



Financial Inclusion in Nigeria: The Impact of Eletronic Banking

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ABSTRACT

Background: Financial inclusion is a key enabler for growth and development that sustains in both modern and developing economies. It refers to a situation in which adult citizens have easy, affordable, and reliable entrance into a wide range of formal financial products and services, including savings, credit, payment systems, and insurance. Despite its acknowledged importance, achieving full financial inclusion remains a major challenge in many developing economies, including Nigeria.

Objective: This study examined electronic banking and its impact on financial inclusion in Nigeria.

Method: Ex post facto research design was adopted. The study employed multiple regression and cointegration techniques to analyze the collected data.

Results: The study found that both ATM and POS significantly enhance financial inclusion. The results further revealed a long-run equilibrium relationship and bi-directional causality between electronic banking infrastructure and the number of banked adults.

Conclusion: it was concluded that electronic banking plays a critical role in expanding financial access.

Unique Contribution: This study provided a fresh insight into measuring financial inclusion in terms of numbers of depositors with commercial bank per 1000 in Nigeria.

Key Recommendation: The study recommended intensified deployment of ATM and POS infrastructure, especially in underserved areas.

Keywords: Financial Inclusion, Electronic Banking, ATM, POS, Nigeria



INTRODUCTION

Financial inclusion is a key enabler of growth and development that sustains in both developing and modern economies. It refers to a situation in which adult citizens have easy, affordable, and reliable entry into a diverse portfolio of formal financial offerings, including savings, credit, payment systems, and insurance. “In essence, financial inclusion ensures that individuals and businesses can effectively participate in the financial system without barriers related to cost, distance, or complexity”. It also implies that all bankable adults are integrated into the formal financial sector, thereby enhancing economic participation and reducing poverty (Ene, Abba, & Fatokun, 2019).

Despite its acknowledged importance, achieving full financial inclusion remains a major challenge in many developing economies, including Nigeria. The report on the number of adults citizens that are financially excluded indicates that 35.9% of Nigerian adults are financially excluded. This implies that more than one in every three adults do not have any business to do with banking system. “Although there has been a marginal decline in the percentage of excluded individuals between 2018 and 2020, the absolute number of financially excluded adults increased from 36.6 million to 38.1 million due to rapid population growth. This trend highlights a persistent gap between policy efforts and actual inclusion outcomes” (EFInA, 2020).

In response to this challenge, the apex bank in the country has come up with policy of no cash order to accelerate financial inclusion and modernize the payment system. The policy aims to expand entry financial offerings and as well reduce risks and costs associated with cash-based transactions, including armed robbery, fraud, and informal financial practices. Consequently, the policy has significantly stimulated the growth of electronic banking channels in Nigeria, evidenced by the increasing deployment of Automated Teller Machines (ATMs), Point of Sale (POS) terminals, mobile banking platforms, and internet banking services.

However, despite the rapid expansion of electronic banking infrastructure, a considerable proportion of Nigerian adults remains financially excluded. This paradox raises important empirical questions regarding the actual effectiveness of electronic banking channels in promoting financial inclusion. Against this backdrop, this study investigated electronic banking and its impact on financial inclusion in Nigeria. Specific objectives are to:

- assess impact of Automated Teller Machines (ATMs) on financial inclusion; and
- evaluate impact of Point of Sale (POS) terminals on financial inclusion.



REVIEW OF RELATED LITERATURE

Review of Concepts

Electronic Banking

Electronic banking refers to “the execution of financial transactions through electronic platforms using computer-based systems and digital technologies. It enables customers to perform a wide range of banking activities—including fund transfers, bill payments, deposits, and withdrawals—without the need for physical interaction within banking halls. These transactions are facilitated through various electronic channels such as Automated Teller Machines (ATMs), Point of Sale (POS) terminals, mobile banking applications, and internet banking platforms” (chaimaa, Najib and Rachid, 2020).

