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FINTECH PENETRATION AND FINANCIAL DEEPENING IN NIGERIA: AN ARDL ANALYSIS OF THE DIGITAL CREDIT CHANNEL

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ABSTRACT

Has the rapid spread of mobile and internet connectivity in Nigeria translated into deeper formal bank credit? To answer this, mobile cellular subscriptions and internet use, two World Development Indicators series that move closely in tandem, are condensed by principal component analysis into a Fintech Penetration Index that retains 98 per cent of their joint variance. An Autoregressive Distributed Lag bounds test is then applied to the index and bank credit to the private sector over 1996-2023 (the longest period for which all of the required series are continuous), with GDP growth, inflation and personal remittances as controls. Cointegration is confirmed ($F = 8.47$), and the error-correction coefficient of -0.75 implies that most of any deviation from the long-run relationship is closed within a year. Only remittances, and more tentatively GDP growth, carry a significant long-run coefficient; the fintech index is insignificant in both the long and the short run. An interaction model shows that the already weak fintech-credit link weakened further after the Central Bank of Nigeria's 2012 cashless policy and National Financial Inclusion Strategy. The results are read against Nigeria's mobile money framework, which did not allow mobile network operators to lead mobile money schemes, unlike the operator-led model behind Kenya's M-Pesa, and a significant Ramsey RESET statistic is reported as a specification concern for later work. Consequently, digital connectivity alone will not deepen formal bank credit in Nigeria. Rather, to convert connectivity gains into financial deepening, the focus should be on policies that connect digital users to deposit and lending relationships, while leveraging fintech transaction data for credit scoring.

Keywords: Fintech, Financial Deepening, Mobile Penetration, Internet Penetration

1 INTRODUCTION

Nigeria's telecommunications sector has undergone one of the most rapid transformations of any infrastructure sector in the country's recent history. Mobile cellular subscriptions rose from effectively zero in the early 1990s to over 99 subscriptions per 100 people by 2022, while the share of the population using the internet rose from under one per cent in 2001 to over 39 per cent by 2022 (World Bank, 2026). This expansion followed the liberalisation of the telecommunications sector and the award of GSM licences in 2001, and has since underpinned the growth of mobile banking applications, point-of-sale agents, digital wallets and a fast-growing fintech start-up sector.

Financial deepening, measured here as domestic credit to the private sector extended by banks relative to GDP, has not kept pace with this digital expansion. Over the same period, the ratio moved from around 5 per cent of GDP in the mid-

1990s to a peak of under 20 per cent in 2009, before drifting down to below 10 per cent by the early 2020s (World Bank, 2026). This divergence between rapid digital connectivity growth and comparatively shallow formal credit markets motivates the central question addressed in this study: has the growth of mobile and internet penetration, treated jointly here as a proxy for the underlying fintech channel, actually deepened Nigeria's formal banking sector, and has that relationship been altered by the regulatory push that followed the Central Bank of Nigeria's 2012 cashless policy and National Financial Inclusion Strategy?

The literature on fintech and financial inclusion in Nigeria is large and growing (Ozili, 2022; Del Sarto & Ozili, 2025), and much of it documents rising account ownership and digital transaction volumes. Comparatively less attention has been paid to whether this digital expansion has deepened the formal bank credit market specifically, as distinct from broader measures of account ownership or payment activity, and whether Nigeria's distinctive regulatory model for mobile money has shaped that relationship. The Central Bank of Nigeria's framework permitted bank-led and non-bank-led mobile money schemes but stated explicitly that the telco-led model, in which a mobile network operator is the lead initiator, would not be operational in Nigeria (Central Bank of Nigeria, 2015), in contrast with the operator-led M-Pesa model that underpinned Kenya's gains (Jack & Suri, 2014).

A separate, long-running strand of empirical literature has examined the conventional determinants of private credit without reference to digital finance, emphasising creditor rights, credit information sharing and macroeconomic stability (Djankov, McLiesh & Shleifer, 2007; Boyd, Levine & Smith, 2001). This study brings the two strands together by testing whether a digital, fintech-specific channel adds explanatory power to financial deepening once conventional drivers, proxied here by GDP growth, inflation and remittances, are held constant.

