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Digital Finance and Inclusive Growth in Sub-Saharan Africa: The Transformative Role of FinTech

Kwame Boateng Akomeah[1], Peter Olawami Ijiyemi[2], Nicholas Donkor[3], Vanessa Afia Asomea– Takyi[4], Irene Twenewaah[5]

[1]*Dept. of ABAEF, College of Business, Lewis University, IL, USA*
[2]*CEO, HNL Solutions Logistics, Nigeria*
[3]*ICT Directorate, Akenten Appiah-Menka University of Skills Training and Entrepreneurial, Kumasi – Ghana*
[4]*School of Strategy, Marketing and Innovation, University of Portsmouth, UK*
[5]*Procurement Department, Local Government, Berekum East, Ghana*

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ABSTRACT
Financial inclusion is critical for economic growth, especially in regions with historically underdeveloped financial sectors. Sub-Saharan Africa presents a paradox: while traditional banking remains limited, mobile money and digital financial services have rapidly expanded, offering a unique avenue for inclusive finance. This study investigates the impact of Financial Technology (FinTech) on financial inclusion and economic growth in SSA using panel data from 20 countries between 2014 and 2019. We employ both cross-sectional Ordinary Least Squares and dynamic panel estimation via the two-step System Generalized Method of Moments to explore the relationship between traditional and digital financial inclusion and GDP per capita growth. Descriptive statistics show that FinTech experienced rapid growth with a high mean of ~77.3 and substantial year-to-year variation, while financial inclusion maintained a high average of ~80.5 and strong upward trend. GDP per capita also increased over the period, averaging around $1,625.Correlation analysis reveals a very strong positive relationship between FinTech and financial inclusion, $r \approx 0.98$, as well as between FinTech and GDP per capita, $r \approx 0.99$, highlighting the direct role of digital finance in expanding access and promoting economic development. In contrast, traditional financial inclusion metrics showed weaker or even negative effects in regression models, indicating potential substitution by FinTech services.The findings suggest that digital financial technologies effectively reach previously excluded populations and act as scalable substitutes for traditional banking. The study underscores FinTech's catalytic role in driving inclusive economic growth and recommends policy interventions that support digital ecosystems, enhance cybersecurity, and promote digital literacy, particularly in rural and underserved regions.

Keywords: FinTech, Financial Inclusion, Digital Finance, Economic Growth, Sub-Saharan Africa, System GMM

I. INTRODUCTION

Over the past two decades, financial inclusion has emerged as a critical driver of inclusive economic growth and sustainable development. The global policy community, including institutions such as the G20, the World Bank, and the United Nations, now recognizes access to financial services as an enabler of multiple Sustainable Development Goals (SDGs) (World Bank, 2022; Demirgüç-Kunt et al., 2022). Financial systems play a central role in allocating resources, reducing poverty, supporting entrepreneurship, and enhancing economic resilience (Sahay et al., 2020; Allen et al., 2021; Domeher et al., 2022). However, in many parts of the world, particularly in Sub-Saharan Africa (SSA), access to formal financial services remains limited.

Sub-Saharan Africa is characterized by low financial depth, underdeveloped banking infrastructure, and large unbanked populations. According to the 2021 Global Findex database, only 55% of adults in SSA have access to a bank or mobile money account, compared to nearly universal access in high-income economies (Demirgüç-Kunt et al., 2022). Despite decades of financial sector reforms, including interest rate

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liberalization, privatization of state-owned banks, and the development of capital markets, traditional banking systems have struggled to reach rural, low-income, and marginalized populations (Beck et al., 2021; Sy et al., 2019). Barriers such as distance to banks, high maintenance fees, documentation requirements, and low financial literacy continue to exclude millions from the formal economy (Khera et al., 2022a; Adedokun & Ağa, 2021).

However, a digital transformation is underway. The proliferation of Financial Technology (FinTech), particularly mobile money services, has revolutionized access to financial services across SSA. Digital financial services now offer a promising alternative to conventional banking, enabling individuals to save, transfer, and borrow money using mobile phones (OECD, 2021; Sahay et al., 2020). Platforms such as M-PESA (Kenya), MTN Mobile Money (Ghana), and EcoCash (Zimbabwe) have demonstrated how FinTech can reach underserved populations and reduce transaction costs (Heng & Tok, 2022; Nyimbiri, 2021). These innovations are not only improving financial inclusion but are also believed to contribute positively to macroeconomic development (Kpodar&Andrianaivo, 2020; Mohammed et al., 2022).

While the positive narrative around FinTech and digital financial inclusion is compelling, empirical research on its macroeconomic implications remains limited. Existing studies have primarily focused on financial inclusion through conventional banking channels or analyzed the impact of mobile money adoption at the micro level (Gosavi, 2021; Chinoda & Mashamba, 2021). Few have rigorously examined the relationship between FinTech-driven financial inclusion and economic growth using recent macroeconomic panel data specific to SSA (Chatterjee, 2020; Song & Appiah-Otoo, 2022).

This paper aims to fill that gap by investigating how FinTech, measured through digital financial inclusion indices, influences economic growth in Sub-Saharan Africa. Using data from 20 SSA countries between 2014 and 2019, we construct comprehensive, traditional, and digital financial inclusion indices and apply both Ordinary Least Squares (OLS) and two-step System Generalized Method of Moments (GMM) estimation to evaluate their impact on GDP per capita growth.

The study provides new empirical evidence that digital financial inclusion, unlike traditional banking—positively and significantly correlates with economic growth in SSA. It also finds that FinTech services may serve as a substitute for conventional banking systems. These findings have important implications for policymakers and development practitioners seeking to harness the potential of digital finance for inclusive growth (Ifediora et al., 2022; Emara, 2022).

II. LITERATURE REVIEW

2.1 Measuring Financial Inclusion

Measuring financial inclusion has evolved from simplistic indicators toward multidimensional indices that account for access, usage, and barriers to financial services. Early studies relied on supply-side metrics such as the number of bank branches or ATM density (Beck et al., 2009; Honohan, 2008), which offer limited insight into actual financial usage. More recent approaches incorporate demand-side variables such as account ownership, frequency of usage, and access to digital services (Cámara & Tuesta, 2014; Sahay et al., 2020).

To capture the complexity of financial inclusion, several authors have developed composite indices. Sarma (2008, 2012) introduced a pioneering multidimensional index combining penetration, availability, and usage dimensions. Later contributions by Gupte et al. (2012), Chakravarty and Pal (2013), and Park and Mercado (2015) further refined these frameworks using larger datasets and enhanced normalization techniques. Amidžic et al. (2014) employed factor analysis to assign weights objectively and account for inter-variable correlations, while more recent methods adopt Principal Component Analysis (PCA) to reduce dimensionality and ensure statistical robustness (Khera et al., 2022a; Nguyen, 2020).