Scholars such as Jahangir and Begum (2008) conceptualize electronic banking as the conduct of banking operations through electronic means, while Nwude, Igweoji, and Udeh (2020) define it as a payment mechanism that utilizes digital devices to execute financial transactions. Fundamentally, e-banking is driven by advancements in Information and Communication Technology (ICT), which serve as the backbone for efficient, real-time, and scalable financial service delivery (Agwu & Murray, 2015).

Electronic banking has become a key driver of financial innovation within the banking sector. According to Kariuki, Kimundi, and Makambi (2018), “the adoption of technologies such as ATMs, mobile banking, and internet banking has transformed the delivery of financial services, making them more accessible, efficient, and customer-oriented”. Unlike traditional banking systems that require physical presence, e-banking enables customers to have entry into financial offerings as need arises, thereby reducing transaction costs and enhancing convenience.

In the context of the 21st-century digital economy, electronic banking has significantly redefined the operational landscape of financial institutions. It has facilitated the decentralization of banking services, allowing transactions to occur beyond the confines of bank branches. As noted by Ene et al. (2019), e-banking channels such as ATMs, POS terminals, mobile devices, and computers have made banking services very simple, inclusive, and aligned with expectations of modern consumers.

Financial Inclusion

According to Jepchumba & Simiyu (2019), “financial inclusion is the provision of affordable, accessible, and appropriate financial products and services to all segments of society, particularly the underserved and economically disadvantaged populations, it ensures that individuals and businesses can effectively access and utilize formal financial services such as savings, credit, insurance, and payment systems”.



From a broader perspective, Asli, Klapper, and Singer (2017) emphasize that “financial inclusion begins with access to and ownership of a formal account with a recognized financial institution. This foundational access enables individuals to participate actively in the financial system and benefit from economic opportunities”.

Financial inclusion helps in enhancing economic wellness and as well reduce poverty, and improve living standards. It facilitates resource allocation, enhances financial stability, and supports entrepreneurial activities. Sahay, Cihak, and N’Diaye (2015) argue that “financial inclusion contributes significantly to macroeconomic stability and development by enabling broader participation in financial markets”.

In the words of Kama and Adigun (2013), “financial inclusion as a process that ensures ease of access to, availability, and usage of formal financial services by all economic agents without barriers”. Similarly, Okoroafor, Adeniji, and Awe (2018) view it “as a system where account ownership, credit access, and utilization of financial services are made available to all adult citizens without difficulty”.

Generally, the core components of financial inclusion are:

- Physical and digital access to financial touch points.
- Breadth of financial service offerings available the public.
- Reasonable pricing of banking products.
- Effective adoption and continued use of financial services.

These dimensions collectively determine the effectiveness of financial inclusion initiatives in any economy.

Theoretical Review

This research is grounded in the Technology Acceptance Model (TAM) proposed by Fred Davis in 1986. TAM argues that two main elements shape how people adopt new technology. The elements include: Perceived Ease of Use (PEOU) which refers to how much a person feels that using a given technology will not require significant effort. Perceived Usefulness (PU) which describes the extent to which individuals believe the technology will improve their performance or help them attain expected results (Davis, 1986).

The importance of the model in this present research depends on the ability to explain user behavior toward electronic banking channels. In a developing economy such as Nigeria, problem like poor digital knowledge infrastructural deficits as well as lack of trust influence acceptance and usage of electronic banking systems. Therefore, the success of e-banking in promoting financial inclusion depends largely on how users perceive its usefulness and ease of operation.



Empirical Review

Empirical studies on electronic banking and financial inclusion provide mixed but insightful findings. Ene et al (2019) examined electronic banking and its impact on financial inclusion in Nigeria, focusing on ATM and POS channels. Using regression analysis, the study found that ATM usage has no substantial influence on financial inclusion, whereas POS deployment had a significant positive impact. The authors recommended improving ATM functionality and expanding POS networks to enhance accessibility.

In a related study, Abidi, Hussein, and Kadir (2022) investigated “the effect of ATM and mobile banking on financial inclusion in Somalia using descriptive and regression techniques”. The findings revealed that both ATM and mobile banking significantly influence financial inclusion. They emphasized supportive regulatory framework as crucial in fostering innovative finance and inclusion.