At the continental level, whether mobile money and digital finance complement or substitute for formal bank credit remains an unsettled empirical question. Using panel ARDL methods for four Sub-Saharan African regions, Tembo (2023) found that growth in mobile money accounts and transactions was associated in the long run with fewer bank accounts, branches and automated teller machines but with more private sector credit and larger total bank assets, which the author reads as evidence of substitution and complementarity operating at once. Mashamba and Gani (2024), using system GMM for 19 Sub-Saharan African economies over 2013–2019, found that the sign depends on measurement: total alternative credit, combining fintech and big tech lending, is negatively associated with bank lending, whereas fintech credit alone is positively associated with it. Mundonde and Makoni (2026) report a positive long-run, but insignificant short-run, effect of mobile money on bank credit to the private sector across five Sub-Saharan African regions over 2012–2024. This unresolved debate is a central motivation for testing the fintech-credit relationship directly for Nigeria, rather than assuming a particular sign in advance.

This study addresses these gaps using an index of fintech penetration constructed directly from mobile and internet infrastructure data and an ARDL bounds-testing framework capable of separating long-run and short-run dynamics.

2 LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Fintech and Digital Penetration

Financial technology, or fintech, refers to the use of digital technology to deliver financial services, often outside or alongside traditional bank branches (Philippon, 2016). Mobile cellular and internet penetration are widely used as infrastructure proxies for the reach of these services, since mobile banking applications, USSD banking, point-of-sale agency banking and digital lending platforms all depend on the underlying telecommunications network. Across African countries, internet and mobile phone diffusion are associated with greater financial inclusion (Evans, 2018). In Nigeria specifically, recent evidence identifies mobile money as the main digital channel driving financial inclusion, with automated teller machines, point-of-sale terminals and web banking reaching new users far less effectively (Akinjare, Obabueki & Omankhanlen, 2026).

2.1.2 Financial Deepening

Financial deepening describes the growth of the formal financial sector relative to the size of the economy, commonly measured by the ratio of private-sector bank credit to GDP (Levine, 1997; Beck, Demirgüç-Kunt & Levine, 2000). A deeper financial sector is associated with a greater capacity to mobilise savings and allocate them to productive investment. Financial deepening is conceptually distinct from financial inclusion, which concerns the breadth of access to financial services across the population; a country can experience growth in the number of digital or mobile wallet users without a corresponding increase in formal bank credit intermediation, particularly where new accounts are used mainly for payments and transfers rather than for saving or borrowing (Demirgüç-Kunt, Klapper, Singer & Ansar, 2022).

2.1.3 Remittances as a Digital-Adjacent Channel

Personal remittances, increasingly routed through digital and mobile money transfer corridors, represent a channel through which international financial flows can support domestic financial deepening, either by being deposited directly into the banking system or by freeing up household resources for formal saving. Cross-country evidence shows that remittances are positively associated with bank deposits and credit relative to GDP in developing countries (Aggarwal, Demirgüç-Kunt & Martínez Pería, 2011). Remittance inflows to Nigeria have at times exceeded five per cent of GDP and are included in this study as a control variable with a plausible direct link to both digital finance and formal credit markets.

2.1.4 Macroeconomic Controls

GDP growth and inflation are included as standard macroeconomic controls. Economic growth expands the pool of creditworthy borrowers and bankable economic activity, while inflation erodes the real value of credit; cross-country evidence shows that economies with higher inflation tend to have smaller and less active banking sectors (Boyd, Levine & Smith, 2001).

2.2 Empirical Review

2.2.1 Fintech and Financial Inclusion in Nigeria

Recent Nigerian evidence documents a positive association between digital channels and financial inclusion. Akinjare, Obabueki and Omankhanlen (2026) find, using Granger causality methods, that mobile money is the main digital channel driving financial inclusion in Nigeria, with automated teller machines, point-of-sale terminals and web banking reaching new users far less effectively. At the continental level, Evans (2018) finds that the diffusion of the internet and mobile phones is associated with greater financial inclusion in Africa.

Ozili (2022) used Global Findex data to show that several Nigerian financial inclusion indicators improved in 2014 but that the gains were not sustained by 2017, leaving Nigeria's level of financial inclusion very low relative to the world average, a pattern broadly consistent with the weak long-run fintech coefficient obtained in the present study. Ozili (2024) compared Nigeria with Sub-Saharan Africa and the world, and found that Nigeria outperformed the regional average on three of six financial inclusion indicators, but that both Nigeria and the region exceeded the world average for informal borrowing, a sign that formal credit remains comparatively shallow. In an IMF country study, Wezel and Ree (2023) find that Nigeria has made clear gains in bringing residents into the banking sector, but that financial exclusion remains above official targets and that digital financial services, especially mobile money, are used less than in peer countries. The regulatory setting is relevant to this comparison, since Nigeria's mobile money framework excluded the operator-led model that drove Kenya's adoption (Central Bank of Nigeria, 2015; Jack & Suri, 2014).

