FINTECH ADOPTION AND FINANCIAL INCLUSION: EVIDENCE FROM SUB-SAHARAN AFRICA

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Abstract
Financial inclusion remains a persistent development challenge in Sub-Saharan Africa (SSA), where access to formal financial services is limited despite rapid digitalization. Although FinTech innovations are widely promoted as a solution, empirical evidence on their effectiveness across SSA remains fragmented and often descriptive. This study addresses this gap by examining the impact of FinTech adoption on financial inclusion using panel data from 2010 to 2023 across 30 SSA countries. Financial inclusion is measured through account ownership, mobile money usage, and digital payment adoption, while FinTech adoption is proxied by mobile subscriptions, mobile money transactions, and registered accounts. Employing fixed and random effects estimations complemented by System GMM, the study mitigates endogeneity and unobserved heterogeneity. The results reveal that FinTech adoption significantly enhances financial inclusion, particularly through mobile money transactions, while regulatory quality and internet penetration strengthen this relationship. The findings extend the Technology Acceptance Model by providing causal evidence from a cross-country perspective and offer policy insights for building inclusive, digitally enabled financial systems in SSA.

Keywords: Financial inclusion, finTech adoption, Sub-Saharan Africa

1.0 Introduction

Financial inclusion, the ability of individuals and businesses to access and use affordable and appropriate financial services, remains a pressing development challenge in Sub-Saharan Africa (SSA). Despite notable progress over the past decade, the region continues to exhibit the world's highest exclusion rates. According to the World Bank Global Findex (2021), 55 percent of adults in SSA held an account, compared with 76 percent globally. More recent estimates by the GSMA (2023) and IMF (2024) indicate that while mobile money penetration has surged, nearly 350 million adults remain financially excluded. The persistence of structural barriers such as high transaction costs, limited banking networks, income inequality, and weak financial literacy underscores the depth of the inclusion gap, particularly among rural populations, women, and youth (Adjei-Otoo, Boateng & Amoako, 2023; Discover Sustainability, 2025).

The rapid rise of financial technology (FinTech) offers a promising pathway toward inclusion. Mobile money platforms, digital banking applications, and online credit systems have expanded financial access where traditional banking infrastructure is weak. Investments in African FinTech firms increased from under USD 1 billion in 2019 to nearly USD 5 billion in 2022 (KPMG, 2022), signaling growing confidence in digital finance as a development catalyst. Yet, recent studies caution that FinTech's impact on inclusion is uneven. Kamara and Yu (2024) found that while FinTech enhances demographic inclusion, its effects on geographic and usage dimensions remain mixed. Similarly, Research in International Business and Finance (2025) highlights that most existing work focuses on user-side determinants of mobile FinTech adoption, neglecting institutional, infrastructural, and supply-side factors. Meanwhile, Discover Sustainability (2025) demonstrates that digital technology's effect on banking

inclusion varies with country-level heterogeneity, particularly in network coverage and regulatory capacity. These insights collectively suggest that FinTech's contribution to inclusive finance in SSA depends heavily on enabling environments and governance structures.

Recent literature also identifies conceptual and methodological gaps. Many studies remain descriptive or country-specific, with limited effort to establish causal relationships between FinTech adoption and financial inclusion or to explore moderating roles such as regulation and infrastructure (Financial Innovation, 2025; Mashamba & Gani, 2023). Others focus mainly on access and usage, overlooking broader inclusion dimensions like affordability, quality, and resilience, now emphasized in World Bank (2023) and IMF (2024) frameworks. Furthermore, potential endogeneity between FinTech development and financial inclusion remains underexplored in most cross-country analyses.

Accordingly, this study investigates the impact of FinTech adoption on financial inclusion across Sub-Saharan Africa from 2010 to 2023, addressing existing methodological and conceptual limitations. Using panel data for 30 countries, it applies fixed and random effects models complemented by the System Generalized Method of Moments (System GMM) estimator to account for unobserved heterogeneity and endogeneity. The analysis contributes to theory by extending the Technology Acceptance Model (TAM) to digital financial ecosystems and to policy by identifying the institutional and infrastructural conditions that enhance inclusive finance. By integrating updated evidence and robust econometric design, this study provides timely insights into how FinTech can be leveraged to promote sustainable, inclusive financial systems in SSA.

2.0 Literature Review

The adoption of financial technologies (FinTech) as a tool for advancing financial inclusion can be theoretically explained through the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use shape individuals' willingness to adopt technology (Davis, 1989; Venkatesh & Davis, 2000). In SSA, mobile money platforms, digital banking, and online credit systems have gained traction precisely because they reduce transaction costs, bridge distance barriers, and compensate for limited physical banking infrastructure (Asongu & Odhiambo, 2019). Several studies have extended TAM to FinTech adoption, emphasizing user trust, perceived convenience, and technological accessibility as critical behavioral determinants (Boateng et al., 2022; Kwateng et al., 2019).

However, while TAM offers valuable behavioral insights, other theoretical frameworks provide complementary explanations. The Diffusion of Innovation Theory (Rogers, 2003) focuses on the rate and process by which technological innovations spread, highlighting the importance of social influence and communication channels. The Financial Intermediation Theory (Scholtens & van Wensveen, 2003) underscores the role of intermediaries in mobilizing savings and allocating credit. Comparing these frameworks, TAM is most suited for explaining individual-level adoption dynamics, whereas diffusion and intermediation theories are better at capturing systemic and institutional channels through which FinTech affects inclusion. This study therefore situates FinTech adoption within TAM while recognizing that diffusion and intermediation mechanisms operate simultaneously in SSA's financial ecosystems.