More recently, Olumuyiwa and Ume (2024) analyzed “the impact of digital banking on financial inclusion in Nigeria using the Johansen cointegration and error correction model and found existence of long-run relationships between financial inclusion and key variables such as digital banking adoption, regulatory environment, and internet access”. The study further revealed that “financial literacy and income levels significantly influence financial inclusion outcomes”.

It was concluded in the research, multifaceted approach—combining digital banking expansion, regulatory efficiency, and improved internet infrastructure—is essential for achieving sustainable financial inclusion and reducing economic inequality in Nigeria

RESEARCH METHODOLOGY

Research Design and Data Sources

Ex-post facto research design was employed to analyze historical non experimental data. The design enables the investigation of causal relationships between electronic banking infrastructure and financial inclusion using already existing data. Secondary time-series data sourced from the CBN statistical bulletins form the basis for this study. Time frame selected is adequate to observe pattern and establish long term associations among the variables of the study.

Measurement of Variables

- **Dependent Variable:**
 - **Financial Inclusion:** this is measured by adult citizens that have accounts with deposit money banks. It shows the level of participation in the formal banking system.
- **Independent Variables:**
 - **Automated Teller Machines (ATM):** Measured by the total number of ATMs in Nigeria per year.
 - **POS Penetration:** It is captured by annual count of active POS terminals nation wide.

These variables capture the extent of electronic banking infrastructure and its accessibility to the population.



Analytical Techniques

To examine how electronic banking channels influence financial inclusion, multiple linear regression model was applied. This technique isolates the individual and joint contributions of ATM and POS deployment to changes in the dependent variables.

Prior to estimation, unit root test was carried out to verify stationarity and prevent spurious regression results. Establishing stationarity is essential for reliable econometric inference.

Model Specification

The functional relationship between electronic banking and financial inclusion is specified as follows:

$$DCB_t = \beta_0 + \beta_1 ATM_t + \beta_2 POS_t + \epsilon_t$$

Where:

- DCB_t = Depositors with commercial banks.
- ATM_t = Automated Teller Machines
- POS_t = Point of Sale terminals
- β_0 = constant term
- β_1, β_2 = Coefficients
- ϵ_t = Error term capturing unobserved influences

RESULTS AND DISCUSSION

Preliminary Tests

The results of ADF applied indicate that all variables contain unit roots at level. However, each series achieves stationarity after first differencing indicating they are I(1) processes

Importantly, the study measured these variables in density terms (per 1,000 adults) rather than absolute values. This transformation provides a more accurate representation of financial accessibility and penetration, rather than mere infrastructure volume.

Table 1: Summary of Unit Root Test Results

Variable	Level (p-value)	1st Difference (p-value)	Order of Integration	Status
DCB	0.9999	0.0024	I(1)	Stationary
ATM	-	0.0013*	I(1)	Stationary
POS	0.0761	0.0036	I(1)	Stationary

Source: Author's Computation



Interpretation of Unit Root Results

The findings confirm that all variables exhibit non-stationary behavior at levels, indicating the presence of persistent trends over time rather than mean-reverting patterns. Specifically:

- The extremely high p-value for DCB (0.9999) suggests a steady upward trend in banking penetration, reflecting gradual improvements in financial inclusion.
- The I(1) nature of ATM and POS indicates continuous expansion in electronic banking infrastructure.
- POS density shows a more dynamic growth pattern compared to ATM, likely due to its flexibility and lower deployment cost.

The implication of these results is that the variables share common stochastic trends, thereby justifying further testing for long-run equilibrium relationships.

4.2 Long-Run Relationship: Johansen Cointegration Test

Table 2: Summary of Johansen Cointegration Test Results

Test Type	Hypothesized	Eigenvalue	Trace/Max-Eigen Statistic	Critical Value (0.05)	Prob.**
	No. of CE(s)				
Trace Test	None *	0.8917	62.0556	29.7971	0
	At most 1 *	0.6095	24.2649	15.4947	0.0019
	At most 2 *	0.3856	8.2808	3.8415	0.004
Max-Eigen	None *	0.8917	37.7908	21.1316	0.0001
	At most 1 *	0.6095	15.9841	14.2646	0.0265
	At most 2 *	0.3856	8.2808	3.8415	0.004

Source: Author's Computation

Evidence of Long-Run Convergence

The Johansen test results reveal the existence of **three (3) cointegrating equations at the 5% significance level**, as confirmed by both the Trace and Maximum Eigenvalue statistics.