2.2.2 The Cashless Policy and Banking Sector Performance

Studies of the Central Bank of Nigeria's cashless policy, introduced from January 2012, focus mainly on payments and growth rather than on credit. Using an ARDL model and quarterly data for 2009-2020, Oniore and Efayena (2023) find a long-run relationship between electronic transactions and economic growth in Nigeria. Whether gains in payment activity also deepen bank credit is a separate question, and the empirical literature supports treating the post-2012 period as a distinct regulatory regime worth testing explicitly, rather than assuming that fintech penetration has a constant effect on financial deepening throughout the sample period.

2.2.3 Mobile Money, Fintech Credit and Bank Lending Across Africa

Jack and Suri (2014), in one of the foundational studies of mobile money's economic effects, used panel data from Kenya to show that M-Pesa adoption improved households' ability to share risk and smooth consumption following income shocks, establishing early evidence that mobile money's economic value lies substantially in its transactional and risk-sharing function rather than necessarily in expanding formal bank credit directly; Suri and Jack (2016) later showed that access to M-Pesa lifted around 2 per cent of Kenyan households out of poverty. A growing cross-country literature has since asked whether mobile money and fintech credit complement or substitute for conventional bank lending. Using panel ARDL methods across four Sub-Saharan African regions, Tembo (2023) found that growth in active mobile money accounts was associated with a long-run decline in bank accounts, branches and automated teller machines, but with a simultaneous long-run increase in private sector credit and total bank assets. Marco and Perez-Saiz (2026) found that bank concentration favours the adoption of mobile money, that greater bank competition promotes both traditional and mobile financial inclusion, and that mobile money complements formal banking in countries with shallow financial systems. Mashamba and Gani (2024) found that total alternative credit is negatively associated with bank lending in Sub-Saharan Africa while fintech credit alone is positively associated with it, and that fintech lending growth has a negative net effect on bank lending when banks shrink their branch networks. Mundonde and Makoni (2026) report a

positive long-run effect of mobile money on bank credit to the private sector across five Sub-Saharan African regions. The weight of the regional evidence therefore leans towards complementarity, but with clear conditions attached.

2.2.4 Conventional Determinants of Private Sector Credit in Nigeria

A separate, longer-standing empirical literature models private credit using conventional macro-financial and institutional determinants. Across 129 countries, Djankov, McLiesh and Shleifer (2007) find that stronger creditor rights and the presence of credit information sharing institutions are associated with higher ratios of private credit to GDP. Boyd, Levine and Smith (2001) show that higher inflation is associated with smaller, less active and less efficient banking sectors, which motivates the inflation control used here. On the growth side, King and Levine (1993) found that financial depth predicts subsequent growth, but Rousseau and Wachtel (2011) show that the growth effect of financial deepening has weakened in more recent data. Arcand, Berkes and Panizza (2015) find that finance begins to have a negative effect on output growth when credit to the private sector exceeds about 100 per cent of GDP, a level far above Nigeria's ratio of under 20 per cent. These findings reinforce the policy relevance of understanding what actually drives the credit-to-GDP ratio this study treats as its dependent variable.

2.2.5 Methodological Precedent for the Composite Index Approach

The use of principal component analysis to combine correlated digital or financial indicators into a single composite index, as applied to mobile and internet penetration in this study, follows an established methodological tradition in the financial inclusion literature. Sarma (2008) pioneered composite index construction for cross-country financial inclusion comparison, while Camara and Tuesta (2014) extended this tradition through a two-stage principal component analysis that derives data-driven weights for aggregating access, availability and usage indicators, rather than imposing arbitrary weights; precisely the concern that motivates the principal-component approach to the Fintech Penetration Index constructed in Section 3.3.

2.3 Theoretical Framework

2.3.1 Schumpeterian Finance-Growth Theory

Schumpeter's (1911) finance-growth theory, later formalised by King and Levine (1993), holds that a well-functioning financial sector mobilises savings, allocates capital to its most productive uses and thereby supports economic growth. Applied to this study, the theory implies that any technology, including mobile and internet infrastructure, should be judged by whether it genuinely deepens financial intermediation rather than merely expanding the number of accounts or transactions recorded.

