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Financial Technology and Financial Inclusion: Evidence from East African Community Member Countries

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Abstract

This study examined the effect of financial technology on financial inclusion in the eight East African Community member countries. Financial technology was operationalised through penetration rate, usage rate and transaction volume. Anchored on the Diffusion of Innovations Theory, the study adopted a positivist philosophy and an explanatory longitudinal panel design. A balanced panel of 80 country-year observations covering 2014–2023 was analysed by random-effects generalised least squares. The model was significant (Wald $\chi^2 = 88.53$, $p < 0.001$) and explained 66.67% of the variation in financial inclusion. Penetration rate ($\beta = 5.107$, $p = 0.001$) and transaction volume ($\beta = 5.198$, $p < 0.001$) had positive significant effects, whereas usage rate was insignificant ($\beta = 4.769$, $p = 0.398$). The reach of digital-financial infrastructure and the intensity of transactions matter more for inclusion than usage frequency. The study recommends affordable digital infrastructure, interoperable payment ecosystems and consumer protection.

Keywords: Financial technology, financial inclusion, penetration rate, usage rate, transaction volume, East African Community.

1. INTRODUCTION

1.1 Background

Financial technology (fintech) has altered the delivery of payments, savings, credit, insurance, and other financial services by combining mobile connectivity, digital platforms, data analytics, and automated processes (Sangwan et al., 2020; Demir et al., 2022). Its development has particular importance in emerging economies, where distance, branch-maintenance costs, documentation requirements, and low incomes have historically restricted access to formal finance (Kouladoun et al., 2022; Ediagbonya & Tioluwani, 2023). Digital channels can lower transaction costs, extend service hours, improve information flows, and allow providers to reach customers who were previously uneconomical to serve (Kanga et al., 2022; Demir et al., 2022). Fintech is therefore a

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plausible mechanism for widening financial inclusion, understood as meaningful access to and use of affordable, appropriate, and secure formal financial services (Kling et al., 2022; Ozili, 2023).

Across Africa, mobile money and related digital services have expanded the practical reach of finance beyond conventional banking infrastructure (Chinoda & Mashamba, 2021; Mpofu & Mhlanga, 2022). Empirical evidence links digital technologies with greater account access, payment participation, and opportunities for underserved households and firms, although the magnitude of these gains differs by market structure and institutional setting (Banna et al., 2022; Kouladoum et al., 2022). Fintech can also reduce information and search costs, provide transaction records, and create alternative pathways to formal products (Demir et al., 2022; Ediagbonya & Tioluwani, 2023). However, unequal connectivity, low trust, limited capability, and weak consumer protection can prevent technological availability from becoming meaningful inclusion (Wezel & Ree, 2023; Ozili, 2023).

East Africa provides a compelling setting for assessing this relationship because the region combines internationally prominent mobile-money ecosystems with persistent cross-country exclusion. Kenya and Tanzania have experienced wide mobile-money diffusion, whereas fragile or infrastructure-constrained member countries have substantially narrower digital and formal-finance coverage (World Bank, 2023; Kamau & Aduda, 2024). Agent banking, digital credit, and app-based payments have expanded, but development remains uneven because member states differ in connectivity, institutional capacity, consumer trust, regulatory maturity, and service coverage (Misati et al., 2021; Ozili, 2023). This heterogeneity permits a regional panel analysis of whether differences in fintech breadth and intensity translate into differences in financial inclusion over time.

Fintech is multidimensional and should not be represented by a single proxy. Penetration rate captures the breadth of access to digital-financial accounts or services; usage rate captures how frequently active users transact; and transaction volume captures the scale or intensity of digital-financial activity (Liu & Walheer, 2022). Treating these dimensions as interchangeable can conceal important differences because an account may remain dormant, frequent low-value activity may not connect a user to broader formal services, and high transaction intensity may

reveal deeper integration into the financial system (Sangwan et al., 2020; Liu & Walheer, 2022). The present article therefore estimates their simultaneous effects on financial inclusion.