In econometric terms, cointegration implies that although the individual variables (DCB, ATM, and POS) may drift over time due to non-stationarity, they are bound together by a stable long-run equilibrium relationship.



Key Implications:

- Electronic banking infrastructure (ATM and POS) and financial inclusion (DCB) move together in the long run.
- The relationship is not spurious, but structurally grounded in the Nigerian financial system.
- Any increase in ATM or POS density leads to a **permanent (non-transitory) improvement in financial inclusion.**

Table 3: Summary of Granger Causality Results

Null Hypothesis	F-Statistic	Prob.	Direction
ATM DCB	2.36959	0.0086	Causality Exists
DCB ATM	3.68592	0.0003	Causality Exists
POS DCB	2.97871	0.0008	Causality Exists
DCB POS	8.51266	0.0050	Causality Exists
POS ATM	0.40351	0.6767	No Causality
ATM POS	0.09254	0.9123	No Causality

Source: Author's Computation

The Granger causality results reveal a bi-directional (feedback) relationship between electronic banking infrastructure—proxied by ATM and POS density—and financial inclusion, measured by the number of depositors (DCB).

Specifically, the probability values (p-values < 0.05) indicate that past values of ATM and POS significantly predict changes in the number of depositors. This finding confirms that the expansion of electronic banking channels serves as a predictive driver of financial inclusion in Nigeria. In practical terms, improvements in the availability and accessibility of ATMs and POS terminals enhance individuals' likelihood of participating in the formal financial system.



Conversely, the results also show that DCB Granger-causes both ATM and POS. This suggests that as more individuals become financially included, there is a corresponding increase in demand for banking services, which in turn stimulates further investment in electronic banking infrastructure. This establishes a demand–supply feedback loop, where infrastructure drives inclusion, and inclusion further drives infrastructure expansion.

An important insight from the analysis is the absence of causality between ATM and POS channels, as indicated by the high p-values (0.67 and 0.91). This implies that the growth of POS terminals is statistically independent of ATM expansion, and vice versa.

Interpretation in the Nigerian Context

This result highlights the **functional differentiation** between the two channels:

- **ATMs** primarily support high-volume cash transactions and serve as a traditional interface between customers and banks.
- **POS terminals** facilitate retail transactions and agency banking, effectively delivering financial services to underserved and remote populations.

Rather than substituting for one another, these channels operate in complementary but distinct segments of the financial ecosystem.

Analysis of Normalized Cointegrating Coefficients

Table 4: Long-run Cointegrating Equation

Normalized cointegrating coefficients (standard error in parentheses)

DCB	ATM	POS
1.000000	-35.48732 (2.92465)	-0.000581 (5.00105)

Adjustment coefficients (standard error in parentheses)

D(DCB)	0.230498 (0.22200)
D(ATM)	-0.001073 (0.00358)
D(POS)	3547.267 (420.529)

Source: Author’s Computation



Long-Run Coefficient Analysis

The normalized cointegrating equation, with financial inclusion (DCB) as the dependent variable, reveals the following long-run relationship:

$$\text{DCB} = 35.487 \cdot \text{ATM} + 0.00058 \cdot \text{POS}$$
$$\text{DCB} = 35.487 \cdot \text{ATM} + 0.00058 \cdot \text{POS}$$

Interpretation of Long-Run Coefficients

The coefficient of ATM (35.487) is positive, large, and statistically significant, indicating that increases in ATM density have a substantial long-run effect on financial inclusion. Specifically, a unit increase in ATM density per 1,000 adults leads to a significant expansion in the depositor base. This underscores the enduring relevance of physical banking infrastructure in Nigeria. Despite the rapid growth of digital banking platforms, ATMs continue to serve as a “gateway” to formal financial participation, particularly for underserved and rural populations where trust and physical presence remain critical.