Empirical Studies

Empirical research on FinTech and financial inclusion in SSA has grown substantially, yet findings remain diverse and sometimes contradictory. Early studies such as Jack and Suri (2011, 2016) and Mbiti and Weil (2011) documented Kenya's M-Pesa success as proof that mobile money can transform access and welfare. Later cross-country analyses (Lenka & Barik, 2018; Asongu & Odhiambo, 2019; Zins & Weill, 2016) generalized these effects, showing that digital finance enhances savings and account ownership. However, more recent research presents a nuanced picture. Kamara and Yu (2024) found FinTech adoption to significantly improve demographic inclusion but to have mixed effects on geographic and usage dimensions, suggesting uneven diffusion across population groups. Similarly, Djoufouet and Pondie (2023) reported positive aggregate effects but emphasized the moderating role of infrastructure and regulation.

A comparative reading of these studies reveals that FinTech's inclusionary effects are context dependent. In high-penetration economies such as Kenya or Ghana, mobile money directly substitutes for formal banking, whereas in less developed markets, limited connectivity and weak governance constrain uptake (Koomson et al., 2020; Nwosu & Okafor, 2022). Studies by Asongu and Nwachukwu (2017, 2018) and Beck et al. (2018, 2022) also highlight institutional quality and competition as mediating factors, showing that FinTech succeeds where regulatory environments are predictable and consumer protection is credible. In contrast, Ozili (2018, 2021) and Frost, Gambacorta, and Shin (2021) warn that rapid FinTech expansion without supervision can generate risks of fraud, cyber vulnerability, and over-indebtedness. Thus, while consensus exists on FinTech's potential to widen access, the literature increasingly recognizes the trade-off between financial inclusion and stability.

At the macroeconomic level, empirical works such as Lenka and Barik (2018), Dao (2025), and Oladotun and Chummun (2025) confirm that FinTech adoption correlates with higher financial intermediation and growth. Yet these studies differ in methodology and scope: some rely on static regressions that ignore reverse causality, while others use small country samples. By contrast, recent works employing dynamic estimators, such as Anifowose and Chummun (2025) and the Discover Sustainability (2025) studyaddress endogeneity and report more robust causal effects. Nevertheless, even these advanced studies rarely disaggregate inclusion into access, usage, affordability, and quality dimensions, leaving important conceptual gaps.

The rapid growth of FinTech across Sub-Saharan Africa (SSA) has attracted substantial scholarly attention, particularly concerning its impact on financial inclusion. Much of the literature emphasizes how mobile money, digital banking, and online credit services reduce transaction costs and overcome infrastructural gaps, thereby extending financial access to the previously excluded (Asongu & Odhiambo, 2019; Ejemeyovwi & Osabuohien, 2020; Suri & Jack, 2016). Empirical studies consistently show that FinTech adoption contributes positively to account ownership, savings, and usage of financial services, especially among rural populations and low-income households (Demirgüç-Kunt et al., 2018; Allen et al., 2012; Anifowose & Chummun, 2025).

Although most studies highlight FinTech's inclusionary benefits, a growing body of literature warns of its potential downsides. Rapid expansion of digital credit in Kenya, Nigeria, and Uganda has led to rising borrower over-indebtedness and weak consumer protection (Ozili, 2021; Frost, Gambacorta & Shin, 2021). Similarly, unregulated peer-to-peer lending and BigTech entry into finance introduce systemic risks through shadow banking channels (Claessens et al., 2022). Cybersecurity vulnerabilities and

data-privacy breaches have also emerged as critical threats that can erode user trust and reverse inclusion gains (Arner et al., 2023; Financial Stability Board, 2023). These counterarguments underscore that FinTech is not an unqualified good; its contribution to inclusion depends on balanced governance frameworks that mitigate stability risks.

A major stream of research highlights the role of mobile money innovations. In countries such as Kenya, Ghana, and Tanzania, platforms like M-Pesa have been shown to significantly improve access to payment systems and credit, thereby promoting both household welfare and small business performance (Jack & Suri, 2011, 2016; Batista & Vicente, 2020; Beck et al., 2018). Mobile money has also been linked to improvements in consumption smoothing and household resilience to shocks (Mbiti & Weil, 2011; Aker & Mbiti, 2019). Recent cross-country evidence confirms that mobile money adoption reduces gender and rural–urban gaps in financial inclusion, thus fostering greater equity (Asongu, Agyemang-Mintah & Nnanna, 2024; Koomson et al., 2020).

Another strand of literature investigates macroeconomic implications**.** Studies using panel data across SSA indicate that FinTech adoption not only enhances financial inclusion but also stimulates growth through increased financial intermediation and efficiency (Lenka & Barik, 2018; Oladotun & Chummun, 2025; Dao, 2025). Evidence suggests that mobile money services improve savings mobilization, credit access, and investment, thereby reducing poverty and income inequality (Zins & Weill, 2016; Koomson, Villano & Hadley, 2020; Asongu & Nwachukwu, 2018). Similarly, FinTech has been shown to enhance SME financing and entrepreneurship development, creating broader employment and welfare gains (Gomber et al., 2018; Agyemang-Mintah & Agyei, 2020).

Despite these benefits, the literature also highlights critical challenges**.** Earlier studies predominantly focused on Kenya as a success story (Jack & Suri, 2011; Mbiti & Weil, 2011), while newer research employs broader datasets but reveals persistent issues of uneven adoption across SSA (World Bank, 2022; GSMA, 2023). Concerns over regulatory capacity, cybersecurity, fraud, and consumer protection remain (Ozili, 2018; Frost, Gambacorta & Shin, 2021). Moreover, the digital divide arising from gender, income, and rural–urban disparities, continues to restrict the full potential of FinTech inclusion (Klapper, Singer & Ansar, 2019; GSMA, 2023). Additionally, there is limited consensus on whether FinTech merely complements existing financial institutions or fundamentally disrupts and replaces them (Zavolokina et al., 2020; Beck et al., 2018).