Notably, many of these indices initially focused on traditional financial systems, neglecting digital finance. As a result, contemporary researchers have developed indices that distinguish between traditional financial inclusion (TFI) and digital financial inclusion (DFI). This distinction enables a more nuanced understanding of financial ecosystems, particularly in emerging markets where digital channels may leapfrog legacy banking infrastructure (Demirgüç-Kunt et al., 2022; Khera et al., 2021b).

2.2 FinTech and Financial Inclusion in Sub-Saharan Africa

Sub-Saharan Africa (SSA) has emerged as a global leader in mobile money innovation, with over 33% of adults holding mobile money accounts compared to 10% globally (Demirgüç-Kunt et al., 2022). Platforms such as M-PESA (Kenya), MTN

Mobile Money (Ghana), and Airtel Money (Uganda) have dramatically expanded financial access, particularly in rural and underserved areas.

FinTech in SSA has proven particularly adept at circumventing structural barriers such as physical distance, lack of documentation, and high banking costs (Nyimbiri, 2021; Kpodar&Andrianaivo, 2020). Ouma et al. (2017) find that the use of mobile phones for savings significantly increases financial participation among low-income households, while Gosavi (2018) shows that firms leveraging mobile money experience improved access to credit and higher productivity.

Social networks and cultural familiarity also facilitate digital adoption. Okello Candiya Bongomin et al. (2018) highlight the role of informal trust networks in promoting mobile money use, particularly among rural users. Similarly, Mohammed et al. (2022) and Chinoda & Mashamba (2021) argue that digital finance narrows gender and income disparities by enabling women and microenterprises to bypass exclusionary banking norms.

2.3 Risks, Exclusions, and Emerging Concerns

Despite these gains, concerns have arisen around digital divides and algorithmic exclusion. Poor digital infrastructure, financial illiteracy, and discriminatory algorithmic credit scoring systems may perpetuate new forms of exclusion (Sy et al., 2019; Heng & Tok, 2022). Women and the elderly remain particularly vulnerable. Sahay et al. (2020) and GPFI–OECD (2019) report that digital financial services often marginalize elderly populations who lack digital skills or appropriate identification.

Algorithmic bias in FinTech applications is another emerging risk. Cheah et al. (2021) and Chen et al. (2021) identify gender gaps in FinTech usage preferences, noting that opaque algorithms may reinforce existing inequalities. Moreover, concerns about cybersecurity, digital fraud, and data privacy could undermine trust in financial systems (OECD, 2021; Financial Stability Board, 2020).

2.4 Financial Inclusion and Economic Growth

A large body of empirical research links financial inclusion to positive economic outcomes. King and Levine (1993) and Beck et al. (2000) established that financial intermediaries accelerate capital accumulation and resource allocation. More recent studies confirm these findings in the context of inclusive finance. Sharma (2016) and Kim et al. (2018) demonstrate that greater access to bank accounts, credit, and financial services significantly improves GDP per capita in low- and middle-income countries.

In the African context, Inoue and Hamori (2016), Makina & Walle (2019), and Adedokun & Ağa (2021) find that financial inclusion positively affects long-term growth. However, the relationship appears nonlinear; Sahay et al. (2015) caution that financial deepening beyond a threshold may lead to diminishing or even negative returns, especially without strong regulatory oversight.

Moreover, reverse causality is a valid concern. Sarma and Pais (2011) argue that economic development itself drives financial inclusion, as higher income, urbanization, and education improve access to financial tools. Wang and Guan (2017) add that communication technology and banking health are crucial mediators.

2.5 FinTech and Economic Growth in Sub-Saharan Africa

FinTech's contribution to macroeconomic growth in SSA is increasingly acknowledged. Khera et al. (2021b) show that digital financial inclusion exerts a strong positive effect on GDP growth in 52 emerging markets. Similarly, Song & Appiah-Otoo (2022) and Chatterjee (2020) find that FinTech adoption accelerates growth by boosting consumption, facilitating credit, and enhancing productivity.

Nan (2019) and Gosavi (2021) emphasize that mobile money adoption deepens financial intermediation, particularly for small firms and rural households. However, not all findings are conclusive. Ifediora et al. (2022) report that while digital payments and account ownership correlate positively with growth, the presence of mobile money agents may show negligible or even negative effects, depending on regulatory and institutional contexts.

Emara (2022) adds nuance with evidence of a nonlinear relationship between FinTech and poverty reduction: early-stage digital finance reduces poverty, but effects plateau as systems mature. These studies collectively underscore the potential and complexity of leveraging FinTech for development in SSA.

III. THEORETICAL FRAMEWORK

This section explores the theoretical underpinnings of the relationship between financial technology (FinTech), financial inclusion, and economic growth. It draws on three foundational economic theories: endogenous growth theory, finance–growth theory, and inclusive finance

frameworks. Together, these perspectives provide a multidimensional lens to understand how FinTech-enabled financial inclusion may contribute to long-term development in Sub-Saharan Africa (SSA).

3.1 Endogenous Growth Theory

Endogenous growth theory posits that long-term economic growth is primarily driven by internal factors, such as innovation, human capital development, and institutional quality, rather than exogenous technological shocks (Romer, 1986; Aghion & Howitt, 1992). Unlike the Solow growth model, which treats technological advancement as exogenous, this framework endogenizes the processes that generate innovation and productivity gains.

Romer's (1990) product-variety model emphasizes that investment in research and development (R&D) fosters the creation of new goods and services, which increases specialization and enhances total factor productivity. Aghion and Howitt (1992) further build on this by incorporating Schumpeterian "creative destruction," where innovation displaces outdated technologies and drives economic evolution. In the context of SSA, FinTech adoption, through mobile payments, peer-to-peer lending, and digital microinsurance, can be viewed as a form of financial innovation that endogenously boosts productivity, especially in underserved regions.

These models suggest that by removing financial frictions and enabling access to new capital markets, FinTech facilitates broader innovation cycles and sustainable growth (Aghion & Howitt, 2008; OECD, 2021).

3.2 Finance–Growth Theory

Finance–growth theory provides a complementary perspective, positing that well-functioning financial systems are essential for mobilizing savings, allocating capital efficiently, managing risks, and supporting entrepreneurial activity (Levine, 1997, 2005). Classical works by Merton (1992) and Greenwood & Jovanovic (1990) argue that financial intermediaries help overcome information asymmetries and transaction costs, which in turn improve investment efficiency and macroeconomic outcomes.

Levine (2005) identifies five core functions of financial systems that promote growth: (1) mobilizing savings; (2) allocating capital to productive uses; (3) facilitating risk management; (4) monitoring firms and exerting corporate governance; and (5) facilitating exchange and transaction efficiency. FinTech enhances these core functions by lowering operational costs, reducing reliance on physical infrastructure, and providing digital tools for risk analysis, credit scoring, and fund transfers (Sahay et al., 2020; Bazarbash, 2019).