1.2 Research Problem

Despite rapid fintech expansion, large segments of the EAC population remain excluded from formal financial systems, and inclusion outcomes remain markedly unequal among member states (World Bank, 2023; Ozili, 2023). Digital access is uneven, transaction activity is concentrated in more mature markets, and effective use continues to be constrained by infrastructure deficits, affordability, limited trust, low financial capability, product relevance, and institutional fragility (Ediagbonya & Tioluwani, 2023; Wezel & Ree, 2023). Consequently, the existence of a mobile account or digital channel does not necessarily mean that households and firms can use a sufficiently broad range of formal services. The coexistence of technological expansion and persistent exclusion raises a substantive question about whether fintech development improves inclusion and which dimension produces the strongest effect.

Existing empirical evidence is positive overall but remains inconclusive in ways that matter for EAC policy. African studies associate fintech with financial inclusion and reduced service barriers (Chinoda & Mashamba, 2021; Kanga et al., 2022; Kouladoum et al., 2022), while other work shows that outcomes vary with institutional quality, market development, financial capability, and the particular technology or service examined (Banna et al., 2022; Ediagbonya & Tioluwani, 2023). Evidence from India and individual African countries cannot automatically be generalised to a region whose member states differ sharply in digital infrastructure, regulation, income, conflict exposure, and financial-system maturity (Asif et al., 2023; Muthengi, 2022). This leaves a contextual gap in comparable region-wide evidence.

A further methodological and measurement gap arises because many studies are cross-sectional, single-country, or user-level and frequently rely on one fintech proxy (Muthengi, 2022; Misati et al., 2021). Such designs may not capture unobserved country differences or changes through time, while single indicators can obscure the distinction between access, repeated activity, and economic intensity (Liu & Walheer, 2022). A longitudinal multi-country test is therefore required to estimate penetration rate, usage rate, and transaction volume jointly while accounting for country-level

heterogeneity. Accordingly, this study determined the effect of financial technology on financial inclusion in the eight EAC member countries from 2014 to 2023. The remainder of the introduction reviews theoretical and empirical literature and states the hypotheses. Section 2 describes the methodology, Section 3 presents the results, and Section 4 discusses them, draws conclusions and suggests directions for further research.

1.3 Theoretical Review

The Diffusion of Innovations Theory provides the anchor explanation for the spread of fintech. Rogers (1962) argues that adoption is shaped by perceived relative advantage, compatibility, complexity, trialability, and observability. Digital finance should diffuse more rapidly when it is cheaper than conventional alternatives, compatible with everyday exchange, easy to learn, and supported by visible agent and communications networks (David-West et al., 2021; Kanga et al., 2022). At the system level, penetration indicates that adoption has moved beyond early users, while transaction volume indicates that the innovation has become embedded in economic activity. The theory therefore predicts a positive relationship between fintech diffusion and financial inclusion, particularly where digital channels extend formal services to previously excluded groups (Kelikume, 2021; Kanga et al., 2022).

The Technology Acceptance Model complements diffusion theory by explaining individual acceptance through perceived usefulness and perceived ease of use (Davis, 1989). A digital service is more likely to be adopted and sustained when users believe that it improves the speed, convenience, cost, or quality of financial activity and when the service requires limited effort to learn (Aldammagh et al., 2021; Baber, 2021). Access alone may not lead to sustained participation if platforms are difficult to navigate, expensive, unreliable, unsafe, or poorly matched to users' needs (Ediagbonya & Tioluwani, 2023). This reasoning is particularly relevant to usage frequency: repeated interaction is not necessarily equivalent to deeper inclusion when activity is narrow, low-value, or confined to basic transfers.

Financial Inclusion Theory views affordable and appropriate financial access as a means of enabling underserved households and firms to participate in the formal economy (Polillo, 2011; Kling et al., 2022). From this perspective, fintech can reduce geographic and cost barriers, increase

service-point density, and produce digital records that support payments, saving, insurance, and credit (Kandpal & Mehrotra, 2019; Kouladoun et al., 2022). The theory also emphasises meaningful participation rather than registration alone; inclusion requires that services be usable, responsive to client needs, and connected to economic opportunity (Kling et al., 2022; Ozili, 2023). Taken together, the three theories predict positive effects from access breadth and transactional depth while leaving open whether usage frequency has an independent effect after the other dimensions are controlled.

