaluating the Impact of Electronic Payment Channels on Sustainable Financial Inclusion in Nigeria. Journal of Reviews on Global Economics.

Omoruyi, E., Osagie, G., & Agbonlahor, O. (2024). Digital payment systems and economic development in Nigeria: A time-series analysis. *Nigerian Economic and Financial Review, 15*(1), 22–44.

Patrick, O. (2023). Web-pay transactions and financial inclusion: Evidence from the Nigerian payment system. *Journal of Digital Economy and Finance, 6*(2), 55–72.

Rogers, E. M. (1962). *Diffusion of innovations*. Free Press.

TC Insights. (2024). *The state of digital finance in Nigeria: Mobile, ATM and internet banking trends 2024*. TechCabal Insights.

Uzor, B. C., Nwosu, E. O., & Agu, C. U. (2023). Internet access, digital banking adoption, and financial inclusion in Nigeria: An ARDL approach, 2004–2020. *Journal of African Economies, 32*(4), 389–414.

World Bank. (2025). *The global Findex database 2025: Financial inclusion, digital payments, and resilience in the age of COVID-19*. World Bank Group.

World Bank. (2025). *World development indicators database*. World Bank Group.