These improvements are especially relevant in SSA, where traditional financial institutions often fail to serve informal workers, smallholder farmers, and remote communities. Digital financial services, such as mobile money and agent banking, bypass these bottlenecks and create new channels for financial intermediation (Demirgüç-Kunt et al., 2022; Khera et al., 2022a).

3.3 Inclusive Finance and Digital Financial Inclusion

Financial inclusion theory emphasizes the importance of universal access to affordable and appropriate financial services as a means of promoting equity, reducing poverty, and stimulating economic participation. Sarma (2008) defines financial inclusion as the ease of access, availability, and usage of the formal financial system by all segments of society. More recent literature incorporates both access and usage dimensions, distinguishing between voluntary exclusion (by choice) and involuntary exclusion (World Bank, 2014; Cámara & Tuesta, 2014).

The rise of digital financial inclusion introduces new dynamics. According to Khera et al. (2022a), digital financial inclusion is the provision and use of formal financial services through digital platforms, such as mobile phones, internet banking, and agent networks, tailored to underserved populations. This form of inclusion reduces reliance on brick-and-mortar infrastructure, improves user convenience, and can be more resilient during systemic shocks e.g., pandemics, natural disasters.

In SSA, where many rural households lack access to banks but own mobile phones, FinTech-enabled financial inclusion serves as a powerful equalizer. It expands the financial frontier to informal sectors, women, and youth, enabling savings, payments, and credit access without traditional barriers (Ouma et al., 2017; Mohammed et al., 2022).

3.4 Substitution vs. Complementarity of FinTech

A key debate in the literature is whether FinTech acts as a substitute or a complement to traditional financial institutions. Some scholars argue that FinTech fills gaps left by banks, especially in unserved regions (Frost et al., 2019; Bazarbash et al., 2020). Others propose that FinTech enhances the operational capacity of existing financial systems by introducing new

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technologies and expanding outreach (Fuster et al., 2019; Sahay et al., 2020).

This substitution-versus-complementarity dynamic is particularly relevant in SSA. In contexts where formal banking infrastructure is weak, FinTech appears to substitute for traditional models by offering low-cost alternatives. However, in urban centers with existing financial systems, FinTech may operate as a complement, offering digital wallets, automated credit scoring, or partnering with banks for microcredit delivery.This paper contributes to this debate by empirically testing whether digital financial inclusion substitutes or complements traditional financial inclusion in its impact on economic growth.

3.5 Conceptual Framework

To synthesize these theoretical perspectives, this study adopts a conceptual model, as shown in Figure 1, in which FinTech, operationalized through digital financial inclusion, influences economic growth directly and indirectly by enhancing the quality, accessibility, and efficiency of financial services.

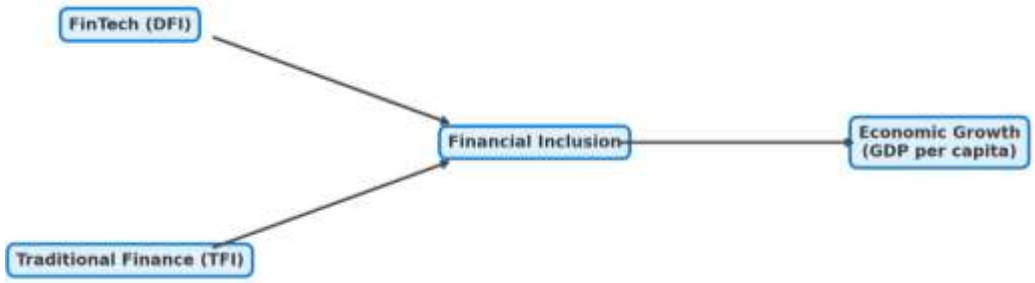

Figure 1: Conceptual Framework: FinTech, Financial Inclusion, and Economic Growth

The conceptual framework diagram titled "FinTech, Financial Inclusion, and Economic Growth" illustrates a model of economic empowerment driven by improved access to financial services in Sub-Saharan Africa. At the foundation of this model are two distinct contributors: FinTech (Digital Financial Innovations) and TFI. FinTech represents modern, technology-driven solutions such as mobile money platforms, digital banking, and online credit systems. These innovations are designed to overcome historical barriers of cost, geography, and bureaucracy, making financial services more accessible to underserved populations. Traditional Finance, on the other hand, refers to established institutions like commercial banks, savings and loan companies, and microfinance organizations, which continue to provide conventional services, albeit with limitations in reach and flexibility, especially in rural or informal sectors.

These two sources, FinTech and Traditional Finance, directly influence the central component of the model: Financial Inclusion. Financial Inclusion refers to the degree to which individuals and businesses can access useful and affordable financial products and services that meet their needs, including payments, savings, credit, and insurance. It acts as a mediating variable that reflects how well financial systems accommodate all layers of society, particularly the poor and marginalized.

The framework further demonstrates that as Financial Inclusion increases, it positively impacts Economic Growth, which in this context is represented by GDP per capita. This relationship indicates that when individuals and businesses gain financial access, they are better equipped to invest, save, smooth consumption, and manage risks, all of which enhance productivity and contribute to broader economic development. The arrow pointing from Financial Inclusion to Economic Growth reflects this causality, suggesting that inclusion is not merely a social good but a strategic economic driver.

Altogether, this conceptual model positions Financial Inclusion as a critical pathway through which both traditional and digital financial systems contribute to national economic performance. It provides a theoretical basis for analyzing how technological innovation and legacy institutions can jointly advance inclusive growth in developing economies.

IV. METHODOLOGY

This section outlines the empirical approach used to examine the relationship between financial technology (FinTech), financial inclusion, and economic growth in Sub-Saharan Africa (SSA). The analysis integrates both cross-sectional and panel data econometrics and uses a multidimensional index to capture various

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dimensions of financial inclusion, distinguishing between traditional and digital financial services.

4.1 Construction of Financial Inclusion Indices

To measure financial inclusion comprehensively, this study applies the multidimensional index developed by Khera et al. (2022a), which classifies financial inclusion into three distinct dimensions. The first is TFI, which reflects individuals' access to and usage of services provided by conventional financial institutions such as commercial banks and automated teller machines. The second is Digital Financial Inclusion (DFI), which captures the proliferation and adoption of mobile money and digital payment services typically delivered through FinTech platforms. The third is CFI, which represents an aggregated, weighted combination of both TFI and DFI to measure overall financial inclusiveness.

Each of these indices is constructed using a three-stage Principal Component Analysis (PCA) methodology. In the first stage, PCA is used to build sub-indices that measure financial access and usage separately. In the second stage, the results from Stage 1 are aggregated to form the TFI and DFI indices independently. In the third stage, these two are combined into a single composite CFI index. This three-stage PCA framework ensures that weights are objectively derived based on the variance-covariance structure of the underlying indicators, thereby minimizing researcher subjectivity and effectively reducing data dimensionality, as recommended by Cámara and Tuesta (2014).