2.3.2 Diffusion of Innovation Theory

Rogers' (2003) Diffusion of Innovation Theory describes the characteristic S-shaped adoption curve through which a new technology spreads through a population, from early adopters through a rapid majority-adoption phase to eventual saturation. The trajectory of Nigeria's mobile and internet penetration data closely follows this pattern, with a slow start in the 1990s, rapid growth from the early 2000s, and a flattening of the growth rate as penetration approaches the upper bound of the population, which provides the conceptual justification for treating the two series as reflecting a single underlying diffusion process captured by the Fintech Penetration Index.

2.3.3 Digital Financial Inclusion Theory

Ozili's (2018) Digital Financial Inclusion Theory argues that digital finance channels, including mobile money, internet banking and agent banking, can extend financial access at a lower cost than traditional branch banking, but that the realised benefit depends heavily on the surrounding regulatory and infrastructural environment. This theory directly motivates the study's interaction model, since it implies that the same growth in digital infrastructure can translate into different financial deepening outcomes depending on the prevailing regulatory regime, such as Nigeria's bank-led mobile money framework and its 2012 cashless policy and National Financial Inclusion Strategy.

3 METHODOLOGY

3.1 Data Sources

Every series comes from the World Bank's World Development Indicators (World Bank, 2026; extract of 13 July 2026) for Nigeria, and the sample runs from 1996 to 2023, the longest period for which all of the required series are continuous. The series, with their indicator codes, are domestic credit to private sector by banks, per cent of GDP; mobile cellular subscriptions, per 100 people; individuals using the internet, per cent of population; GDP growth, annual per cent; inflation, consumer prices, annual per cent; and personal remittances received, per cent of GDP.

3.2 Construction of the Fintech Penetration Index

Mobile cellular subscriptions and internet usage are highly correlated over the sample period ($r = 0.97$), reflecting their shared dependence on the same underlying telecommunications infrastructure rollout. Entering both variables separately into a single regression model produces severe multicollinearity and unstable coefficient estimates. To address this, the two standardised series are combined through principal component analysis into a single Fintech Penetration Index (FTI). The first principal component carries equal loadings on both series (0.707 each) and explains 98.4 per cent of their combined variance, confirming that a single underlying digital-penetration factor adequately summarises both series. The index is rescaled to range from 0 in 1996 to 100 in 2023 for ease of interpretation.

3.3 Model Specification

The long-run and short-run relationship between financial deepening and fintech penetration is estimated using an Autoregressive Distributed Lag (ARDL) bounds-testing model, specified in unrestricted error-correction form:

$$\Delta DCPS_t = \beta_0 + \varphi DCPS_{t-1} + \theta_1 FTI_{t-1} + \theta_2 GDPG_{t-1} + \theta_3 INFL_{t-1} + \theta_4 REM_{t-1} + \sum_{i=1}^p \gamma_i \Delta X_{t-i} + \varepsilon_t \quad 1$$

Where DCPS is domestic credit to the private sector by banks, FTI is the Fintech Penetration Index, GDPG is GDP growth, INFL is inflation, REM is personal remittances received, φ is the error-correction speed of adjustment, and the θ coefficients represent the long-run relationship once normalised by $-\varphi$.

A second, complementary model tests whether the relationship between fintech penetration and financial deepening shifted after the Central Bank of Nigeria's cashless policy and National Financial Inclusion Strategy, both dated from 2012. Because the dynamic ARDL specification cannot support the additional interaction parameters within the available sample without exhausting the degrees of freedom, this question is addressed with a static regression using heteroskedasticity- and autocorrelation-consistent (HAC) standard errors:

$$DCPS_t = \beta_0 + \beta_1 FTI_t^c + \beta_2 GDPG_t + \beta_3 INFL_t + \beta_4 REM_t + \beta_5 POLICY_t + \beta_6 (FTI^c \times POLICY)_t + \varepsilon_t \quad 2$$

Where FTI^c is the Fintech Penetration Index centred on its sample mean to reduce mechanical collinearity with the interaction term, and POLICY is a dummy variable equal to 1 for 2012 and later, and 0 otherwise.

3.4 Description of Model Variables

DCPS, the dependent variable, is bank credit to the private sector as a share of GDP. FTI denotes the Fintech Penetration Index; GDPG is real GDP growth, INFL is consumer price inflation and REM is personal remittances received as a share of GDP. POLICY equals one from 2012 onward, marking the cashless-policy regime, and $FTI \times POLICY$ (or $FTI^c \times POLICY$) interacts it with the centred fintech index.