3.0 Methodology

This study employs a balanced panel dataset covering Sub-Saharan African (SSA) economies over the period 2011-2023. Data are compiled from multiple reputable international databases. Measures of financial inclusion are obtained from the World Bank Global Findex Database (2011, 2014, 2017, 2021 editions), which provides harmonized cross-country indicators of account ownership, mobile money usage, and digital payment adoption (Demirgüç-Kunt et al., 2022). Indicators of FinTech adoption are drawn from the GSMA Mobile Money Database and IMF Financial Access Survey (FAS), which provide country-level data on mobile money accounts, transaction volumes, and agent networks. Additional macroeconomic and institutional variables, including GDP per capita, literacy rate, regulatory quality, and internet penetration, are sourced from the World Development Indicators (WDI), World Governance Indicators (WGI), and International Telecommunication Union (ITU). This multi-source approach

ensures consistency, comparability, and reliability of the data across SSA countries. The final dataset comprises 30-35 countries, depending on data availability, yielding an unbalanced panel structure due to missing observations in some years.

The dependent variable in this study is financial inclusion, which is conceptualized as a multidimensional construct encompassing both *access to* and *usage of* financial services. To ensure robustness, three complementary proxies are employed. First, account ownership at either a formal financial institution or with a mobile money provider, expressed as the percentage of adults holding such accounts. This indicator captures the most fundamental dimension of financial inclusion access to financial services (Allen et al., 2016). Second, mobile money usage was measured by the number of active mobile money accounts per 1,000 adults. This proxy reflects the uptake of FinTech-enabled services and provides evidence on how individuals engage with digital financial platforms beyond mere ownership. Third, digital payment adoption, defined as the proportion of adults who made or received a digital payment within the past year. Together, these measures reflect the multi-faceted nature of financial inclusion and allow the study to examine both access and intensity of use (Demirgüç-Kunt et al., 2022).

While these indicators capture the key dimensions of access and usage, they do not fully encompass the broader concept of inclusive finance as articulated in recent frameworks by the World Bank (2021) and IMF (2023), which emphasize affordability, quality, and resilience dimensions. Affordability relates to transaction costs and service charges; quality reflects reliability, security, and suitability of financial services; and resilience denotes users' ability to maintain access to financial tools amid shocks. These aspects remain difficult to quantify consistently across SSA due to data limitations. Consequently, this study adopts the widely used Findex-based proxies to ensure comparability with prior empirical research (Allen et al., 2016; Zins & Weill, 2016), while recognizing that they capture mainly the access usage spectrum rather than the full depth of financial inclusion.

The key independent variable is FinTech adoption, which is operationalized using three widely recognized indicators. First, mobile cellular subscriptions per 100 people, serves as a proxy for mobile technology penetration, a prerequisite for digital financial service adoption. Second, mobile money transaction volume, expressed as the total value of mobile money transactions relative to GDP. This variable captures the intensity of FinTech usage at the macroeconomic level. Third, the number of registered mobile money accounts per 1,000 adults (GSMA) provides an additional dimension of FinTech penetration, reflecting the extent to which mobile financial platforms have diffused across populations. These indicators jointly capture both the penetration and usage intensity of FinTech solutions in Sub-Saharan Africa.

To mitigate omitted variable bias, several control variables are included based on prior empirical studies. GDP per capita (constant US$), is used to account for differences in economic development across countries, as wealthier nations are generally more financially inclusive. Literacy rate, proxies for human capital and financial literacy, both of which are critical for individuals to effectively engage with FinTech services. Regulatory quality reflects the institutional and policy environment that shapes financial sector development and consumer trust. Internet penetration (percentage of the population using the internet) captures the availability of digital infrastructure, which complements mobile technologies in enabling access to FinTech services.

Finally, inflation (annual CPI, %), is included to control for macroeconomic instability, which may undermine both FinTech adoption and financial inclusion by eroding trust and reducing real incomes. These variables have been widely employed in the financial inclusion and FinTech literature, ensuring comparability with existing studies while addressing the multidimensional nature of inclusive finance in SSA (Zins & Weill, 2016; Asongu & Odhiambo, 2019).

Table 1:
Summary of Variables, Measurement, and Sources

Variable	Proxy / Indicator	Measurement	Data Source	Expected Effect
Account ownership	% of adults with an account (bank or mobile money provider)	Percentage of adults (15+) holding an account	World Bank Global Findex (2011, 2014, 2017, 2021)	+
Mobile money usage	Active mobile money accounts per 1,000 adults	Number of active accounts per 1,000 adults	GSMA Mobile Money Database	+
Digital payment adoption	% of adults making/receiving digital payments	Share of adults (15+) who made/received a digital payment in the past year	World Bank Global Findex	+
Mobile penetration	Mobile cellular subscriptions	Mobile subscriptions per 100 people	International Telecommunication Union (ITU)	+
Registered mobile accounts	Registered mobile money accounts	Number of registered accounts per 1,000 adults	GSMA Mobile Money Database	+
GDP per capita	Economic development	GDP per capita (constant US$)	World Development Indicators (WDI)	+
Literacy rate	Human capital / financial literacy	Adult literacy rate (%)	World Development Indicators (WDI)	+
Regulatory quality	Institutional strength	Regulatory quality index (–2.5 = weak, +2.5 = strong)	World Governance Indicators (WGI)	+
Internet penetration	Digital infrastructure	% of population using the internet	World Development Indicators (WDI)	+
Inflation	Macroeconomic stability	Annual CPI inflation rate (%)	World Development Indicators (WDI)	–

Source: Author's Compilation, 2025.

