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# Digital Financial Inclusion and Growth Quality: A Governance-Based Structural Analysis of Financial Sustainability in Nigeria

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Abstract

This study investigates the impact of digital financial inclusion on the quality of economic growth in Nigeria, specifically examining how governance-led structural financial reforms influence long-term stability. Utilizing annual time-series data (2000–2024), the research employs an Autoregressive Distributed Lag (ARDL) model to examine the short- and long-run effects of fintech adoption and financial accessibility. The findings demonstrate that digital financial inclusion serves as a primary driver of high-quality growth by reducing information asymmetry and lowering transaction costs. Crucially, the analysis reveals that financial sustainability is significantly enhanced when technological diffusion is anchored by robust regulatory frameworks and governance mechanisms. The results suggest that for digital inclusion to remain a sustainable engine of development, policymakers must harmonize legal protections with technological infrastructure. The study concludes with governance recommendations to strengthen the nexus between fintech and inclusive economic performance.

Keywords: Sustainable Development Goals (SDGs), Human Development Index (HDI), migrant remittances, development paradox, longitudinal analysis, social sustainability.

JEL Classification: G21; O16; O33; C22; I32.

## Introduction

The expanding role of digital technologies in shaping contemporary economic systems has increasingly elevated digital financial inclusion (DFI) to the center of debates on inclusive and sustainable development, particularly in developing economies. The transformative potential of technological innovation has long been emphasized in classical growth theory, where knowledge accumulation and innovation are viewed as central engines of productivity and welfare improvement. Over recent decades, attention has shifted to information and communication technologies (ICTs), especially mobile communications, which have demonstrated unprecedented capacity to connect individuals, firms, and markets across spatial and economic boundaries. Global development institutions have recognized mobile

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technologies as among the most transformative innovations of modern history, largely due to their ability to lower transactional costs, enhance information flows, and expand economic participation in cost-effective ways (Ahmad et al., 2023).

In the African context, the relationship between ICT and financial inclusion is particularly salient, given historical constraints such as sparse banking networks, inadequate financial infrastructure, and pronounced spatial dispersion of populations. Mobile-based financial solutions, including mobile money platforms and online banking services, offer an alternative pathway to formal financial access by enabling users to save, transfer funds, receive payments, and insure against risks without requiring proximity to brick-and-mortar institutions (Sha'ban et al., 2024). Empirical evidence suggests that mobile money improves household welfare through enhanced consumption smoothing, increased resilience to shocks, and expansion of economic choices available to microenterprises and individuals, thereby contributing to inclusive growth (Asongu & Odhiambo, 2022; Verma & Chatterjee, 2025). These outcomes underscore the catalytic role of digital finance in addressing pervasive income inequality, poverty, and economic vulnerability in developing economies.

However, the transformative promise of ICT adoption has not been uniformly realized. Historical instances, such as the diffusion of personal computers in the 1990s, indicate that large-scale technological investments can coexist with stagnant productivity and limited economic impact (Ahmad et al., 2023). Contemporary literature further demonstrates that the expansion of mobile connectivity alone is insufficient for driving meaningful digital financial inclusion. The adoption and effective utilization of mobile-based financial services are contingent upon broader macroeconomic conditions, including the level and stability of economic growth. Studies indicate that mobile connectivity produces positive financial inclusion outcomes only when a country achieves minimum GDP growth thresholds, typically ranging between 4.2% and 6.2% (Asongu & Odhiambo, 2022). This evidence highlights that digital financial inclusion is both a technological and macroeconomic process: without sustained income growth, households and enterprises may lack the financial capacity, confidence, or incentives to engage with digital financial tools effectively.

Despite rapid technological diffusion in Nigeria however, particularly in mobile telephony and internet penetration, substantial financial inclusion gaps persist. Structural barriers, including income inequality, poverty, limited digital literacy, cybersecurity risks, and uneven access to digital infrastructure, constrain the potential of digital financial platforms to generate equitable economic outcomes (Ayeni, 2025). Research shows that rural and marginalized communities often remain excluded from digital finance, even when mobile networks are accessible, illustrating that technological availability alone does not guarantee effective participation (Asongu & Odhiambo, 2022). Consequently, national policies that focus solely on expanding digital infrastructure without addressing income, literacy, and institutional quality may fall short of promoting inclusive growth.

Global patterns in financial inclusion reinforce the relevance of these observations. Account ownership worldwide increased from 51% in 2011 to 76% in 2021, largely driven by digital financial platforms, while Sub-Saharan Africa has emerged as a leader in mobile money adoption, with account ownership rising from 12% to 33% over the same period (Sha'ban et al., 2024). Despite these gains, persistent barriers, such as low-income levels, high service costs, documentation requirements, and gender-based disparities, continue to limit universal access.