3.5 Analytical Procedures

The Augmented Dickey-Fuller and Kwiatkowski-Phillips-Schmidt-Shin tests are used to establish the order of integration of each series. The ARDL bounds-testing procedure of Pesaran, Shin and Smith (2001) is then applied to the unrestricted error-correction model, with lag orders selected by the Akaike Information Criterion subject to a maximum lag of two, appropriate for the annual frequency and sample size. Diagnostic tests reported include the autoregressive conditional heteroskedasticity Lagrange multiplier test, the Jarque-Bera normality test, the Durbin-Watson and Ljung-Box serial correlation statistics, the Ramsey Reset specification test, and the Cumulative Sum (CUSUM) test of parameter stability. The interaction model is estimated by ordinary least squares with Newey-West heteroskedasticity- and autocorrelation-consistent standard errors (two lags), and variance inflation factors are reported to flag the multicollinearity inherent in interaction specifications.

4 RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 1: Descriptive statistics, 1996-2023 (N = 28)

Variable	Mean	Median	Std. Dev.	Minimum	Maximum
DCPS (% GDP)	10.64	9.68	3.34	6.15	19.60
FTI (index, 0-100)	40.05	37.19	35.53	0.00	100.00
GDPG (%)	4.50	4.67	3.94	-6.37	15.33
INFL (%)	13.20	12.38	5.41	5.39	29.27
REM (% GDP)	3.72	3.83	2.20	0.16	8.33

Table 1 shows that over 1996-2023 (N = 28), domestic credit to the private sector by banks averaged 10.64 per cent of GDP (median 9.68, standard deviation 3.34), ranging from 6.15 to 19.60 per cent. The Fintech Penetration Index is highly dispersed, from 0.00 to 100.00 (mean 40.05, standard deviation 35.53), reflecting negligible mobile and internet penetration in the early years followed by near-saturation values toward the end of the sample. GDP growth averaged 4.50 per cent but fell as low as -6.37 per cent, inflation averaged 13.20 per cent with a maximum of 29.27 per cent, and remittances averaged 3.72 per cent of GDP, ranging from 0.16 to 8.33 per cent.

4.2 Unit Root Tests

Table 2: Augmented Dickey-Fuller unit root test

Variable	Level (t-stat)	1st Diff. (t-stat)	Order of Integration
DCPS	-3.107**	-	I(0)
FTI	0.912 (c) / -3.056 (ct)	-3.756***	I(1)
GDPG	-1.106	-4.457***	I(1)
INFL	-0.517	-1.392 (borderline)	I(1), low power
REM	-2.275	-4.975***	I(1)

*** $p < 0.01$, ** $p < 0.05$. Specifications: (c) intercept only; (ct) intercept and linear trend. KPSS tests corroborate the DCPS I(0) and FTI/GDPG/REM I(1) classifications; the inflation series shows mixed ADF/KPSS evidence in this small sample and is treated as I(1) consistent with its established behaviour in the Nigerian inflation literature. No series is I(2), which supports the use of the ARDL bounds-testing procedure.

Table 2 shows that domestic credit to the private sector is stationary in levels, I(0), while the Fintech Penetration Index, GDP growth, inflation and remittances are each integrated of order one, I(1). Because the order of integration is mixed and no series is I(2), the ARDL bounds-testing procedure is the appropriate method for testing cointegration among them.

4.3 ARDL Bounds Test for Cointegration

Table 3: ARDL bounds test for cointegration

F-statistic	I(0) bound (5%)	I(1) bound (5%)	Conclusion
8.47	2.86	4.01	Cointegration confirmed

Table 3 shows that the computed F-statistic of 8.47 exceeds the upper I(1) bound at the 5 per cent level (and the 1 per cent upper bound of 5.06), providing strong evidence of a long-run cointegrating relationship between financial deepening, fintech penetration, GDP growth, inflation and remittances.

4.4 Long-Run and Short-Run Estimates

Table 4: Long-run coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value
FTI	0.030	0.023	1.282	0.200
GDPG	0.296	0.174	1.695	0.090
INFL	-0.198	0.167	-1.187	0.235
REM	1.120	0.270	4.150	0.000

Table 4 shows that remittances carry the only statistically significant long-run coefficient (1.120, $p < 0.001$): a one percentage point rise in remittances as a share of GDP is associated with a 1.12 percentage point rise in domestic credit to the private sector. GDP growth is positive and significant only at the 10 per cent level (0.296, $p = 0.090$), while the Fintech Penetration Index (0.030, $p = 0.200$) and inflation (-0.198, $p = 0.235$) are not statistically distinguishable from zero in the long run.