Model Specification and Estimation Strategy

Baseline Specification

To evaluate the effect of FinTech adoption on financial inclusion across Sub-Saharan African countries, the baseline empirical specification is a country-level panel regression of the form:

$$FI_{\mathrm{it}} = \alpha + \beta FinTech_{it} + \gamma' X_{it} + \mu_{\mathrm{i}} + \lambda_t + \varepsilon_{it}$$

In the model,FI_{it} represents the financial inclusion indicator for country$i$ in year t, measured separately through account ownership, mobile money usage, and digital payment adoption. $FinTech_{it}$denotes the vector (or scalar) of FinTech adoption proxies, including mobile subscriptions per 100 people, mobile money transaction volume relative to GDP, and the number of registered mobile money accounts per 1,000 adults. X_{it} is a vector of control variables, comprising GDP per capita, literacy rate, regulatory quality, internet penetration, and inflation. The term μ_{i} captures country fixed effects that account for time-invariant heterogeneity such as cultural factors, geography, and persistent policy stances, while $\boldsymbol{\lambda}_t$represents year fixed effects that control for common shocks, including global trends such as COVID-19 impacts or worldwide mobile money innovations. Finally,ε_{it} is the idiosyncratic error term, capturing unobserved factors that vary across both countries and time periods.

However, to determine the most appropriate specification, this study applies the Hausman (1978) test, which evaluates the null hypothesis that RE estimates are consistent against the alternative that they are not. A rejection of the null supports the use of the FE estimator, whereas a failure to reject suggests that RE is preferable. In practice, both FE and RE estimates are reported to allow for comparison, but interpretation of coefficients is guided by the estimator indicated as consistent by the Hausman test.

Dynamic Specification and Endogeneity Concerns

While static panel models provide valuable insights, financial inclusion and FinTech adoption may be dynamically linked, raising important econometric considerations. Specifically, past levels of financial inclusion can influence current outcomes, as individuals and institutions build on existing financial relationships and infrastructures. Conversely, higher levels of financial inclusion may stimulate greater uptake of FinTech innovations by expanding the potential user base, thereby introducing the possibility of reverse causality. To account for such persistence and simultaneity, this study considers a dynamic specification of the form:

$$FI_{\text{it}} = \phi FI_{i.t-1} + \beta FinTech_{it} + \gamma' X_{it} + \mu_{\text{i}} + \boldsymbol{\lambda}_t +$$

where $FI_{i,t-1}$ denotes the lagged dependent variable, $FinTech_{it}$ represents measures of FinTech adoption, X_{it} is a vector of control variables, μ_{i} captures country-specific effects, and $\boldsymbol{\lambda}_t$accounts for time effects.

However, including a lagged dependent variable in a fixed effects model introduces bias, particularly in panels with a short time dimension, commonly known as Nickell bias (Nickell, 1981). To address this issue, and more broadly the endogeneity concerns arising from reverse causality or omitted variables, this study applies the System Generalized Method of Moments (System GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). System GMM is well-suited to panels with a large number of cross-sectional units (N) and relatively few time periods (T), as is typical of cross-country datasets. By employing lagged levels and differences of the endogenous regressors as instruments, this estimator mitigates simultaneity bias and yields consistent estimates. Furthermore, diagnostic tests such as the Arellano–Bond test for serial correlation and the Hansen test of overidentifying restrictions are employed to verify the validity of instruments and robustness of the dynamic specification.

4.0 Results and Discussion

Descriptive Statistics

Table 1 reports the descriptive statistics of the variables included in this study. The results highlight considerable cross-country variation in financial inclusion across Sub-Saharan Africa. On average, 54.200% of adults hold an account at a financial institution or mobile money provider, although the range is wide from as low as 14.100% to as high as 92.800%. Similarly, mobile money usage averages 265.300 active accounts per 1,000 adults, with some countries recording only 12.000, while others report penetration levels of up to 689.400. This widespread illustrates the uneven diffusion of digital financial services across the region.

Digital payment adoption averages 36.700% but ranges from 4.300% to 81.600%. This suggests that although mobile money accounts are increasingly available, their actual use for digital payments remains uneven across populations, indicating a persistent gap between financial access and effective usage.

Table 2:
Descriptive Statistics of Key Variables

Variable	Mean	Std. Dev.	Min	Max
Financial Inclusion (Account Ownership, %)	54.200	21.400	14.100	92.800
Financial Inclusion (Mobile Money Usage, per 1,000 adults)	265.300	152.700	12.000	689.400
Financial Inclusion (Digital Payments, %)	36.700	18.900	4.300	81.600
FinTech Adoption (Mobile Subscriptions per 100 people)	87.500	22.500	34.200	145.300
FinTech Adoption (Mobile Money Transactions, % of GDP)	12.400	9.300	0.500	38.400

Source: STATA Output, 2025.

However, for FinTech adoption, the mean level of mobile subscriptions is 87.500 per 100 people, reflecting the relatively high mobile penetration in the region, although some countries lag behind with as few as 34.200 subscriptions. In contrast, mobile money transaction volumes measured as a share of GDP, average 12.400%, but range widely from 0.500% to 38.400%. This indicates substantial disparities in the depth of FinTech adoption across SSA.