Digital financial inclusion offers mechanisms for overcoming these limitations by lowering transaction costs, reducing administrative burdens, and extending outreach to underserved populations (Sha'ban et al., 2024). Yet digital divides remain a critical determinant of who benefits from digital financial systems, as disparities in device ownership, internet connectivity, and digital literacy continue to reinforce socio-economic inequalities. The interplay between digital and traditional financial inclusion adds further tone to the discourse. Evidence suggests that digital financial inclusion can complement and strengthen traditional financial inclusion by familiarizing users with formal financial concepts and gradually integrating them into mainstream banking systems (Sha'ban et al., 2024). Multi-dimensional indices of financial inclusion indicate that several African developing countries now surpass advanced economies in digital financial inclusion metrics, reflecting the effectiveness of mobile money platforms in circumventing conventional financial barriers. Nevertheless, the expansion of digital finance is accompanied by emerging risks, including cybersecurity vulnerabilities, insufficient regulatory frameworks, and the potential exacerbation of existing inequities (Ayeni, 2025). In Nigeria, these risks are amplified by infrastructural deficits, uneven rural connectivity, and systemic vulnerabilities, which collectively hinder the equitable realization of digital financial benefits.

Recent global crises, ranging from the 2008 financial meltdown to the COVID-19 pandemic, the Russia-Ukraine conflict, and climate-induced economic shocks, have underscored the critical importance of financial resilience. Digital financial inclusion enhances resilience by ensuring that households and firms maintain access to payments, savings, and insurance mechanisms during periods of economic uncertainty (Verma & Chatterjee, 2025). However, structural vulnerabilities in emerging markets continue to obstruct both traditional and digital inclusion, highlighting the essential role of inclusive finance in stabilizing households and supporting macroeconomic recovery.

Nigeria's pursuit of inclusive growth increasingly relies on digital financial inclusion to broaden financial access, strengthen economic participation, and reduce poverty. Yet, despite improvements in mobile connectivity and the expansion of digital platforms, adoption and utilization gaps remain substantial. Mobile connectivity does not automatically translate into mobile money adoption or productive financial behaviour, particularly in contexts where economic growth is fragile and uneven (Asongu & Odhiambo, 2022). In Nigeria, fluctuating macroeconomic performance and systemic vulnerabilities limit the extent to which digital financial tools contribute to inclusive economic outcomes. Investments in digital infrastructure, while necessary, have yet to generate commensurate improvements in mobile money uptake, weakening the potential of digital financial inclusion to support broad-based growth.

Persistent socio-economic disparities further complicate the achievement of inclusive growth. Low-income households, marginalized groups, and women continue to face barriers to accessing digital financial services due to affordability, documentation requirements, and digital literacy deficits (Sha'ban et al., 2024). Traditional financial institutions, constrained by operational costs and risk-averse lending practices, often exclude micro-enterprises and small-scale entrepreneurs from essential credit and financial services (Chen et al., 2025; Adil & Nazir, 2023). Digital financial platforms, while offering efficiency and broader outreach, cannot fully overcome these structural challenges without complementary policy measures that promote literacy, regulatory oversight, and economic empowerment.

Finally, the uneven adoption of digital financial services in Nigeria underscores the need for rigorous empirical investigation into the mechanisms linking digital finance to inclusive growth. The potential of DFS to enhance financial inclusion, promote entrepreneurship, and support household welfare remains constrained by infrastructure gaps, socio-economic inequalities, and institutional weaknesses (Gulati & Singh, 2024). Against this backdrop and other germane issues, this study is motivated to examine evaluate how digital financial inclusion (mobile money and digital banking) contribute to and improve the quality inclusive growth in Nigeria.

## 1. Literature Review

### Conceptual Review

Digital financial inclusion (DFI) represents a transformative approach to widening access to financial services through digital technologies, including mobile phones, internet platforms, and electronic payment systems (Sha'ban et al., 2024; Xi & Wang, 2023; Oanh, 2024). Conceptually, DFI extends beyond mere access to banking, emphasizing affordability, convenience, efficiency, and usability of financial products such as mobile payments, online loans, and digital insurance. These platforms are especially critical in contexts with limited physical banking infrastructure, allowing previously underserved populations, including rural communities and micro-entrepreneurs, to participate in formal financial systems (Ayeni, 2025; Alfiana et al., 2025). FinTech innovations, such as mobile money, peer-to-peer lending, and digital wallets, serve as primary instruments in achieving DFI, reducing transaction costs, mitigating information asymmetries, and enabling secure financial transactions (Gulati & Singh, 2024; Rahayu et al., 2022).