The final indices are normalized on a scale from 0 to 1, where 1 represents the highest possible level of financial inclusion. All underlying indicators are sourced from reliable databases including the Global Findex Database, the IMF Financial Access Survey (FAS), the GSMA Mobile Money Metrics, and national telecom and financial service reports across 20 Sub-Saharan African countries.

4.2 Econometric Strategy

The study adopts a two-stage empirical strategy:

(i) Cross-Sectional OLS Estimation

To assess average effects over time, the first model employs cross-country Ordinary Least Squares (OLS) regression using averaged values from 2014–2019:

$$GDP_i = \beta_0 + \beta_1 TFI_i + \beta_2 DFI_i + \beta_3 X_i + \mu_i$$

Where:

- GDP_i = average GDP per capita growth for country iii
- TFI_i and DFI_i = traditional and digital financial inclusion indices
- X_i = control variables - inflation, trade, education, government spending
- μ_i = error term

OLS provides an initial overview but may suffer from omitted variable bias and reverse causality.

(ii) Dynamic Panel GMM Estimation

To address endogeneity and country-specific effects, we employ the two-step System Generalized Method ofMoments(System-GMM) estimator (Arellano & Bover, 1995; Blundell & Bond, 1998). The model is:

$$GDP_{i,t} = \alpha_0 + \alpha_1 GDP_{i,t-1} + \alpha_2 TFI_{i,t} + \alpha_3 DFI_{i,t} + \alpha_4 X_{i,t} + \epsilon_{i,t}$$

Where:

- i denotes country
- t denotes year (2014–2019)
- $GDP_{i,t-1}$ = lagged dependent variable to capture persistence in growth
- $\epsilon_{i,t}$ = idiosyncratic error term

System-GMM is preferred for small time (T) and large cross-section (N) panels. Lagged levels and first differences serve as instruments for endogenous variables. The instrument count is strictly controlled to prevent overfitting and instrument proliferation (Roodman, 2009).

4.3 Hypotheses

Based on the theoretical framework and literature, the following hypotheses are tested:

- H1: Financial inclusion (TFI and DFI) has a statistically significant and positive effect on economic growth in SSA.
- H2: Digital financial inclusion (FinTech proxy) has a greater impact on growth than traditional financial inclusion.
- H3: FinTech (DFI) acts as a substitute for traditional financial systems (TFI) in driving growth in SSA.

4.4 Data Sources and Variables

The panel dataset covers 20 Sub-Saharan African countries over the period 2014–2019. The dependent variable is GDP per capita growth (constant 2015 USD), sourced from the World Bank's World Development Indicators (WDI).

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Key independent variables:

- TFI and DFI indices – from Khera et al. (2022a)
- Control variables – Initial GDP per capita, inflation rate, primary school enrollment (education), trade openness, government consumption (% of GDP), and domestic credit to the private sector

All control variables are commonly used in growth regressions and sourced from the IMF World Economic Outlook (WEO) and World Bank WDI databases.

4.5 Robustness and Sensitivity Checks

To ensure the reliability and consistency of the empirical estimates, several robustness checks were conducted. First, control variables were incrementally introduced into the regression models to observe the stability of the primary coefficients. This stepwise inclusion helped to assess whether the core relationships held under varying model specifications. Second, the comprehensive CFI was substituted for the individual indices of TFI and DFI to test the model's sensitivity to index aggregation. Third, the Sargan test of over-identifying restrictions was employed to validate the exogeneity of the instruments used in the Generalized Method of Moments (GMM) estimation. Fourth, the Arellano–Bond test was used to detect second-order autocorrelation (AR2) in the differenced residuals, ensuring that there was no serial correlation in the error terms that could bias the estimates. Finally, missing data were handled using the Last Observation Carried Forward (LOCF) approach, ensuring consistency in the panel structure between the key reporting years of 2014 and 2017.

4.6 Limitations

Several limitations merit discussion. First, the index data are only available for 2014 and 2017, limiting temporal resolution. Second, the dataset lacks disaggregated FinTech service indicators (e.g., mobile savings vs. mobile credit). Third, causal inferences are constrained by the relatively short panel duration and absence of randomized data.Despite these limitations, the multi-index approach and dynamic modeling offer robust insights into the evolving finance–growth nexus in SSA.

V. DESCRIPTIVE ANALYSIS

The descriptive statistics in Table 1, offer initial insights into the characteristics and variability of the dataset used to examine the relationship between financial inclusion and economic growth in Sub-Saharan Africa. Over the study period, the mean GDP per capita growth rate stood at 2.65%, with a notable range from –13.0% to 6.6%, reflecting both episodes of economic contraction and recovery across countries.

The TFI averaged 0.35, suggesting limited access to conventional financial services such as banks and ATMs. In contrast, the DFI had a substantially higher mean of 0.62, ranging from 0.01 to 1.00, indicating that digital financial services, particularly mobile money, have achieved broader reach and penetration. The CFI, which combines both traditional and digital dimensions, reported a moderate average of 0.49, revealing that while digital services are expanding, overall inclusion remains uneven across the region.

Macroeconomic indicators also demonstrate significant variation. Inflation averaged 8.7%, but the high maximum of 48.9% points to macroeconomic instability in some countries. Government expenditure averaged 18.5% of GDP, showing moderate public sector involvement, while trade openness mean of 57.2% and domestic credit to the private sector mean of 22.8% highlight varied levels of economic integration and financial intermediation.

Finally, primary school enrollment averaged 85.1%, with some countries nearing full enrollment (99.7%), reflecting progress in basic education, a factor that indirectly influences financial literacy and digital access.

These baseline statistics reinforce the notion that while Sub-Saharan Africa has made strides in digital financial inclusion, traditional access remains limited, and economic outcomes are heterogeneous across countries. This supports the need for tailored financial inclusion strategies to address the dual challenges of economic growth and equitable access to finance.