1.4 Empirical Review and Hypotheses

Empirical work across Africa and other emerging markets generally associates digital finance with wider inclusion. Chinoda and Mashamba (2021) found a positive fintech–inclusion relationship in Africa, while Demir et al. (2022) showed that fintech can improve inclusion although distributional effects vary. Kanga et al. (2022) connected fintech diffusion with financial inclusion and income outcomes, and Kouladoun et al. (2022) identified digital technologies as important inclusion drivers in Sub-Saharan Africa. These studies support the proposition that lower delivery costs and wider digital reach can bring underserved users into formal finance.

Evidence outside the region reinforces this association but also demonstrates contextual variation. Asif et al. (2023) reported that fintech and digital-financial services supported inclusion in India, while Goswami et al. (2022) found that fintech improved rural inclusion. Banna et al. (2022) showed that fintech-based inclusion affected the behaviour of microfinance institutions in Sub-Saharan Africa, illustrating that fintech can alter both access and provider incentives. However, differences in regulation, market depth, infrastructure, income, and consumer capability limit the direct transferability of these findings to the EAC (Ediagbonya & Tioluwani, 2023; Ozili, 2023). Regionally relevant studies provide useful but incomplete evidence. Misati et al. (2021) found that financial innovation enhanced financial deepening and growth in Kenya, and Muthengi (2022) reported a significant relationship between financial technology and inclusion in a Kenyan setting. Their country-specific and, in the latter case, cross-sectional designs do not establish whether the association holds across heterogeneous EAC countries over time. Kamau and Aduda (2024) also highlighted the importance of financial technologies in Kenya, but a regional panel is needed to separate common effects from country-specific conditions.

Measurement further explains why findings may differ. Digital accounts may remain inactive, users may rely on limited cash-in/cash-out functions, and transaction frequency may follow income cycles rather than the depth of financial participation (Liu & Walheer, 2022). Transaction volume can better reflect the practical integration of digital tools into commerce, transfers, saving, and payments, while penetration captures how widely the opportunity to participate is distributed (Sangwan et al., 2020; Liu & Walheer, 2022). The present study consequently tested the following null hypotheses:

H_{01a}: Penetration rate has no significant effect on financial inclusion in EAC member countries.

H_{01b}: Usage rate has no significant effect on financial inclusion in EAC member countries.

H_{01c}: Transaction volume has no significant effect on financial inclusion in EAC member countries.

2. METHODOLOGY

2.1 Research Design and Data

The study adopted a positivist philosophy and an explanatory longitudinal panel design. The unit of analysis was the country-year. All eight EAC member countries represented in the approved thesis dataset—Burundi, Democratic Republic of Congo, Kenya, Rwanda, Somalia, South Sudan, Tanzania, and Uganda—were observed over ten years from 2014 to 2023, yielding a balanced panel of 80 observations. The longitudinal design captured both cross-country differences and changes over time.

Secondary data were compiled from the World Bank Global Findex and World Development Indicators, national central banks, national statistics agencies, and official financial-sector reports. Financial inclusion was measured using a composite Financial Inclusion Index (FII) that captured the availability, accessibility, and utilization of formal services. Fintech penetration was measured as the proportion of adults with access to mobile-money or digital-financial accounts; usage rate represented the frequency of digital transactions per active user; and transaction volume represented the annual value of digital financial transactions reported in official statistics. Indicators were harmonized to support cross-country and intertemporal comparability.

2.2 Model Specification and Estimation

Descriptive statistics summarized the distributions. Panel diagnostics assessed normality, multicollinearity, heteroskedasticity, serial correlation, stationarity, and model specification. The Hausman specification test supported the use of a random-effects estimator. The direct-effects model was estimated to use random-effects generalized least squares (GLS):

$$Y_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_{it}$$

where Y_{it} is the Financial Inclusion Index of country i in year t ; X_{1it} is penetration rate; X_{2it} is usage rate; X_{3it} is transaction volume; β_0 is the intercept; β_1 to β_3 are the regression coefficients; and ε_{it} is the error term. Hypotheses were evaluated at the 5% level of significance.