The literature underscores that the effectiveness of DFI is not only a function of technological availability but also of macroeconomic and institutional conditions, such as mobile penetration, banking sector stability, and urbanization, which collectively shape usage patterns and inclusivity (Sha'ban et al., 2024; Adil & Nazir, 2023). Theoretical perceptions from Schumpeter, Solow, and Romer emphasize that technological change, including information and communication technologies (ICT), stimulates structural transformation, increases productivity, and supports inclusive growth (Ahmad et al., 2023). Empirical studies suggest that DFI facilitates both household and enterprise-level economic engagement, promotes entrepreneurship, enhances risk management, and strengthens resilience against economic shocks (Chen et al., 2025; Ayeni, 2025). Moreover, DFI complements traditional financial inclusion, often creating a medium-term pathway through which digital financial participation enhances overall access to formal banking.

In Nigeria, where structural barriers, geographic dispersion, and low banking penetration limit financial access, DFI emerges as a critical policy and development tool for promoting inclusive and sustainable economic growth. By leveraging mobile and digital platforms, individuals and enterprises can engage in productive economic activities, expand income-generating opportunities, and contribute to broad-based improvements in welfare, illustrating the interdependent relationship between technological innovation, financial inclusion, and quality of growth (Sam-Abugu et al., 2025; Mamun & László, 2025).

## Theoretical Review

This study is anchored in Financial Development Theory (FDT), which posits that a well-functioning, mature financial system mobilises savings, allocates capital efficiently, mitigates risk, and fosters sustained economic activity. Within the context of digital finance, FDT provides a robust conceptual foundation: mobile money and digital financial services overcome traditional banking barriers by delivering credit, payment, and savings products to previously excluded, rural, or low-income populations. This expansion facilitates the integration of underbanked segments into the formal economy, thereby enhancing investment and broader economic participation (Ahmad et al., 2023; Nnaomah et al., 2024).

From the perspective of FDT, the supply-leading hypothesis, or finance-led growth theory, is particularly pertinent. This hypothesis argues that the development of financial institutions and markets precedes and stimulates real economic growth by channelling resources to productive sectors, lowering transaction costs, and fostering entrepreneurial activity. Empirical evidence from Nigeria reinforces this view: Karimo & Ogbonna (2017), employing Granger-causality tests, demonstrate that financial deepening leads economic growth, consistent with the supply-leading framework.

The theoretical foundations of FDT also align closely with endogenous growth theory, which emphasises the role of innovation, human capital, and institutional quality in sustaining long-term economic growth. As digital financial inclusion spreads, FDT suggests that digital finance not only mobilises capital but also promotes innovation and human-capital accumulation by linking entrepreneurs with financial resources and facilitating investment in technology and knowledge-intensive activities, including mobile platforms and FinTech solutions (Valderrama, 2003).

Furthermore, FDT resonates with broader perceptions from developmental finance: the World Bank (2016) highlights that financial development reduces information and transaction costs, improves risk management, and expands access to financial services, benefits that are especially critical in low-income or geographically dispersed economies.

Collectively, FDT offers a compelling theoretical lens for this study. Digital financial inclusion is framed not merely as a mechanism to broaden access but as a transformative force through which financial systems can mobilise savings, allocate capital more inclusively, and stimulate innovation-driven, equitable growth. The theory also recognises potential non-linear effects: initial stages of financial inclusion may disproportionately advantage certain groups before more widespread adoption contributes to reducing inequality, emphasising the necessity of careful policy design and robust institutional support.

## Empirical Review

Over the past two decades, research on digital financial inclusion (DFI), mobile money, and their interplay with economic growth and poverty reduction has gained significant momentum, reflecting both technological and policy-driven transformations in financial access globally. Ahmad et al. (2023) employed a rigorous two-stage cross-country empirical strategy using 23 years of panel data for 146 countries. The first stage modified the Barro-Mankiw-Romer-Weil growth model in log-difference form, integrating physical and human capital, money-in-production, ICT, mobile money, institutional quality, and non-linear interactions, while the second stage modelled financial inclusion using the IMF's comprehensive financial inclusion index. The study demonstrated that mobile money exerts both direct and indirect

positive effects on economic growth and enhances financial inclusion, particularly in settings with high mobile penetration and geographically dispersed populations. Similarly, Asongu & Odhiambo (2022) focused on developing countries, utilizing Tobit regression to assess threshold effects of economic growth on mobile money adoption. They found that a minimum GDP growth level, 6.1% for connectivity performance and 4.6% for coverage, is necessary before mobile connectivity translates into higher mobile money usage, highlighting the conditionality of technological adoption on economic conditions.

Sha'ban et al. (2024) further elaborated on financial inclusion by constructing multidimensional indices for digital and traditional inclusion using IMF Financial Access Survey data from 2004 to 2020. Their cross-country econometric estimations revealed that digital financial inclusion significantly reinforced traditional inclusion over time, with African developing countries leading digital adoption while high-income European countries dominated conventional banking inclusion. Complementing these macro-level findings, Ayeni (2025) applied qualitative case studies from sub-Saharan Africa, Latin America, and South Asia to show that FinTech solutions such as M-Pesa, Paystack, and GCash expand access to financial services, support entrepreneurship, and promote sustainable economic growth, although persistent challenges like cybersecurity risks and infrastructural gaps, particularly in rural areas, limit full inclusion.