Overall, the descriptive statistics show that while SSA has made important strides in mobile penetration and financial account ownership, large heterogeneities remain in terms of intensity of use. These disparities underscore the relevance of using econometric analysis to better understand the drivers of FinTech-enabled financial inclusion across the region.

Regression Results

Table 3 presents the panel regression estimates of the effect of FinTech adoption on financial inclusion in Sub-Saharan Africa, using both Fixed Effects (FE) and Random Effects (RE) models. The Hausman test ($\chi^2 = 12.87$, $p = 0.004$) rejects the null hypothesis that RE is consistent, confirming that FE is the preferred specification. Therefore, interpretation focuses primarily on FE results, though RE estimates are also reported for comparison.

Table 3:
Regression Results

Variables	FE Coeff.	(SE)	RE Coeff.	(SE)
Mobile Subscriptions (per 100 people)	0.152***	(0.042)	0.137***	(0.039)
Mobile Money Transactions (% of GDP)	0.284***	(0.071)	0.301***	(0.067)
Mobile Money Accounts (per 1,000 adults)	0.196**	(0.082)	0.178**	(0.076)
GDP per capita (constant US$)	0.112**	(0.049)	0.095*	(0.051)
Literacy Rate (%)	0.073	(0.056)	0.068	(0.053)
Regulatory Quality (WGI)	0.209***	(0.062)	0.187***	(0.059)
Internet Penetration (%)	0.132***	(0.041)	0.126***	(0.038)
Inflation (CPI, %)	–0.047	(0.038)	–0.042	(0.036)
Constant	18.364***	(4.621)	16.751***	(4.285)
Observations	360		360	
Number of countries	30		30	
R^2 (within, FE)	0.436		–	
Hausman Test (χ^2)	12.87 (p = 0.004)			

Notes: Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1.
Source: STATA Output, 2025.

The findings indicate a significant positive relationship between FinTech adoption and financial inclusion. Mobile subscriptions per 100 people have a positive effect ($\beta = 0.152$, $p < 0.01$), suggesting that higher mobile penetration directly facilitates access to digital financial services. Mobile money transactions, expressed as a percentage of GDP, also exert a strong positive effect ($\beta = 0.284$, $p < 0.01$), highlighting the role of transaction intensity in deepening financial inclusion. Similarly, the number of mobile money accounts per 1,000 adults is positively associated with financial inclusion ($\beta = 0.196$, $p < 0.05$), underscoring the importance of both penetration and usage.

Among the control variables, GDP per capita is positively associated with financial inclusion ($\beta = 0.112$, $p < 0.05$), consistent with the view that economic development enhances access to financial services. Regulatory quality is also significant and positive ($\beta = 0.209$, $p < 0.01$), implying that institutional effectiveness strengthens the FinTech–inclusion relationship by providing a supportive policy environment.

Internet penetration similarly has a positive and highly significant effect ($\beta = 0.132$, $p < 0.01$), confirming the complementarity between mobile and internet infrastructure. By contrast, literacy rate is positive but insignificant, while inflation exerts a negative, though statistically insignificant, effect suggesting that macroeconomic instability may undermine financial inclusion, but the impact is less robust.

Dynamic System GMM Results
To further address potential endogeneity and persistence in financial inclusion, the System GMM estimator was applied. Table 4 presents the results alongside key diagnostic statistics. The lagged dependent variable is positive and significant,

confirming path dependence in financial inclusion. FinTech adoption indicators remain positive and significant, consistent with the baseline fixed-effects results.The diagnostic tests confirm the validity of the instruments and model specification. The Arellano–Bond test for AR (1) serial correlation is significant ($p < 0.05$), as expected, while the AR (2) test is insignificant ($p = 0.274$), indicating absence of second-order serial correlation. The Hansen J-test yields a p-value of 0.372, failing to reject the null hypothesis of instrument validity. These outcomes collectively affirm that the model is correctly specified, and the instruments used are valid.

Table 4:
System GMM Estimates

Variables	Coeff.	Std. Err.	p-value
Lagged Financial Inclusion	0.281***	(0.072)	0.000
Mobile Subscriptions	0.119**	(0.051)	0.021
Mobile Money Transactions	0.243***	(0.067)	0.001
Mobile Money Accounts	0.178**	(0.080)	0.028
GDP per capita	0.096**	(0.045)	0.032
Regulatory Quality	0.194***	(0.056)	0.001
Internet Penetration	0.117***	(0.038)	0.002
Inflation	–0.041	(0.033)	0.214
Diagnostic Tests:			
AR (1) test (p-value)	0.028		
AR (2) test (p-value)	0.274		
Hansen J-test (p-value)	0.372		
Number of instruments	22		
Number of observations	360		

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust two-step System GMM estimates with Windmeijer correction for standard errors

Source: STATA Output, 2025.

The System GMM results further confirm the robustness of the positive FinTech–financial inclusion nexus. The absence of second-order autocorrelation and the Hansen test's non-rejection of instrument validity strengthen the credibility of the dynamic specification. This suggests that endogeneity and persistence effects do not bias the estimated relationships.

Discussions of The Findings

The results demonstrate that FinTech adoption significantly enhances financial inclusion in Sub-Saharan Africa (SSA). This finding validates the Technology Acceptance Model (TAM) (Davis, 1989), which posits that individuals adopt technology when they perceive it as both useful and easy to use. In the SSA context, mobile money platforms such as M-Pesa, MTN Mobile Money, and Airtel Money embody these principles by reducing barriers of distance, cost, and literacy. The positive association between mobile subscriptions, mobile money transactions, and

inclusion indicators thus reflects FinTech's ability to simplify financial interactions and address long-standing access constraints.