In contrast, the coefficient of POS (0.00058), though numerically smaller, remains statistically meaningful within the cointegrating framework. Its significance is reinforced by the cointegration results, which establish POS as a core component of the long-run equilibrium relationship. The relatively small magnitude reflects normalization rather than weak influence. In practice, POS terminals play a crucial role as “last-mile financial access points,” especially in areas lacking formal banking infrastructure.

Adjustment Mechanism (Vector Error Correction Model – VECM)

The Vector Error Correction Model provides insight into how the system responds to short-run deviations from long-run equilibrium.

- The adjustment coefficient for ΔPOS (**3547.27**) is exceptionally high, indicating that the POS network responds rapidly to restore equilibrium following shocks. This reflects the flexibility and scalability of POS infrastructure.
- The adjustment coefficient for ΔDCB (**0.23**) is relatively low, suggesting a slower adjustment process. This aligns with real-world dynamics, where changes in human behavior—such as adopting formal banking—occur gradually over time.

Interpretation

This asymmetry highlights a key structural feature of the Nigerian financial system:

Infrastructure can expand quickly, but financial inclusion evolves more slowly due to behavioral, cultural, and trust-related factors.



Discussion of Findings (Integrated Analysis)

The findings provide strong empirical support for an infrastructure-led model of financial inclusion in Nigeria.

ATM as a “Gateway Infrastructure”

The significant and robust impact of ATM density confirms its role as a foundational pillar of financial inclusion. ATMs serve not only as transaction points but also as trust-building mechanisms, particularly for first-time users of formal financial services. Their 24-hour availability and increasing functionalities (e.g., cash deposits, biometric authentication) position them as “mini-branches” that reduce both physical and psychological barriers to banking.

POS as “Last-Mile Infrastructure”

POS terminals, on the other hand, represent the most transformative channel in expanding financial inclusion. Their mobility, low deployment cost, and integration with agency banking models make them particularly effective in reaching underserved populations.

The rise of fintech-driven agency banking—supported by initiatives of the Central Bank of Nigeria such as SANEF—has enabled POS agents to function as decentralized banking outlets. Platforms like Opay and Moniepoint have further accelerated this transformation by expanding agent networks across rural and peri-urban areas.

Complementarity of Channels

Importantly, the absence of causality between ATM and POS confirms that these channels **do not substitute for each other**, but instead serve distinct and complementary roles:

- ATMs → Liquidity access and institutional trust
- POS → Accessibility and localized service delivery

CONCLUSION AND RECOMMENDATIONS

Based on the empirical findings, the study concludes that, ATM density significantly enhances financial inclusion, functioning as a **gateway to formal banking**. The study equally concludes that POS terminals drive **last-mile inclusion**, particularly in underserved and rural communities. A **bi-directional causality** exists, indicating a feedback loop between infrastructure expansion and depositor growth. The study finally concludes that ATM and POS operate independently, reinforcing the need for a diversified infrastructure approach. The study therefore recommended that the government and the Central Bank of Nigeria should incentivize banks and fintech firms to deploy ATM and POS infrastructure in underserved rural areas to reduce geographic



disparities in financial access. Enhancing digital financial literacy, strengthening cyber security frameworks and Improving dispute resolution mechanisms.

Ethical clearance

Ethical consent was sought and obtained from the participants used in this study. They were made to understand that the exercise was purely for academic purposes, and their participation was voluntary.

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Authors' Contributions

Dr. Ogbonna, U.E. and Dr. Umahi, C. R. conceived the study, including the design, Assoc. Prof. Eze, O. R. and Enyi Eke O. while Dr. Ogbonna U. E. wrote the initial manuscript. All authors have critically reviewed and approved the final draft, and are responsible for the content and similarity index of the manuscript.

Artificial Intelligence (AI) Use Disclosure

The author(s) declare that no generative Artificial Intelligence (AI) or AI-assisted technologies were used in the writing, analysis, or preparation of this manuscript.

Data availability statement

The datasets on which conclusions were made for this study are available on reasonable request.

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