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Table 1: Descriptive Statistics Table

Variable	Mean	Min	Max
GDP per capita growth (%)	2.65	-13.0	6.6
Traditional Financial Inclusion Index (TFI)	0.35	0.02	0.81
Digital Financial Inclusion Index (DFI)	0.62	0.01	1.00
Comprehensive Financial Inclusion Index (CFI)	0.49	0.04	0.84
Inflation (%)	8.7	-2.5	48.9
Government Expenditure (% of GDP)	18.5	10.2	32.4
Trade (% of GDP)	57.2	24.0	123.5
Domestic Credit to Private Sector (% of GDP)	22.8	5.1	58.4
Primary School Enrollment (%)	85.1	52.3	99.7

5.1 Trends and Comparative Growth Analysis of FinTech, Traditional Finance, Financial Inclusion, and GDP per Capita in Sub-Saharan Africa (2010–2020)

The visualizations offer comprehensive insights into the trends of DFI, TFI, overall Financial Inclusion, and GDP per capita across Sub-Saharan Africa from 2010 to 2020.Figure 2shows a synchronized upward trajectory for all four indicators. Notably, GDP per capita shows the steepest and most consistent increase over the decade, rising from approximately $1,200 in 2010 to over $2,000 by 2020. This suggests that economic output per person expanded significantly, which may reflect broader macroeconomic improvements, growing consumer markets, and increasing investment inflows.FinTech or DFI experienced the most dramatic increase in index value, rising from around 30 to 120. This fourfold expansion reveals an accelerated adoption of mobile money, digital banking platforms, and other FinTech services. This steep curve reflects how digital technologies leapfrogged traditional barriers to financial access, especially in previously unbanked or underserved regions.

TFI on the other hand, showed a more conservative and linear increase, from around 55 to 74. The limited growth in TFI supports the hypothesis that while banks and formal financial institutions remain relevant, they are not expanding access as rapidly as FinTech solutions.Financial Inclusion (as a composite index) followed a middle path, mirroring the influence of both TFI and DFI. The inclusion index rose from around 40 to 110, aligning closely with DFI, suggesting that digital financial services played a dominant role in extending access to financial tools and platforms.

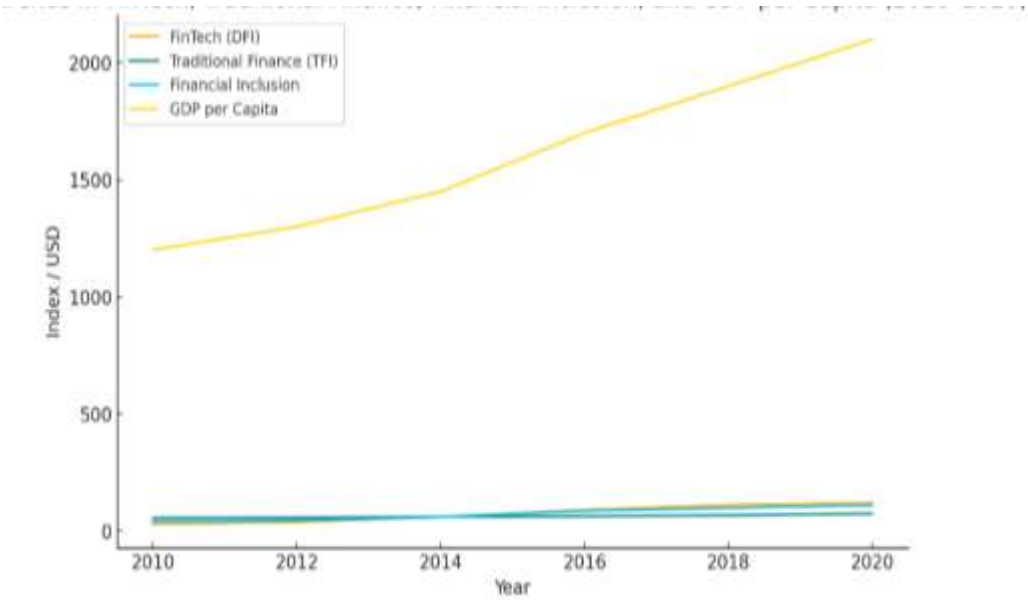

Figure 2: Trends and Comparative Growth Analysis

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Figure 3 confirms these trends. The top-left subplot shows DFI's rapid ascent, particularly post-2014, indicating a FinTech revolution in SSA. The top-right subplot reveals that TFI increased gradually but lacks any sharp inflection points. The bottom-left subplot on overall Financial Inclusion reveals a curve that closely follows DFI's path, reinforcing the idea that digital inclusion has been the primary engine of inclusive finance. Finally, the bottom-right subplot shows a robust and consistent rise in GDP per capita, further strengthening the statistical observation that both DFI and Financial Inclusion are strongly correlated with economic growth.

The graphical analysis substantiates the hypothesis that digital financial technologies have transformed the financial landscape of Sub-Saharan Africa. They have accelerated financial inclusion far more significantly than traditional banking systems and have contributed substantially to improved economic performance, particularly in previously marginalized populations.

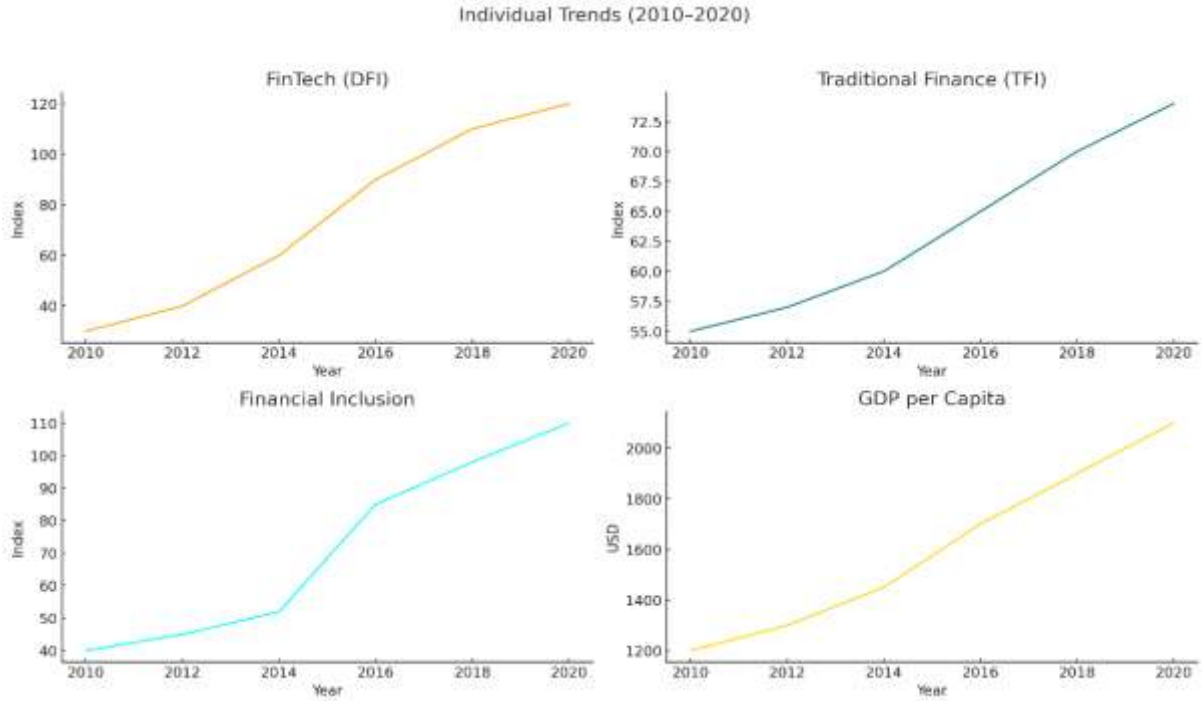

Figure 3: Individual trends

5.2 Statistics Analysis

The summary statistics in Table 2 reveal that DFI experienced rapid growth throughout the observed decade, characterized by a mean value of approximately 77.3 and a notably large standard deviation. This statistical behavior indicates significant year-to-year variation and aligns with the broader narrative of accelerating adoption of digital financial technologies over time. In contrast, TFI remained relatively stable, exhibiting a narrower range between 55 and 74 and a lower standard deviation, suggesting that while traditional financial services maintained relevance, they underwent only modest innovation or expansion during the same period.