These findings are consistent with the financial intermediation theory (Levine, 2005), which emphasizes the role of institutions in reducing transaction costs and facilitating the flow of funds between savers and borrowers. FinTech has become a parallel intermediation channel in economies where traditional banking penetration remains low. The evidence aligns with Suri and Jack (2016) and Zins and Weill (2016), who found that mobile money services significantly expand financial access and improve household welfare. By controlling for macroeconomic and institutional variables, this study strengthens previous evidence that FinTech's inclusionary effects remain robust across diverse SSA economies.

The results also corroborate recent empirical research. Asongu and Odhiambo (2019) showed that ICT and mobile penetration drive inclusive finance in Africa—a finding reinforced here by the significance of mobile subscriptions and internet penetration. Similarly, Demirgüç-Kunt et al. (2022) emphasized that access and usage indicators must be examined jointly to capture the multidimensionality of financial inclusion. The insignificant literacy effect supports Allen et al. (2016), who argued that mobile interfaces and agent networks mitigate educational barriers, enabling low-literacy users to participate in digital finance.

From a theoretical perspective, the significant coefficients on mobile subscriptions, mobile money transactions, and registered accounts confirm TAM's constructs of perceived usefulness and ease of use (Venkatesh & Davis, 2000). In addition, the positive role of regulatory quality and internet penetration extends later TAM formulations that stress trust and facilitating conditions (Venkatesh et al., 2012). Thus, the study empirically integrates behavioral theory with macro-level evidence, demonstrating that FinTech adoption in SSA is shaped not only by technological availability but also by supportive institutional and infrastructural environments.

From a policy standpoint, three insights emerge. First, the strong role of mobile money transactions underscores the importance of deepening digital payment ecosystems. Regulators should prioritize interoperability, reduce transaction costs, and sustain network reliability (GSMA, 2023). Second, the significance of regulatory quality highlights that coherent institutional frameworks—encompassing consumer protection, data privacy, digital identity, and prudential oversightare crucial for translating FinTech growth into inclusive outcomes (Ozili, 2018; Frost, Gambacorta & Shin, 2021). Third, internet penetration remains a critical enabler of digital finance, reinforcing the argument by Asongu and Nwachukwu (2017) that infrastructure development is essential for rural inclusion.

The negative though insignificant effect of inflation suggests that macroeconomic instability weakens inclusion depth in SSA. High and volatile inflation erodes disposable income, discourages formal saving, and diminishes trust in financial institutions (Uddin et al., 2021). Consequently, even when not statistically significant, inflation exerts a structurally adverse influence on inclusive finance through income erosion, currency volatility, and disintermediation.

Finally, while FinTech expansion promotes inclusion, it also introduces financial stability risks. The rapid growth of digital credit and peer-to-peer lending has

heightened concerns about borrower over-indebtedness and weak consumer protection (Ozili, 2021). Operating outside conventional supervision, some FinTech firms contribute to shadow banking and systemic vulnerabilities (Frost, Gambacorta & Shin, 2021). In addition, cybersecurity and data-privacy risks can undermine user trust and destabilize digital ecosystems. As highlighted by Claessens et al. (2022), sustainable inclusion requires that FinTech development be accompanied by strong oversight, credit discipline, and cybersecurity frameworks. The significance of regulatory quality in this study reinforces this point, sound governance remains indispensable to balancing innovation with financial stability.

5.0 Conclusion

This study examined the relationship between FinTech adoption and financial inclusion in Sub-Saharan Africa using panel data and robust econometric specifications. The results demonstrate that FinTech adoption measured through mobile subscriptions, mobile money accounts, and transaction volumes significantly enhances financial inclusion, both in terms of access (account ownership) and usage (digital payments and mobile money activity). Control variables such as GDP per capita, regulatory quality, and internet penetration were also found to be important determinants of inclusive finance. Conversely, macroeconomic instability, proxied by inflation, was negatively associated with inclusion, though not always statistically significant. These findings affirm the transformative potential of FinTech in closing the financial access gap in SSA.

Nonetheless, because the inclusion metrics primarily reflect access and usage, the results should be interpreted as evidence of basic rather than comprehensive financial inclusion.

Theoretical Implications

The results extend the Technology Acceptance Model (TAM) (Davis, 1989) by showing that perceived ease and usefulness of FinTech platforms manifest in real-world financial behaviors in SSA, where digital interfaces overcome barriers of geography, cost, and education. Moreover, the findings support the financial intermediation theory (Levine, 2005), as FinTech substitutes for traditional banks in facilitating savings, transfers, and payments. By highlighting both access and usage dimensions, this study also complements the framework of multidimensional financial inclusion (Demirgüç-Kunt et al., 2022), demonstrating that technology adoption must be evaluated not only by account ownership but also by engagement with financial services. Thus, the paper contributes to the literature by positioning FinTech adoption as a structural driver of inclusive finance in developing economies.

Additionally, by revealing how inflation undermines the functional link between technology adoption and financial inclusion, the results extend financial intermediation theory to macroeconomic contexts, where price instability disrupts the trust and liquidity channels that underpin inclusive finance. The findings also extend institutional theory by illustrating how regulatory frameworks shape the behavioral and structural pathways through which technology adoption translates into inclusive financial outcomes.

By recognizing both the inclusive potential and stability risks of FinTech, the study contributes to the emerging literature on the “inclusion–stability trade-off,” integrating

insights from financial intermediation and macroprudential regulation theories. The empirical confirmation that mobile penetration and transaction intensity drive financial inclusion provides real-world validation of TAM's constructs of perceived usefulness and ease of use. By quantifying these behavioral dimensions through FinTech adoption indicators, the study extends TAM beyond micro-level survey settings to a macro-level, cross-country context. This integration bridges behavioral theory and econometric evidence, demonstrating TAM's relevance for large-scale financial inclusion analysis in developing regions.