At the household level, Verma & Chatterjee (2025) applied *bi-probit* models with instrumental variables on Global Findex data for 13 emerging economies and 33,933 individuals. Their results emphasized that savings, bank account ownership, and digital payments significantly improve financial resilience, while digital borrowing and receipts had minimal effects, underscoring differential impacts of financial inclusion instruments.

Firm-level analyses complement these findings. Adil & Nazir (2023) investigated 400 Pakistani manufacturing firms using Method of Moments Quantile Regression and system GMM, demonstrating that financial inclusion and asset management significantly affect export performance, with debt-to-equity ratios beneficial only for moderately leveraged firms.

At the micro-entrepreneurial level, Chen et al. (2025) utilized the China Household Finance Survey to show that digital inclusive finance enhances entrepreneurial activity by improving financial access and asset allocation, particularly in cities with higher levels of digital financial inclusion. Bibliometric analyses by Gulati & Singh (2024) highlighted emerging research trends in digital financial services (DFS), emphasizing blockchain, machine learning, and advanced analytics as critical frontiers, while Osabutey & Jackson (2024) underscored that benefits of mobile money in Africa are often concentrated among wealthier strata, revealing persistent equity gaps.

Mashoene et al. (2025) linked DFI to inclusive growth and poverty reduction in 21 emerging and developing economies using system-GMM, demonstrating that DFI promotes equitable growth, which in turn reduces poverty. Alfiana et al. (2025) corroborated this by showing that mobile technology, especially M-Pesa, facilitates access to microcredit for underserved populations, though adoption is hindered by low digital literacy and infrastructure. Cross-national comparisons, such as Nnaomah et al. (2024) contrasting the United States and Nigeria, revealed that regulatory frameworks and economic conditions critically shape digital banking success, with Nigeria relying heavily on mobile banking to reach unbanked populations despite infrastructural challenges.

Region-specific analyses reinforce these conclusions. Basnayake et al. (2024) found that digital financial inclusion significantly boosts economic growth in 30 Asia-Pacific countries, with threshold effects confirming a non-linear relationship. In China, Huang et al. (2025) demonstrated that DFI mitigates urban-rural income gaps through industrial upgrading, while Peng & Zeng (2023) linked DFI to inclusive green growth via green technology innovation and entrepreneurship. Contrastingly, Oanh (2024) identified trade-offs, where DFI in low-financial-development countries improved environmental quality but temporarily constrained economic growth, highlighting contextual heterogeneity. Meniago (2025) emphasized the moderating role of institutional quality in SADC countries, showing that robust governance amplifies DFI's positive effect on growth. Xi & Wang (2023) similarly highlighted spatial spillover effects in China, with DFI stimulating entrepreneurial vitality and enhancing the quality of economic growth regionally.

Further research has mapped the intellectual landscape of DFI, with bibliometric studies by Yang et al. (2025) and Mamun & László (2025) identifying digital services' role in reducing inequality, supporting sustainable finance, and revealing risks such as cybercrime and regulatory fragmentation. Regional studies in MENA (Al-Smadi, 2025) and Indonesia (Tandilino et al., 2025) confirmed that DFI and government support jointly enhance MSME performance and sustainable development.

Studies in China (Becha et al., 2025) highlight the non-linear effects of digital financial inclusion (DFI), contingent on environmental sustainability conditions. Complementary global evidence from Pal et al. (2025) and Kumar & Rajeswari (2024) confirms the transformative role of mobile money in emerging economies, including India. In the Nigerian context, analyses by Nkechika (2022) and Sam-Abugu et al. (2025) reveal substantial yet uneven progress in digital financial inclusion, emphasizing that financial literacy is often more decisive than technology access alone. Finally, Li et al. (2025) demonstrate that digital adoption, together with public expenditure, significantly reduces income inequality in Sub-Saharan Africa. Collectively, these findings consolidate the view that digital financial inclusion operates as a multifaceted driver of economic growth, entrepreneurship, poverty alleviation, and equitable development.

Collectively, these studies converge on the premise that DFI, mobile money, and related ICT innovations are key catalysts for economic development, though their effectiveness is mediated by contextual factors such as institutional quality, infrastructure, regulatory environments, and socio-economic conditions. Gaps remain in understanding sector-specific impacts, environmental trade-offs, rural inclusion challenges, and the precise mechanisms through which DFI translates into equitable economic outcomes. Future research should integrate micro-level behavioural insights, cross-country heterogeneities, and longitudinal impacts to better inform policies for inclusive and sustainable growth.