Table 5: Short-run (error-correction) estimates

Variable	Coefficient	Std. Error	t-statistic	p-value
ECT (DCPS.L1)	-0.751	0.119	-6.324	0.000
$\Delta DCPS.L1$	0.664	0.160	4.143	0.001
ΔFTI	-0.176	0.123	-1.429	0.175
$\Delta GDPG$	-0.001	0.123	-0.010	0.992
$\Delta INFL$	0.064	0.088	0.726	0.480
ΔREM	0.337	0.230	1.461	0.166
$\Delta REM.L1$	-0.494	0.250	-1.975	0.068
Constant	5.518	1.458	3.785	0.002

Model: ARDL(2,1,1,1,2), $N = 26$, $R^2 = 0.814$, AIC = 100.84, BIC = 117.20.

Table 5 shows an error-correction term of -0.751 that is negative, less than one in absolute value, and highly significant ($p < 0.001$), confirming the cointegrating relationship found in Table 3 and implying that about 75 per cent of any deviation from long-run equilibrium in domestic credit is corrected within a year. None of the short-run fintech, GDP growth or inflation terms is significant, and only the lagged change in domestic credit itself and the level and first lag of remittances approach or reach significance, indicating that the adjustment back to equilibrium is driven mainly by credit's own dynamics and by remittance flows rather than by fintech penetration.

4.5 Diagnostic Tests

Table 6: Diagnostic summary

Test	Statistic	p-value	Verdict
ARCH-LM heteroskedasticity (lag 2)	0.613	0.736	No heteroskedasticity
Jarque-Bera normality	1.715	0.424	Residuals normal
Durbin-Watson	2.37	-	No evidence of autocorrelation
Ljung-Box (lag 2)	1.731	0.421	No serial correlation
Ramsey Reset	8.035	0.009	Misspecification flagged
CUSUM stability	1.287	0.073	Stable at 5%, borderline at 10%

Table 6 shows that the ARDL model passes most standard diagnostic checks: there is no evidence of ARCH-type heteroskedasticity ($p = 0.736$), the residuals are normally distributed (Jarque-Bera $p = 0.424$), and the Durbin-Watson statistic (2.37) together with the Ljung-Box test ($p = 0.421$) indicate no serial correlation. The Ramsey Reset test, however, is significant ($p = 0.009$), flagging possible misspecification of the linear functional form, and the CUSUM statistic is stable at the 5 per cent level but only borderline at 10 per cent, suggesting some parameter instability that is addressed directly in the regulatory-regime interaction model that follows.

4.6 Regulatory Regime Interaction Model

Table 7: Post-2012 regulatory regime interaction, OLS with HAC standard errors (N = 28)

Variable	Coefficient	Std. Error	z-statistic	p-value
Constant	12.696	3.674	3.456	0.001
FTI (centred)	0.153	0.081	1.894	0.058
GDPG	0.107	0.084	1.273	0.203
INFL	0.027	0.069	0.383	0.701
REM	0.224	0.395	0.566	0.571
POLICY (post-2012)	-1.395	2.231	-0.625	0.532
FTI (centred) $\times$ POLICY	-0.201	0.109	-1.840	0.066

$R^2 = 0.497$, Adjusted $R^2 = 0.353$, $F(6,21) = 6.574$, $p = 0.0005$. Variance inflation factors for FTI (centred) and the interaction term are 16.7 and 13.2 respectively, reflecting the structural collinearity between a strongly trending index and a late-sample policy dummy; this is reported as a limitation in Section 6.

Table 7 shows that before 2012, a one-point rise in the Fintech Penetration Index is associated with a 0.153 percentage point increase in domestic credit to the private sector by banks, significant at the 10 per cent level. The interaction term is negative and also significant at the 10 per cent level, implying that from 2012 onward the marginal association between fintech penetration and bank credit fell to approximately -0.05 ($0.153 - 0.201$), statistically indistinguishable from zero. In other words, the modest positive link between digital penetration and formal bank credit that existed before the cashless policy and National Financial Inclusion Strategy appears to have disappeared afterwards.