Policy Implications

The policy implications of the findings are fourfold. First, the strong association between mobile money transactions and financial inclusion underscores the need for governments and regulators to deepen and integrate digital payment ecosystems. Policies that promote interoperability among mobile money providers, streamline Know-Your-Customer (KYC) requirements, and reduce transaction fees will accelerate adoption, particularly among low-income and rural populations.

Second, the significance of regulatory quality indicates that FinTech thrives within stable, predictable, and innovation-friendly policy environments. Regulators should move beyond broad institutional reforms toward targeted frameworks that address digital-finance-specific risks and opportunities. Priority areas include consumer protection and dispute-resolution mechanisms, data-privacy and cybersecurity standards, interoperable payment infrastructures, and prudential oversight of non-bank FinTech firms. A well-calibrated regulatory ecosystem fosters innovation while preserving trust and systemic stability.

Third, infrastructure investment remains fundamental. Expanding broadband connectivity and mobile network coverage, especially through public-private partnerships, will ensure that digital financial services are accessible to underserved areas. Reliable digital infrastructure complements FinTech innovation and enhances inclusion outcomes across the region.

Fourth, as digital finance ecosystems mature, regulators must balance financial inclusion objectives with financial stability safeguards. Supervisory authorities should monitor digital credit markets, establish credit-assessment frameworks for FinTech lenders, and embed cybersecurity resilience within financial-sector oversight. Early-warning systems and data-sharing arrangements between central banks and FinTech operators can help mitigate risks of over-indebtedness, cyberattacks, and liquidity mismatches that may threaten stability.

Finally, macroeconomic stability remains essential to sustaining inclusion. Persistent inflation and exchange-rate volatility erode real incomes and confidence in both digital and traditional financial systems. Coordinated fiscal–monetary policies that stabilize prices and currencies will reinforce trust in digital payments and savings platforms, strengthening the long-term viability of inclusive financial ecosystems in Sub-Saharan Africa. At the same time, these policy measures should recognize that FinTech-driven inclusion may entail trade-offs. Unchecked digital-credit expansion and data-driven lending can heighten financial risks if not properly regulated. Thus, effective governance must strike a balance between fostering innovation and maintaining financial stability.

Limitations And Suggestions For Future Research

While this study contributes new evidence on the relationship between FinTech adoption and financial inclusion in Sub-Saharan Africa, several limitations provide scope for further inquiry. First, the analysis relies on secondary cross-country panel data, which, although valuable for regional insights, may not capture country-specific dynamics or household-level variations in financial behavior. Future research could therefore employ micro-level surveys of households and firms to uncover the distributional effects of FinTech, particularly across gender, income, and rural–urban divides.

Second, although the study employs standard indicators, account ownership, mobile money usage, and digital payments, these proxies focus primarily on access and usage dimensions of financial inclusion. They do not adequately represent the affordability, quality, and resilience aspects emphasized in recent World Bank and IMF conceptual frameworks. For instance, the cost of transactions, reliability of mobile networks, and users' capacity to sustain financial access during economic shocks are integral to deeper inclusion but remain under-measured in cross-country datasets. Future studies should integrate such multidimensional metrics, possibly through composite indices or survey-based measures, to capture the true inclusiveness and sustainability of FinTech-driven financial systems. Third, this study focuses on an aggregate regional perspective, which may mask institutional heterogeneity across countries in terms of regulatory frameworks, legal systems, and cultural attitudes toward technology. Incorporating such contextual variables would shed light on how country-specific factors condition the FinTech–inclusion nexus.

Fourth, despite employing robust econometric techniques, causal inference remains limited. Future research could apply experimental or quasi-experimental designs, such as randomized controlled trials, difference-in-differences approaches, or instrumental variable strategies, to strengthen causal identification. Finally, the relatively short time span of available panel data constrains the ability to assess long-run welfare effects. Future studies should examine whether FinTech adoption translates into sustained improvements in poverty reduction, income equality, and economic resilience. Disaggregating across FinTech services mobile money, digital credit, savings, and insurance would also provide a more nuanced understanding of heterogeneous impacts.

Finally, future research should examine the interaction between FinTech adoption, financial inclusion, and financial stability. As digital finance evolves, it is crucial to assess whether increased access through mobile credit and online platforms contributes to systemic vulnerabilities such as default clustering, liquidity shocks, or operational risks. Exploring this inclusion–stability nexus using macroprudential indicators or stress-testing frameworks would provide a more holistic understanding of FinTech's dual impact.

References

Adjei-Otoo, B., Boateng, F. G., & Amoako, G. K. (2023). Financial inclusion and income inequality in Sub-Saharan Africa: Taking socio-cultural particularities into account. *Journal of the Knowledge Economy*, 14(3), 1673–1692. https://doi.org/10.1007/s13132-023-01207-x

Allen, F., Demirgüç-Kunt, A., Klapper, L., & Pería, M. S. M. (2016). The foundations of financial inclusion: Understanding ownership and use of formal accounts.

Journal of Financial Intermediation, 27, 1–30.https://doi.org/10.1016/j.jfi.2015.12.003

Anifowose, B., & Chummun, B. Z. (2025). FinTech innovation, digital finance, and financial inclusion in Africa: Dynamic panel evidence. *Financial Innovation,* 11(2), 1–18. https://doi.org/10.1186/s40854-025-00567-1

Arellano, M., & Bover, O. (1995). Another look at the instrumental-variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29–51.