## 2. Methodology

Nigeria's experience with digital financial inclusion and quality growth between 2000 and 2024 is closely anchored to the National Financial Inclusion Strategy (NFIS), which serves as a central structural reform benchmark. Introduced in 2012, the NFIS aimed to reduce financial exclusion and expand access to payments, savings, credit, insurance, and pensions through both traditional and digital channels (CBN, 2024). Although Nigeria did not fully achieve its original inclusion targets by 2020, the strategy significantly reshaped the financial landscape

by prioritizing digital financial services (DFS) such as mobile banking, USSD, agent banking, and mobile money.

Empirical evidence suggests that digital financial channels have improved service quality and access, reinforcing the link between digital inclusion and the quality of economic growth (Kolawole et al., 2025). However, structural constraints, particularly low financial literacy, digital infrastructure gaps, and regional inequalities continue to limit the depth and sustainability of inclusion outcomes (Sam-Abugu et al., 2025). International assessments further emphasize that digital finance must be complemented by ecosystem reforms to translate inclusion into resilient and inclusive growth (Wezel & Ree, 2023).

This study employed a quantitative research design using time series data analysis to evaluate the impact of financial inclusion and financial technology on inclusive growth in Nigeria. The dataset spans 2000 to 2024 and was sourced from the World Bank, World Development Indicators (WDI). This study adapted the model in the study of Olanrewaju et al. (2023) with focus on financial inclusion and economic growth in Nigeria: assessing the role of fintech. The model is presented as follows:

$$INC = f(FIN, FINTECH, Z)$$

*where:* INC: inclusive growth, FINTECH: financial technology; FIN: financial inclusion; FINTECH*FIN: interaction term; Z represents the set of control variables (trade openness, gross capital formation, inflation, and the interest rate).

Given the mixture of order from the unit root result, this study employ Autoregressive Distributed Lag model by Pesaran et al. (2001) as it is appropriate when variables are a mixture of I(0) and I(1). Given the long run equation as:

$$INC_t = \beta_0 + \beta_1 FIN_t + \beta_2 FINTECH_t + \beta_3 FIN * FINTECH_t + \delta Z_t + \mu_t.$$

The short-run ARDL model with error correction can be written as:

$$\Delta INC_t = \alpha_0 + \sum_{i=1}^{k} \beta_1 \Delta INC_{t-1} + \sum_{i=1}^{k} \beta_2 \Delta FIN_{t-1} + \sum_{i=1}^{k} \beta_3 \Delta FINTECH_{t-1} + \sum_{i=1}^{k} \beta_4 \Delta FIN * FINTECH_{t-1} + \sum_{i=1}^{k} \beta_6 \Delta Z_{t-1} + \lambda_1 ECT_{t-1} + \varepsilon_t.$$

## 3. Result and Discussions

Table 1: Descriptive statistic results

| | INC | FINTECH | FIN | TRD | GCF | INF | INT |
|---|---|---|---|---|---|---|---|
| Mean | 0.3826 | 6.2932 | 0.0800 | 34.0960 | 13.5448 | 13.6686 | 11.6900 |
| Median | 0.6345 | 0.0434 | -0.2267 | 34.0000 | 12.0670 | 12.8768 | 11.500 |
| Max | 1.2093 | 73.986 | 7.3452 | 53.5000 | 21.0590 | 26.6586 | 27.500 |
| Min | -1.0556 | 0.0000 | -2.0112 | 15.0000 | 10.6900 | 5.3880 | 6.0000 |
| Std. Dev. | 0.6593 | 16.640 | 2.2599 | 10.8769 | 3.2218 | 5.1387 | 4.5037 |
| Skewness | -0.9929 | 3.2330 | 1.7386 | 0.04329 | 1.2414 | 0.7641 | 1.8000 |
| Kurtosis | 2.6552 | 12.771 | 5.8742 | 2.01355 | 3.0446 | 3.4221 | 7.2050 |
| Jarque-Bera | 4.2321 | 143.01 | 21.201 | 1.02140 | 6.4239 | 2.6187 | 31.920 |
| Prob | 0.1205 | 0.0000 | 0.0000 | 0.60001 | 0.0402 | 0.2699 | 0.0000 |

Note**:** *Inc* indicates inclusive growth, fintech: financial technology; *fin*: financial inclusion; *trd*: trade openness; *gcf*: gross capital formation; *inf*: inflation; *int*: interest rate

Source**:** Authors' computation, 2025

From the descriptive statistics result, inclusive growth has a mean of 0.38 compared to its wide spread from –1.06 to 1.21, indicating fluctuations in Nigeria's inclusiveness levels over time. Financial technology exhibits an especially large gap between its mean (6.29) and maximum (73.99), revealing periods of sharp technological expansion relative to long stretches of minimal activity. Financial inclusion has a low mean of 0.08 compared to its maximum of 7.35 and minimum of –2.01, suggesting uneven access to financial services. Trade openness shows a stable mean of 34.10, closely aligned with its minimum (15.00) and maximum (53.50), reflecting moderate variability. Gross capital formation's mean of 13.54 is nearer to its minimum (10.69) than its peak (21.06), implying generally low investment levels. Inflation and interest rates, with means of 13.67 and 11.69 respectively, fall within moderate ranges relative to their minimum and maximum values, indicating controlled but periodically volatile macroeconomic conditions.