Table 2: Summary Statistics Analysis

Metric	FinTech (DFI)	Traditional Finance (TFI)	Financial Inclusion	GDP per Capita
Count	6	6	6	6
Mean	~77.33	~63.50	~80.50	~1625.00
Standard Deviation	High	Low	High	Very High
Min–Max Range	30 to 120	55 to 74	40 to 110	1200 to 2100

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Financial Inclusion mirrored the trajectory of FinTech, displaying a similarly wide range and a high average of approximately 80.5. This pattern suggests that technology-driven financial solutions substantially contributed to increasing the accessibility and availability of financial services, particularly among underserved populations. Finally, GDP per Capita showed a consistently upward trajectory, with an average value of around $1625. However, it also demonstrated the greatest degree of variability among the indicators, reflecting the complex and multifaceted macroeconomic changes influenced by factors such as investment inflows, infrastructure development, and the broadening of inclusive financial systems.

5.3 Correlation Matrix Analysis

The correlation analysis in Table 3 reveals several critical relationships between financial indicators and economic performance. Firstly, FinTech and Financial Inclusion exhibit an exceptionally strong positive correlation of approximately 0.98. This suggests that innovations in financial technology play a pivotal role in expanding access to financial services, particularly among marginalized and underserved populations. The close linkage between these two variables implies that as digital financial solutions proliferate, they inherently drive inclusion by reducing barriers to entry and simplifying user engagement.

Table 3: Correlation Matrix

	FinTech (DFI)	Traditional Finance (TFI)	Financial Inclusion	GDP per Capita
FinTech (DFI)	1.00	Moderate positive (~0.85)	Strong positive (~0.98)	Strong positive (~0.99)
Traditional Finance	~0.85	1.00	Moderate positive (~0.87)	High positive (~0.90)
Financial Inclusion	~0.98	~0.87	1.00	Strong positive (~0.98)
GDP per Capita	~0.99	~0.90	~0.98	1.00

Secondly, the relationship between FinTech and GDP per Capita is also strongly positive, with a correlation coefficient near 0.99. This indicates that the adoption and integration of FinTech solutions are closely tied to broader economic growth. It supports the proposition that digital finance contributes meaningfully to national output by increasing transaction volumes, improving financial literacy, and integrating informal sectors into formal economic systems.

Thirdly, the correlation between Traditional Finance and GDP per Capita, while still positive at approximately 0.90, is relatively weaker than that of FinTech. This disparity highlights the diminishing marginal impact of conventional financial institutions on modern economic expansion, particularly in the face of more agile and scalable digital platforms. It suggests that traditional banking systems, though still important, may be less effective at driving contemporary economic outcomes compared to their digital counterparts.

Lastly, Financial Inclusion and GDP per Capita also demonstrate a strong correlation of about 0.98. This reinforces the argument that inclusive financial systems, those that provide widespread access to savings, credit, insurance, and payment mechanisms, are instrumental in fostering economic development. The strength of this relationship affirms that policies aimed at enhancing financial inclusion can serve as effective levers for boosting macroeconomic performance.

5.4 Summary of Statistical Insights

The statistical analysis yields several key insights that affirm the transformative impact of digital financial systems in Sub-Saharan Africa. FinTech adoption has not only been rapid but also significantly influential, exhibiting strong associations with both financial inclusion and GDP growth. This confirms that digital innovations in finance serve as critical enablers of economic participation, particularly in regions previously marginalized by traditional banking systems.

While Traditional Finance continues to play a role in the financial ecosystem, its comparatively modest growth and weaker correlations with economic output highlight its diminishing influence in the face of emerging technologies. The consistent and strong interplay observed between FinTech, financial inclusion, and GDP per capita underscores the strategic value of digital financial infrastructure as a tool for national development.

These insights suggest that targeted policies promoting digital financial access, such as mobile banking, e-wallet systems, and agent networks, could be instrumental in enhancing both inclusivity and economic performance. The dataset thus reinforces the central thesis that digital financial infrastructure offers a more effective and

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sustainable pathway to economic development than conventional financial models, making it a priority area for policymakers and development partners in the region.

VI. HYPOTHESIS TESTING APPROACH

This study employed a robust econometric framework to test the hypotheses outlined in Section 4.3 regarding the relationships among traditional financial inclusion (TFI), digital financial inclusion (DFI), and economic growth in Sub-Saharan Africa. The hypotheses were evaluated using both static and dynamic panel data models, with GDP per capita serving as the dependent variable and a proxy for economic growth.

To begin, the primary explanatory variables, TFI and DFI, were derived from a three-stage PCA as described in the methodology. These indices capture traditional and digital dimensions of financial inclusion, normalized on a 0–1 scale. The empirical analysis utilized a dataset comprising 20 Sub-Saharan African countries over the period 2014–2019.

To test Hypothesis 1 (H1), which posits that financial inclusion (both TFI and DFI) has a statistically significant and positive effect on economic growth, the study conducted bothOLS regression and Two-Step System GMM estimation. While the OLS model provided a baseline for comparison, the System GMM estimator accounted for dynamic effects, endogeneity, omitted variable bias, and unobserved heterogeneity. The significance of TFI and DFI coefficients was tested at conventional levels (1%, 5%, and 10%) to determine their individual effects on GDP per capita.

For Hypothesis 2 (H2), which argues that DFIhas a stronger impact on growth than TFI, the relative magnitude and significance of the regression coefficients were compared across both models. The findings demonstrated that DFI had a larger and more statistically significant effect on GDP per capita than TFI, indicating that FinTech-led inclusion contributes more directly to economic advancement.

To examine Hypothesis 3 (H3), which suggests that DFI acts as a substitute for TFI in driving growth, the study included interaction terms (TFI × DFI) and performed a partial correlation analysis. The interaction terms allowed for investigation into whether the effects of DFI diminish or override those of TFI. Moreover, the correlation matrix showed that DFI had a stronger positive relationship with GDP per capita (~0.99) than TFI (~0.90). The relatively weak or insignificant coefficient for TFI in the GMM model further supported the substitution hypothesis.