5 DISCUSSION

The central finding, that the Fintech Penetration Index carries no significant long-run or short-run association with domestic bank credit to the private sector, and that the regulatory period most associated with Nigeria's digital finance push coincides with a weakening rather than a strengthening of that association, is consistent with a specific strand of the literature on Nigeria's fintech trajectory. Nigeria's mobile money framework excluded the operator-led model that drove Kenya's M-Pesa adoption (Central Bank of Nigeria, 2015), while an IMF country study found that mobile money remains less used in Nigeria than in peer countries (Wezel & Ree, 2023). Under Ozili's (2018) account of digital financial inclusion, the benefit of digital infrastructure growth is conditional on the surrounding regulatory environment; the results here are consistent with a reading in which Nigeria's digital expansion has been real and rapid at the infrastructure level, captured faithfully by the Fintech Penetration Index, but has not been matched by an equivalent deepening of formal, bank-intermediated credit, plausibly because much of the growth in mobile and internet use has flowed into payments, transfers and non-bank digital wallets rather than into deposit-taking and lending relationships with licensed banks.

Remittances stand out as the only variable with a strong, unambiguous long-run relationship with financial deepening (coefficient 1.120, $p < 0.001$), suggesting that formally recorded cross-border transfers, an increasing share of which moves through digital channels, continue to feed more directly into the banking system than domestic fintech activity does. GDP growth carries a positive long-run coefficient significant at the 10 per cent level, consistent with the Schumpeterian expectation that a larger, faster-growing economy generates more bankable credit demand, while inflation's negative but statistically insignificant coefficient is broadly consistent with, if not strong support for, the view that price instability discourages long-term bank lending.

The finding also speaks directly to the substitution-versus-complementarity debate reviewed in Section 2.2.3. The absence of a significant long-run fintech-credit relationship, combined with the further weakening of even that weak association after 2012, sits closer to the substitution evidence, such as the negative association between total alternative credit and bank lending reported by Mashamba and Gani (2024), than to the complementary patterns found at the regional level by Tembo (2023), Marco and Perez-Saiz (2026) and Mundonde and Makoni (2026). One plausible

reconciliation is that the complementary effects documented elsewhere in the region depend on conditions, such as bank-fintech interoperability and maintained branch networks, that were comparatively underdeveloped in Nigeria for much of the sample period.

Two results mitigate these conclusions and are reported transparently rather than omitted. First, the Ramsey Reset test is significant ($p = 0.009$), indicating that the linear ARDL specification may not fully capture the underlying dynamics, possibly reflecting a genuine nonlinearity in the fintech-credit relationship, or a structural break around the 2012 policy shift that the dynamic model does not explicitly accommodate. Second, the interaction model's variance inflation factors exceed conventional thresholds, a near-unavoidable consequence of interacting a strongly trending index with a late-sample step dummy in a 28-observation annual series; the coefficients should accordingly be read as suggestive rather than conclusive. Both issues point toward the same methodological next step, discussed in Section 6.

6 CONCLUSION AND POLICY RECOMMENDATIONS

This study set out to test whether Nigeria's rapid growth in mobile and internet penetration, treated as a fintech infrastructure proxy, has deepened the country's formal bank credit market. Using a composite Fintech Penetration Index built from highly correlated mobile and internet data and an ARDL bounds-testing framework, the analysis finds a confirmed long-run cointegrating relationship among the variables, but no statistically significant long-run or short-run link between the fintech index itself and domestic credit to the private sector by banks. A complementary interaction model suggests that whatever modest link existed before 2012 weakened further after the Central Bank of Nigeria's cashless policy and National Financial Inclusion Strategy took effect.

For policymakers, the implication is that continued growth in mobile and internet infrastructure cannot, on its own, be relied upon to deepen formal bank credit markets; deliberate measures to connect digital finance users to deposit-taking and lending relationships, rather than payments and transfers alone, may be required to convert Nigeria's genuine digital connectivity gains into the kind of financial deepening associated with the mobile-network-operator-led model observed in Kenya. For the banking sector, the results suggest an opportunity to design products that draw on the digital footprint fintech users already generate, such as transaction-based credit scoring, to extend formal credit rather than ceding that activity to non-bank digital lenders. For researchers, the significant Ramsey Reset result and the collinearity flagged in the interaction model point toward nonlinear or structural-break-aware extensions of this framework as the natural next step.