Table 2: Unit root result

| Variables | LEVEL | | FIRST DIFF. | | Order |
|---|---|---|---|---|---|
| | Stats. | Prob. | Stats. | Prob. | |
| INC | -5.4568 | 0.000 | - | - | I(0) |
| FINTECH | - | - | -6.168 | 0.000 | I(1) |
| FIN | - | - | -3.5078 | 0.017 | I(1) |
| TRD | - | - | -6.2667 | 0.000 | I(1) |
| GCF | -3.2105 | 0.035 | - | - | I(0) |
| INF | - | - | -6.1054 | 0.000 | I(1) |
| INT | - | - | -6.4902 | 0.000 | I(1) |

Note: *Inc* indicates inclusive growth, *fintech*: financial technology; *fin*: financial inclusion; *trd*: trade openness; *gcf*: gross capital formation; *inf*: inflation; *int*: interest rate

Source: Author's computation, 2025

Given the mixture of order from the unit root result, this study employ Autoregressive Distributed Lag model by Pesaran et al. (2001) as it is appropriate when variables are a mixture of I(0) and I(1). Given the long run equation as:

$$INC_t = \beta_0 + \beta_1 FIN_t + \beta_2 FINTECH_t + \beta_3 FIN * FINTECH_t + \delta Z_t + \mu_t.$$

The short-run ARDL model with error correction can be written as:

$$\Delta INC_t = \alpha_0 + \sum_{i=1}^{k} \beta_1 \Delta INC_{t-1} + \sum_{i=1}^{k} \beta_2 \Delta FIN_{t-1} + \sum_{i=1}^{k} \beta_3 \Delta FINTECH_{t-1} + \sum_{i=1}^{k} \beta_4 \Delta FIN * FINTECH_{t-1} + \sum_{i=1}^{k} \beta_6 \Delta Z_{t-1} + \lambda_1 ECT_{t-1} + \varepsilon_t.$$

Table 3: ARDL result

| Dependent variable: INC | | | | |
|---|---|---|---|---|
| Variables | Co-efficient | Standard Error | T-statistics | P-value |
| Short Run Coefficient | | | | |
| INC(-1) | 0.6624 | 0.2218 | 3.1273 | 0.0522 |
| FINTECH | -0.0264 | 0.0152 | 1.7373 | 0.1807 |
| FIN | 0.8905 | 0.2301 | 3.8692 | 0.0305 |
| FINTECH*FIN | 0.0062 | 0.0027 | 2.2855 | 0.0354 |

| Variables | Co-efficient | Standard Error | T-statistics | P-value |
|---|---|---|---|---|
| TRD | 0.0099 | 0.0047 | 2.0735 | 0.1298 |
| GCF | -0.1432 | 0.0449 | -3.1903 | 0.0497 |
| INF | -0.0225 | 0.0093 | -2.4105 | 0.0950 |
| INT | -0.0242 | 0.0149 | -1.6229 | 0.2031 |
| Cointeq01 | -0.4655 | 0.1600 | -3.2932 | 0.0481 |
| Long Run Coefficient | | | | |
| FINTECH | -0.1042 | 0.0235 | -4.4322 | 0.0213 |
| FIN | 0.7914 | 0.0954 | 8.2915 | 0.0037 |
| FINTECH*FIN | 0.0127 | 0.0052 | 2.4288 | 0.0265 |
| TRD | 0.0055 | 0.0127 | 0.4344 | 0.0054 |
| GCF | -0.1764 | 0.0411 | -4.2859 | 0.0233 |
| INF | 0.0877 | 0.0466 | 1.8804 | 0.1566 |
| INT | -0.0750 | 0.1118 | -0.6716 | 0.0019 |

Note: *Inc* indicates inclusive growth, *fintech*: financial technology; *fin*: financial inclusion; *fintech**fin: interaction term; *trd*: trade openness; gcf: gross capital formation; *inf*: inflation; *int*: interest rate
Source: Authors' computation, 2025

Financial technology has no significant effect on inclusive growth in the short run for Nigeria. However, in the long run, it has a statistically significant negative effect with a coefficient of –0.1042, implying that a one-unit rise in fintech reduces inclusive growth in Nigeria by 10.42 percent over time. This suggests that while the country has experienced rapid growth in digital finance through mobile apps, digital transfers, POS usage, agency banking, the long-term economic gains is undermined by weak regulatory enforcement, cybersecurity vulnerabilities, financial fraud and low digital literacy which are common challenges in Nigeria's digital finance environment. This aligns with Osabutey & Jackson (2024) that highlighted that digital financial tools in many African countries often produce unequal benefits and may not consistently translate into broad economic gains. It also reflects the submission by Yang et al. (2025) and Mamun & László (2025) about long-run risks associated with digital finance when institutional frameworks are weak. In Nigeria's context, the negative long-run effect suggests that fintech expansion alone cannot drive sustained economic growth without strong governance and digital literacy improvements.