3. RESULTS

3.1 Descriptive Results

Table 1 summarizes the study variables. Financial inclusion averaged 41.03 on the index, ranging from 5.60 to 83.70 (SD = 23.05), a range of 78.10 index points that shows the typical country-year was far removed from both the most and least inclusive observations. The coefficient of variation (CV) of 0.56 indicates moderate relative dispersion and reflects persistent regional disparities.

Fintech penetration averaged 0.537 and reached a maximum of 0.980, indicating near-universal digital-finance access in the most developed observations, while its minimum of 0.071 confirms that access remained extremely limited in some country-years. Its CV of 0.49 was the lowest of the fintech indicators. Usage rate averaged only 0.241, less than half the mean penetration rate, and varied from 0.030 to 0.461 with a CV of 0.65, showing greater relative heterogeneity than penetration. Transaction volume recorded the largest relative dispersion (CV = 1.26), with a mean of 978 million and values ranging from 6.763 million to 4,820 million local-currency units; its standard deviation exceeded its mean, indicating that a small number of mature markets and high-activity years dominated the regional distribution.

Table 1: Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	SD	CV
Financial inclusion index	80	5.600	83.700	41.030	23.050	0.56
Penetration rate	80	0.071	0.980	0.537	0.265	0.49
Usage rate	80	0.030	0.461	0.241	0.156	0.65
Transaction volume (millions)	80	6.763	4,820	978	1,230	1.26

N = 80 country-year observations (8 countries, 2014–2023). SD = standard deviation; CV = coefficient of variation. Source: Authors' computation.

3.2 Regression Results and Hypothesis Tests

Table 2 reports the random effects GLS estimates. The model was jointly significant (Wald $\chi^2(3) = 88.53$, $p < 0.001$). Its overall R-squared was 0.6667; the within- and between-country R-squared values were 0.5232 and 0.6762, respectively. The three fintech indicators therefore collectively explained a substantial proportion of the variation in financial inclusion across the panel.

Penetration rate had a positive and statistically significant coefficient ($\beta = 5.107$, $z = 3.31$, $p = 0.001$; 95% CI 2.083 to 8.131). Holding usage rate and transaction volume constant, a one-unit rise in penetration was associated with an increase of approximately 5.11 units in the financial inclusion index. The confidence interval excluded zero, so H01a was rejected.

Usage rate was positive but statistically insignificant ($\beta = 4.769$, $z = 0.84$, $p = 0.398$; 95% CI –6.293 to 15.831). Its wide confidence interval crossed zero, so H01b was not rejected.

Transaction volume had a positive and highly significant coefficient ($\beta = 5.198$, $z = 4.50$, $p < 0.001$; 95% CI 2.934 to 7.462), leading to the rejection of H01c. The constant was negative and marginally insignificant ($\beta = -47.272$, $p = 0.087$).

Table 2: Random-Effects GLS Estimates of the Effect of Financial Technology on Financial Inclusion

Variable	Coefficient	Std. Err.	z	p-value	95% Confidence Interval
Penetration rate	5.107	1.543	3.31	0.001***	2.083 to 8.131
Usage rate	4.769	5.644	0.84	0.398	−6.293 to 15.831
Transaction volume	5.198	1.155	4.50	0.000***	2.934 to 7.462
Constant	−47.272	27.661	−1.71	0.087*	−101.486 to 6.942

R-squared: within = 0.5232; between = 0.6762; overall = 0.6667

Wald $\chi^2(3)$ (Prob.) 88.53
(0.000)

Observations = 80; groups = 8; observations per group = 10

Decision: H01a rejected; H01b not rejected; H01c rejected

*Dependent variable: Financial Inclusion Index. Random-effects GLS regression; group variable: country; $\text{corr}(u_i, X) = 0$ assumed. *** $p < 0.01$; * $p < 0.10$. Source: Authors' estimation.*

4. DISCUSSION

4.1 Discussion of Findings

The descriptive pattern is informative. The wide dispersion in financial inclusion is consistent with differences in financial infrastructure, institutional stability, income, regulation, and the maturity of digital-finance ecosystems across the EAC (Ozili, 2023; World Bank, 2023). The gap between mean penetration (0.537) and mean usage (0.241) indicates that service availability advanced faster than recurring engagement: accounts may remain dormant or be used only intermittently because of transaction charges, unreliable networks, limited income, lack of trust, or products that do not address users' priorities (Ediagbonya & Tioluwani, 2023; Wezel & Ree, 2023). The heavy concentration of transaction volume shows that countries can achieve broad account access without generating comparable economic intensity, which justified estimating breadth, frequency, and transaction depth simultaneously.