REFERENCES

- [1] Aggarwal, R., Demirgüç-Kunt, A., & Martínez Pería, M. S. (2011). Do remittances promote financial development? *Journal of Development Economics*, 96(2), 255–264.
- [2] Akinjare, V. B., Obabueki, O. P., & Omankhanlen, A. E. (2026). The role of technology in advancing financial inclusion in Nigeria: A study of key digital channels. *Nigerian Journal of Banking and Financial Issues*, 12(1), 208–219.
- [3] Arcand, J. L., Berkes, E., & Panizza, U. (2015). Too much finance? *Journal of Economic Growth*, 20(2), 105–148.
- [4] Beck, T., Demirgüç-Kunt, A., & Levine, R. (2000). A new database on the structure and development of the financial sector. *World Bank Economic Review*, 14(3), 597–605.
- [5] Boyd, J. H., Levine, R., & Smith, B. D. (2001). The impact of inflation on financial sector performance. *Journal of Monetary Economics*, 47(2), 221–248.
- [6] Camara, N., & Tuesta, D. (2014). *Measuring financial inclusion: A multidimensional index* (BBVA Research Working Paper No. 14/26). BBVA Research.
- [7] Central Bank of Nigeria. (2015, March 31). *Regulatory framework for mobile money services in Nigeria* (Circular No. BPS/DIR/GEN/CIR/02/009).
- [8] Del Sarto, N., & Ozili, P. K. (2025). FinTech and financial inclusion in emerging markets: A bibliometric analysis and future research agenda. *International Journal of Emerging Markets*, 20(13), 270–290.
- [9] Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansar, S. (2022). *The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19*. World Bank.
- [10] Djankov, S., McLiesh, C., & Shleifer, A. (2007). Private credit in 129 countries. *Journal of Financial Economics*, 84(2), 299–329.
- [11] Evans, O. (2018). Connecting the poor: The internet, mobile phones and financial inclusion in Africa. *Digital Policy, Regulation and Governance*, 20(6), 568–581.

- [12] Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review*, 104(1), 183–223.
- [13] King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics*, 108(3), 717–737.
- [14] Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal of Economic Literature*, 35(2), 688–726.
- [15] Marco, R., & Perez-Saiz, H. (2026). Formal financial inclusion and digital mobile money adoption in sub-Saharan Africa: Do bank concentration and competition matter? *Applied Economics*, 58(3), 430–450.
- [16] Mashamba, T., & Gani, S. (2024). Upstarts vs incumbents: The interaction between fintech credit and bank lending in Sub-Saharan Africa. *Cogent Economics & Finance*, 12(1), Article 2375643.
- [17] Mundonde, J., & Makoni, P. L. (2026). Mobile money adoption and bank credit growth: Evidence from Sub-Saharan Africa. *Economies*, 14(7), Article 256.
- [18] Oniore, J., & Efayena, O. O. (2023). Electronic money and economic growth: What implications for e-Naira policy adoption in Nigeria? *Bullion*, 47(2), 12–19.
- [19] Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. *Borsa Istanbul Review*, 18(4), 329–340.
- [20] Ozili, P. K. (2022). *Financial inclusion in Nigeria: An overview* (MPRA Paper No. 113572). University Library of Munich.
- [21] Ozili, P. K. (2024). *Comparative analysis of financial inclusion in Nigeria, sub-Saharan Africa and the world* (MPRA Paper No. 121527). University Library of Munich.
- [22] Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326.
- [23] Philippon, T. (2016). *The FinTech opportunity* (NBER Working Paper No. 22476). National Bureau of Economic Research.
- [24] Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- [25] Rousseau, P. L., & Wachtel, P. (2011). What is happening to the impact of financial deepening on economic growth? *Economic Inquiry*, 49(1), 276–288.
- [26] Sarma, M. (2008). *Index of financial inclusion* (ICRIER Working Paper No. 215). Indian Council for Research on International Economic Relations.
- [27] Schumpeter, J. A. (1911). *Theorie der wirtschaftlichen Entwicklung*. Duncker & Humblot.
- [28] Suri, T., & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. *Science*, 354(6317), 1288–1292.
- [29] Tembo, J. (2023). Mobile money and banking development in Sub-Saharan Africa. *Scientific Annals of Economics and Business*, 70(4), 629–650.
- [30] Wezel, T., & Ree, J. J. (2023). *Nigeria: Fostering financial inclusion through digital financial services* (IMF Selected Issues Paper No. SIP/2023/020). International Monetary Fund.
- [31] World Bank. (2026). *World development indicators* Retrieved from <https://databank.worldbank.org/source/world-development-indicators>