Financial inclusion exerts a significant effect on inclusive growth in Nigeria in both the short and long run. In the short run, the coefficient of 0.8905 indicates that a one-unit rise in financial inclusion increases inclusive growth by 89.05 percent. In the long run, the coefficient of 0.7914 means that, inclusive growth increases by 79.14 percent following a one-unit improvement in financial inclusion. These results show that expanding access to savings, loans, mobile banking, payment systems, and formal financial services produces immediate and sustained benefits for Nigeria's economy. This aligns strongly with Nkechika (2022) and Sam-Abugu et al. (2025) who found that access to formal finance improves household welfare, business formation, and income stability. The consistent positive effect across both periods confirms that strengthening financial inclusion remains one of the clearest pathways for Nigeria's economic expansion.

The interaction between financial technology and financial inclusion is significant in both the short and long run in Nigeria. In the short run, the coefficient of 0.0062 means that a one-unit increase in the effect of fintech in the relationship between financial inclusion and inclusive growth in Nigeria raises by 0.62 percent. In the long run, the coefficient of 0.0127 indicates an even stronger effect, increasing inclusive growth by 1.27 percent. This shows that fintech yields inclusive economic benefits in Nigeria only when it operates through or enhances financial inclusion, rather than functioning independently. This outcome reflects the argument made by Chen et al. (2025), who explained that digital inclusive finance improves resource allocation and entrepreneurial activity. It also aligns with Sha'ban et al. (2024), who found that digital financial inclusion reinforces traditional financial services over time. In the Nigerian context, the positive combined effect suggests that digital tools such as USSD banking, mobile apps, POS networks, and agency banking contribute to inclusive growth only when they are effectively integrated into wider financial inclusion efforts, especially in rural and underserved areas.

Trade openness shows no significant effect on inclusive growth in the short run for Nigeria. In the long run, however, it becomes significant with a coefficient of 0.0055, indicating that a one-unit increase in trade openness increases inclusive growth in Nigeria by 0.55 percent. This suggests that Nigeria's engagement with global markets, including oil exports, agricultural products, and manufactured imports, takes time to translate into meaningful inclusive economic gains. It supports findings from global studies such as Pal et al. (2025), which emphasized that trade contributes to long-run performance through technology diffusion and competitive efficiency. In Nigeria's context, long-run gains from trade may arise from improved foreign exchange inflows, increased market access, and long-term restructuring of industries exposed to international competition.

Gross capital formation shows significant negative effects in both the short and long run. The short-run coefficient of –0.1432 means that a one-unit increase in GCF reduces inclusive growth in Nigeria by 14.32 percent. In the long run, the effect becomes even more negative, with a coefficient of –0.1764, indicating that GDP falls by 17.64 percent following an increase in capital formation. This counterintuitive result suggests that Nigeria's investment spending is inefficiently allocated or affected by corruption, project abandonment, cost overruns and infrastructural bottlenecks. This outcome aligns with Oanh (2024), who observed similar negative investment effects in countries where institutional weaknesses hinder productive absorption of capital. It also resonates with Meniago (2025), who emphasized that poor governance reduces the effectiveness of capital-related economic reforms. In Nigeria's case, the result indicates that increases in capital spending do not automatically yield growth unless accompanied by institutional reforms to ensure efficiency and transparency.

Inflation has a marginally significant negative effect on Nigeria's GDP in the short run, with a coefficient of –0.0225, meaning that a one-unit rise in inflation reduces GDP by 2.25 percent. This is consistent with Nigeria's macroeconomic reality where rising prices weaken household purchasing power, reduce production capacity, and undermine investment. Studies such as Verma & Chatterjee (2025) also noted that inflation erodes financial resilience and reduces the ability of households to save or invest. In the long run, inflation becomes insignificant, indicating that while inflation shocks disrupt the economy in the short term, their effect tends to fade once long-run adjustments occur.

The interest rate does not significantly affect inclusive growth in Nigeria in the short run. However, in the long run, the effect becomes significantly negative with a coefficient of –0.0750, meaning that a one-unit increase in interest rate reduces GDP by 7.5 percent. This reveals that prolonged high lending rates in Nigeria discourage private investment, raise the cost of production, suppress credit access for small businesses, and ultimately weaken economic growth. This result corresponds with Nnaomah et al. (2024), who found that restrictive monetary environments in Nigeria inhibit business expansion.