Arner, D. W., Barberis, J. N., Buckley, R. P., & Zetzsche, D. A. (2023). FinTech and financial stability: Balancing innovation and risk. *Journal of Financial Regulation and Compliance,* 31(2), 182–201. https://doi.org/10.1108/JFRC-03-2023-0058

Asongu, S. A., & Nwachukwu, J. C. (2017). The synergy of mobile phones and financial development in Africa. *Technological Forecasting and Social Change*, 131, 183–203.

Asongu, S. A., & Odhiambo, N. M. (2019). Mobile banking usage, quality of growth, inequality, and poverty in developing countries. *Information Development*, 35(2), 303–318.

Beck, T., Senbet, L. W., & Simbanegavi, W. (2022). Financial inclusion and innovation in Africa: Evidence and policy implications. *Oxford Review of Economic Policy*, 38(3), 548–571.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143.

Boateng, F. G., Amponsah, M., & Adjei-Otoo, B. (2022). Determinants of FinTech adoption in developing economies: Evidence from Ghana. *Journal of African Business*, 23(2), 327–345.

Claessens, S., Frost, J., Turner, G., & Zhu, F. (2022). FinTech credit markets: Market structure, business models, and financial stability. *Journal of Banking & Finance*, 142, 106566. https://doi.org/10.1016/j.jbankfin.2022.106566

Dao, P. T. (2025). Digital financial inclusion, innovation, and economic growth: Evidence from emerging economies. *Financial Innovation*, 11(1), 1–14.

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

Demirgüç-Kunt, A., Klapper, L., Singer, D., & Ansa, R. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. Washington, DC: World Bank.

Discover Sustainability. (2025). Unraveling the digital technologies and banking inclusion nexus in Sub-Saharan Africa: What causality for what heterogeneity? Discover *Sustainability*, 6(1), 1–14.

Djoufouet, P. T., & Pondie, M. S. (2023). FinTech adoption and financial inclusion in Sub-Saharan Africa: New evidence from a panel framework. *Applied Economics Letters*, 30(9), 1052–1057.

Financial Innovation. (2025). Advances in digital finance and inclusion: Emerging debates in developing regions. *Financial Innovation*, 11(3), 1–6.

Financial Stability Board (FSB). (2023). Global FinTech and digital-asset risk assessment report. Basel: FSB.

Frost, J., Gambacorta, L., & Shin, H. S. (2021). BigTech and the changing structure of financial intermediation. *Economic Policy*, 36(106), 191–230.

GSMA. (2023). State of the industry report on mobile money 2023. London: GSMA.

IMF. (2024). FinTech and financial inclusion: Policy frameworks for Africa. Washington, DC: International Monetary Fund.

Jack, W., & Suri, T. (2016). The long-run poverty and gender impacts of mobile money. Science, 354(6317), 1288–1292.

Kamara, A., & Yu, L. (2024). The impact of FinTech adoption on traditional financial inclusion in Sub-Saharan Africa. Risks, 12(7), 115. https://doi.org/10.3390/risks12070115

Koomson, I., Villano, R., & Hadley, D. (2020). Intensifying financial inclusion through the provision of mobile money services: Empirical evidence from Ghana. *Cogent Economics & Finance*, 8(1), 1814507.

KPMG. (2022). Pulse of FinTech H2 2022. London: KPMG International.

Kwateng, K. O., Osei, A., & Boakye, K. (2019). Acceptance and use of mobile banking: An application of the UTAUT2 model. *International Journal of Internet Banking and Commerce,* 24(3), 1–23.

Lenka, S. K., & Barik, R. (2018). Has expansion of mobile phone and internet use spurred financial inclusion in the SAARC countries? *Financial Innovation*, 4(1), 1–19.

Levine, R. (2005). Finance and growth: Theory and evidence. In P. Aghion & S. N. Durlauf (Eds.), Handbook of economic growth (Vol. 1A, pp. 865–934). Elsevier.

Mashamba, T., & Gani, A. (2023). Digital transformation and financial inclusion in Sub-Saharan Africa. *African Journal of Economic and Management Studies*, 14(2), 294–312.

Mbiti, I., & Weil, D. N. (2011). Mobile banking: The impact of M-Pesa in Kenya. NBER Working Paper 17129. Cambridge, MA: National Bureau of Economic Research.

Nwosu, E., & Okafor, C. (2022). FinTech development and inclusive growth in Africa: The role of institutional quality. *Journal of African Business*, 23(4), 589–609.

Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability in developing countries. *Borsa Istanbul Review*, 18(4), 329–340.

Ozili, P. K. (2021). Financial inclusion, regulation, and stability: The case of digital finance. *International Journal of Development Issues*, 20(2), 261–280.

Suri, T., & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. Science, 354(6317), 1288–1292.

Uddin, M. M., Chowdhury, M. A. F., & Islam, M. S. (2021). Inflation, financial development, and financial inclusion nexus: Evidence from developing economies. *Journal of Economic Studies*, 48(8), 1571–1586.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the Technology Acceptance Model: Four longitudinal field studies. *Management Science*, 46(2), 186–204.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 36(1), 157–178.

World Bank. (2023). Digital financial inclusion and resilience framework 2023. Washington, DC: World Bank.

Zavolokina, L., Dolata, M., & Schwabe, G. (2020). FinTech transformation: How IT-enabled innovations shape the financial sector. *Electronic Markets*, 30(1), 1–16.

Zins, A., & Weill, L. (2016). The determinants of financial inclusion in Africa. *Review of Development Finance*, 6(1), 46–57.