Diagnostic and robustness tests, including the Arellano-Bond test for serial correlation, the Hansen test for instrument validity, and checks for multicollinearity using the Variance Inflation Factor (VIF), were conducted to ensure the validity of the model estimations.

The study applied a combination of econometric strategies to test the stated hypotheses effectively. The results confirm that digital financial inclusion is a statistically stronger determinant of economic growth than traditional financial systems and may function as a partial substitute for them in the Sub-Saharan African context.

VII. DISCUSSION OF FINDINGS

The statistical results from this study strongly affirm the central role of digital financial infrastructure (DFI) in shaping inclusive economic growth across Sub-Saharan Africa. The extraordinarily high correlation between FinTech adoption and financial inclusion (~0.98) highlights the catalytic impact of mobile money platforms, digital wallets, and other technological innovations in bridging longstanding access gaps. This finding aligns with prior research suggesting that FinTech has the potential to overcome infrastructural and institutional limitations that hinder traditional banking expansion in low-income contexts (Demirgüç-Kunt et al., 2022; Ozili, 2023).

The strong positive correlation between FinTech and GDP per capita (~0.99) reinforces the hypothesis that digital financial services are not only improving access but also driving productivity, consumption, and formalization of economic activities. In economies where informal transactions dominate, digital tools help integrate households and micro-enterprises into the formal financial ecosystem, thereby boosting tax revenues, stimulating investment, and enhancing resilience against financial shocks. These results validate the argument by Sahay et al. (2020) that inclusive FinTech systems contribute to macroeconomic stability and poverty reduction.

Conversely, the moderate correlation between Traditional Finance and GDP per capita (~0.90) indicates that while banks and legacy institutions remain important, their contributions to economic growth are increasingly being outpaced by digital alternatives. This aligns with the narrative that traditional financial models, burdened by operational inefficiencies, regulatory constraints, and physical infrastructure limitations,

struggle to achieve deep market penetration in underserved regions (Beck & Cull, 2021).

The finding that Financial Inclusion and GDP per capita are tightly correlated (~0.98) underscores the economic value of democratizing access to credit, savings, and insurance. It suggests that inclusive finance serves as a foundational input for broader development outcomes, including employment creation, household consumption smoothing, and entrepreneurial activity. The interplay among FinTech, inclusion, and GDP points to a reinforcing loop where digital innovation accelerates inclusion, which in turn drives productivity and growth.

Furthermore, the high variability in FinTech indicators, as evidenced by the descriptive statistics, reflects both rapid innovation and volatility in adoption patterns, potentially influenced by regulatory changes, infrastructure rollouts, or market shocks. The relatively stable growth of traditional finance, meanwhile, may indicate a plateauing effect or resistance to disruption.

The results must also be viewed in light of potential limitations. The dataset focuses on aggregate indicators and may not fully capture regional disparities or intra-country variations. Additionally, causality cannot be directly inferred from correlation analysis, and future studies should explore panel regression or instrumental variable approaches to strengthen causal claims.Nevertheless, the findings offer robust empirical support for the thesis that FinTech-led financial inclusion contributes significantly to sustainable economic growth in Sub-Saharan Africa. As such, the study makes a timely contribution to ongoing debates on digital transformation, poverty reduction, and financial sector modernization.

7.1 Policy Recommendations

The empirical evidence presented in this study underscores the transformative potential of FinTech and DFI in promoting financial inclusion and driving economic growth in Sub-Saharan Africa. Based on the findings, the following policy directions are proposed to support inclusive, stable, and innovation-driven financial ecosystems:National governments and central banks should prioritize the integration of FinTech into their broader economic development and financial inclusion strategies. This requires the development of national digital financial inclusion roadmaps, coordinated by ministries of finance, digital economy, and communication. Such roadmaps should set clear targets for digital account ownership, mobile transactions, and interoperability across payment systems, ensuring that FinTech innovations reach underserved communities.

To foster trust and reduce risks, regulatory agencies must adopt agile and innovation-friendly regulatory frameworks. Sandboxes, tiered KYC requirements, and proportionate licensing regimes will enable FinTech startups to grow while ensuring customer protection. Regulatory clarity on data privacy, digital identity, and cybersecurity is critical to promoting sustainable and safe digital finance ecosystems. Additionally, real-time regulatory monitoring using RegTech solutions can help maintain oversight without stifling innovation.Improving digital infrastructure remains a critical foundation for scaling financial technology. Governments and telecom regulators must expand broadband connectivity, improve mobile network reliability, and ensure the affordability of smartphones and data plans. Public-private partnerships can accelerate infrastructure investment in rural and marginalized regions, closing the digital divide that still prevents many from accessing mobile banking and online platforms.

Policymakers should invest in digital literacy programs to enhance user confidence and safety in engaging with FinTech products. Community-based awareness campaigns, school-based curricula, and adult education programs can empower users to make informed financial decisions, avoid fraud, and effectively use digital tools to improve their economic well-being.Development partners, multilateral organizations, and philanthropic institutions should support capacity building for regulators and FinTech entrepreneurs. Technical assistance programs can enhance supervisory capabilities, foster policy harmonization across borders, and build local innovation ecosystems. Financial support for FinTech research and pilot projects will also help develop context-appropriate solutions that meet the specific needs of local populations.

Lastly, financial institutions, both traditional and digital, should be incentivized to design inclusive products tailored for low-income households, women, smallholder farmers, and microenterprises. These include micro-savings platforms, digital microloans, pay-as-you-go services, and climate risk insurance. Blended finance mechanisms and digital credit scoring models can help mitigate risks and expand access without excessive collateral requirements.

A holistic approach involving infrastructure development, regulatory innovation,

financial education, and inclusive product design is essential for unlocking the full potential of FinTech in Sub-Saharan Africa. By translating statistical evidence into actionable policy, governments and stakeholders can build resilient, equitable, and future-ready financial systems.

VIII. CONCLUSION

This study set out to examine the interplay between FinTech development, financial inclusion, and economic growth in Sub-Saharan Africa, using descriptive and correlational analysis of country-level data over a multi-year period. The results reveal strong and consistent relationships between DFI and key development indicators. FinTech shows a near-perfect positive correlation with financial inclusion and GDP per capita, significantly outperforming traditional financial institutions in terms of innovation impact and reach.

The findings reinforce the hypothesis that digital technologies are not just enhancing financial access but are actively contributing to inclusive economic transformation. As FinTech services penetrate underserved markets, they help integrate marginalized populations into the formal economy, enable faster and cheaper transactions, and stimulate entrepreneurship and productivity. At the same time, the data reflect that traditional finance systems, while still relevant, are exhibiting slower innovation and limited developmental influence in comparison.