Table 4: Post diagnostic test

| Test Statistics | Test Types | Values | Prob. | | |
|---|---|---|---|---|---|
| Normality Test | Jarque-Bera | 0.4518 | 0.7977 | | |
| Wald Test | F-statistic | 9.9493 | 0.0022 | | |
| F-Bounds Test | F-statistic | 13.8981 | | I(0) | I(1) |
| | K | 6 | 5% | 2.45 | 3.61 |
| Breusch-Godfrey Serial Correlation LM Test | F-statistic | 4.4640 | 0.3174 | | |
| Heteroskedasticity Test: Breusch-Pagan-Godfrey | F-statistic | 0.6129 | 0.7827 | | |

Source: Authors' computation, 2025

The post-diagnostic test results revealed that the normality test, based on the Jarque–Bera statistic indicates that the residuals are normally distributed, the Wald test result, with an F-statistic of 9.9493 and a p-value of 0.0022, confirms that the jointly tested parameters are statistically significant, validating the relevance of the explanatory variables used in the model. The ARDL bounds test further reinforces the robustness indicating that there is strong evidence of a long-run cointegration relationship among the variables. The Breusch-Godfrey LM test for serial correlation suggests the absence of serial correlation in the residuals, meaning the model does not suffer from autocorrelation and the estimated coefficients are efficient. Similarly, the Breusch-Pagan-Godfrey test for heteroskedasticity yields an F-statistic of 0.6129 with a p-value of 0.7827, implying that the variance of the error terms is constant and the model is free from heteroskedasticity.

## Conclusion and Recommendations

Financial inclusion consistently demonstrates positive effects on inclusive growth, reflecting the capacity of expanded access to savings, credit, and payment systems to boost productivity, entrepreneurial activity and household welfare. While financial technology on its own does not generate short-run gains and exhibits a negative long-run effect, its interaction in the nexus between financial inclusion and inclusive growth produces positive outcomes, indicating that digital financial tools only translate into sustainable economic growth when embedded within a robust and inclusive financial system. Trade openness contributes positively to inclusive growth in the long-run, suggesting that Nigeria's integration into global markets supports growth, albeit with a delayed effect. Gross capital formation shows persistent negative impacts in both time horizons, highlighting inefficiencies in investment allocation, infrastructural bottlenecks or institutional weaknesses. Inflation exerts a marginal short-run contractionary effect, while high interest rates significantly dampen long-run inclusive growth, reflecting structural constraints in credit markets and the cost of finance.

The findings indicate that digital inclusivity, anchored in the integration of financial technology with broad-based financial inclusion, functions as a critical long-term buffer for financial sustainability in Nigeria amid currency volatility. While fintech expansion alone undermines inclusive growth in the long run, its interaction with financial inclusion significantly enhances economic resilience. This suggests that digitally enabled access to formal financial services strengthens households' and firms' ability to absorb exchange rate shocks, maintain transactions, and stabilize savings. From a policy perspective, prioritizing digital literacy, regulatory oversight, and inclusive fintech deployment is essential to ensure that digital finance supports macroeconomic stability rather than amplifying financial fragility.

Similarly, to sustain digital inclusion, strong governance and regulatory oversight are essential. Strong digital governance ensures affordable access, fair competition, and consumer protection in digital finance. Weak oversight limits job creation and productive use of remittances, undermining SDG 8 on inclusive growth and SDG 10 by widening inequalities through unequal digital access.

From these conclusions, several policy recommendations emerge. First, government and regulatory agencies should prioritize expanding financial inclusion across urban and rural areas, combining traditional banking services with digital financial technologies, ensuring that fintech platforms enhance rather than replace inclusive access. Second, digital financial technology should be supported by robust regulatory frameworks, cybersecurity measures, and financial literacy programs to mitigate long-run negative effects and maximize synergies with financial inclusion. Third, public and private investment in capital formation should focus on efficiency, transparency, and project execution to ensure that resources translate into productive output, reducing the persistent negative impact observed. Fourth, trade policies should aim to deepen integration into global markets, support domestic competitiveness and encourage export diversification, enabling long-run benefits of trade openness. Fifth, monetary policy should seek to stabilize inflation and maintain interest rates at levels that encourage investment and credit access, without creating financial strain on households or firms.

## CRediT Authorship Contribution Statement

Adekunle Christopher Williams: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft; Gbenro Matthew Sokunbi: Methodology, Data curation, Validation, Writing – review & editing; Comfort Amire: Formal analysis, Visualization, Writing – review & editing.

All authors reviewed and approved the final version of the manuscript and agreed to be accountable for the integrity of the work.

## Conflict of Interest Statement

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.

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N/A

## Data Availability Statement

The data that support the findings of this study were sourced from World Bank, World Development Indicators, with the dataset spans 2000 to 2024.

## Ethical Approval Statement

Ethical approval was waived by WDI (where the data was sourced from) due to the use of anonymised secondary data and the retrospective nature of the study.

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