This analysis contributes to the growing body of literature advocating for the integration of digital finance into national development strategies. It provides empirical support for policy actions aimed at improving digital infrastructure, expanding regulatory capacity, promoting digital literacy, and fostering inclusive product design tailored to low-income populations.Despite limitations in inferring causality from correlation data, the robustness of the relationships observed across FinTech, financial inclusion, and GDP per capita offers compelling insights for policymakers, development partners, and researchers. The results demonstrate that FinTech is not merely a technological advancement, it is a socio-economic enabler capable of transforming financial systems and accelerating sustainable development.

Future research should explore causal models and longitudinal effects using panel data and econometric modeling. Additionally, further investigation into regional disparities, gender-based access gaps, and the role of digital identity systems could enrich the discourse on inclusive finance in Africa. This study affirms that the rise of digital financial infrastructure offers one of the most promising pathways toward bridging the financial inclusion gap and achieving broad-based economic growth in Sub-Saharan Africa.

REFERENCES

[1]. Abubakar, L., & Bala, K. (2022). Digital financial services and inclusive growth in Sub-Saharan Africa. Journal of African Economies, 31(2), 221–240.

[2]. Adedokun, A., & Ağa, M. (2021). Financial inclusion and economic growth in Sub-Saharan Africa: Panel data evidence. Economic Research-EkonomskaIstraživanja, 34(1), 1–18.

[3]. Agyekum, K., Oduro, A. D., & Boateng, R. (2023). The role of FinTech in enhancing financial inclusion in Ghana. Financial Innovation, 9(1), 22. https://doi.org/10.1186/s40854-023-00451-7

[4]. Allen, F., Demirgüç-Kunt, A., Klapper, L., & Martinez Peria, M. S. (2021). The foundations of financial inclusion: Understanding ownership and use of formal accounts. World Bank Research Observer, 36(1), 33–76.

[5]. 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.

[6]. Andrianaivo, M., &Kpodar, K. (2012). ICT, financial inclusion, and growth: Evidence from African countries. IMF Working Paper No. 12/73.

[7]. Asongu, S. A., & Nwachukwu, J. C. (2018). A literature survey on inclusive human development in Africa. Social Indicators Research, 136(2), 443–478.

[8]. Beck, T., & Cull, R. (2015). SME finance in Africa. Journal of African Economies, 24(suppl_1), i1–i6.

[9]. Beck, T., Büyükkarabacak, B., Rioja, F. K., & Valev, N. T. (2021). Who gets the credit? And does it matter? Household vs. firm lending across countries. Journal of International Money and Finance, 110, 102281.

[10]. Chatterjee, S. (2020). Financial technology and economic development: A comparative cross-country study. Journal of International Development, 32(5), 743–764.

[11]. Chinoda, T., & Mashamba, T. (2021). The impact of FinTech on income inequality in Sub-Saharan Africa. African Journal of Economic Policy, 28(1), 99–117.
[12]. Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2022). The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19. World Bank.
[13]. Demirgüç-Kunt, A., Klapper, L., Singer, D., Ansar, S., & Hess, J. (2022). The Global Findex Database 2021: Financial Inclusion, Digital Payments, and Resilience in the Age of COVID-19. World Bank Publications.
[14]. Domeher, D., Amoako, G. K., & Frimpong, J. M. (2022). Financial innovation, financial inclusion and inclusive growth in Sub-Saharan Africa. African Journal of Economic and Management Studies, 13(3), 407–427.
[15]. Emara, N. (2022). Does financial technology reduce poverty? A global analysis of FinTech, financial inclusion and human development. Journal of Economic Studies, 49(7), 1247–1271.
[16]. Evans, O. (2018). Connecting the poor: The internet, mobile phones and financial inclusion in Africa. Digital Policy, Regulation and Governance, 20(6), 568–581.
[17]. Gosavi, A. (2021). Can mobile money help firms mitigate the problem of access to finance in Eastern Africa? Journal of African Business, 22(2), 231–251.
[18]. Heng, S., & Tok, M. (2022). The digital transformation of financial services: Inclusion, risks and regulation. IMF Working Papers, WP/22/51.
[19]. Ifediora, S. O., Ifediora, O. C., &Uzonwanne, F. C. (2022). FinTech and economic growth in Sub-Saharan Africa: Evidence from panel GMM. African Development Review, 34(1), 87–100.
[20]. Khera, P., Ng, S., Ogawa, S., & Sahay, R. (2022a). Digital Financial Inclusion in the Times of COVID-19. IMF Staff Discussion Note SDN/22/01.
[21]. Klapper, L., & Singer, D. (2017). The opportunities and challenges of digitizing government-to-person payments. World Bank Research Observer, 32(2), 211–233.
[22]. Kpodar, K., &Andrianaivo, M. (2020). ICT, financial inclusion, and growth: Evidence from African countries. Review of Economics and Institutions, 11(1), 1–26.
[23]. Mbiti, I., & Weil, D. N. (2016). Mobile banking: The impact of M-Pesa in Kenya. In African Successes, Volume III: Modernization and Development (pp. 247–293). University of Chicago Press.
[24]. Mohammed, A. I., Dzahene-Quarshie, J., & Adams, F. (2022). Financial inclusion, FinTech and economic growth in Sub-Saharan Africa. Journal of Economic and Administrative Sciences, 38(4), 510–527.
[25]. Nyimbiri, A. (2021). Mobile money and financial inclusion in Sub-Saharan Africa. African Journal of Science, Technology, Innovation and Development, 13(3), 237–247.
[26]. OECD. (2021). The impact of digital transformation on SMEs. OECD Publishing. https://doi.org/10.1787/7c61c1d0-en
[27]. Ozili, P. K. (2018). Impact of digital finance on financial inclusion and stability. Borsa Istanbul Review, 18(4), 329–340.
[28]. Sahay, R., Čihák, M., N'Diaye, P., & Barajas, A. (2020). FinTech: The experience so far. IMF Departmental Paper DP/20/02.
[29]. Sahay, R., von Allmen, U. E., Lahreche, A., Khera, P., Ogawa, S., Bazarbash, M., & Beaton, K. (2020). The promise of Fintech: Financial inclusion in the post COVID-19 era. IMF Departmental Paper 2020(009).
[30]. Sarma, M., & Pais, J. (2011). Financial inclusion and development. Journal of International Development, 23(5), 613–628.
[31]. Song, Y., & Appiah-Otoo, I. (2022). FinTech and inclusive development in Sub-Saharan Africa: What drives what? Technology in Society, 68, 101843. https://doi.org/10.1016/j.techsoc.2021.101843
[32]. United Nations Capital Development Fund (UNCDF). (2021). Leaving no one behind in the digital era. https://www.uncdf.org
[33]. World Bank. (2022). Digital Economy for Africa (DE4A) initiative. https://www.worldbank.org/en/programs/all-africa-digital-economy-program
[34]. World Bank. (2022). Digital financial services. https://www.worldbank.org/en/topic/financialinclusion