The significant positive effect of penetration rate supports the Diffusion of Innovations Theory: when access points, accounts, mobile connectivity, and agent networks reach a larger share of the population, previously excluded users can enter formal financial channels. The finding is consistent with evidence that digital technologies reduce distance and cost barriers in Sub-Saharan Africa (Kouladoun et al., 2022) and with studies linking fintech diffusion to broader inclusion (Kanga et al., 2022; Chinoda & Mashamba, 2021).

The insignificant effect of usage rate draws an important distinction between activity and inclusion. Frequency may reflect repeated use of a narrow function, such as person-to-person transfers, without expanding savings, credit, insurance, or formal account ownership. It may also be constrained by fees, irregular incomes, network reliability, or limited product relevance. The finding is compatible with the Technology Acceptance Model (Davis, 1989): access and occasional interaction do not establish that a service is sufficiently useful and easy to use to deepen financial participation (Aldammagh et al., 2021; Ediabonyia & Tioluwani, 2023).

The strong positive effect of transaction volume indicates that the economic intensity of fintech use provides a stronger signal of integration than frequency alone. Higher volumes imply that digital platforms are being used for meaningful payments, transfers, commerce, and possibly saving or credit-related activity. The result accords with research showing that digital-financial ecosystems can extend the reach and functionality of formal finance (Demir et al., 2022; Chinoda & Mashamba, 2021) and with the emphasis in Financial Inclusion Theory on meaningful participation rather than registration alone (Kling et al., 2022; Ozili, 2023).

Taken together, the findings show that fintech contributes to inclusion through reach and substantive transaction activity rather than through mere repetition of use. Penetration creates the entry point; transaction volume reveals that the entry point is being used for economically meaningful activity. Usage frequency, when separated from reach and value, does not independently guarantee a broader or deeper connection to the formal system. This resolves part of the mixed evidence in earlier research (Banna et al., 2022; Muthengi, 2022; Liu & Walheer, 2022) by showing that conclusions depend on the fintech proxy selected.

4.2 Conclusion

This article examined the direct effect of financial technology on financial inclusion in eight EAC member countries between 2014 and 2023. Random-effects GLS evidence shows that the fintech dimensions jointly explain a substantial share of financial-inclusion variation. Penetration rate and transaction volume have positive significant effects, whereas usage rate does not have a statistically significant independent effect. The study therefore concludes that fintech promotes inclusion when digital-financial infrastructure reaches more people and supports substantial transaction activity. Access that does not translate into useful, affordable, and sufficiently valuable activity is unlikely to close inclusion gaps by itself.

The study contributes empirically by separating breadth of access, frequency of use, and transaction intensity within a regional panel. It contributes theoretically by showing that diffusion and perceived usefulness are complementary: the diffusion of access is necessary, but the economic usefulness expressed through transactions determines whether technology becomes a pathway to inclusion.

4.3 Recommendations

EAC governments and regulators should prioritize affordable mobile and internet coverage, reliable electricity, agent-network expansion, digital identification, and interoperable payment infrastructure, particularly in rural and fragile settings. Regional harmonization of rules for payments, data protection, cybersecurity, and cross-border transactions would allow fintech providers to scale while protecting consumers.

Financial institutions and fintech providers should design beyond account acquisition. Products should solve recurring financial needs, disclose fees clearly, work on low-cost devices, support local languages, and provide dependable redress for fraud and failed transactions. Providers should monitor active, meaningful use and transaction value alongside registration counts. Consumer education, transparent pricing, and trust-building measures should accompany infrastructure investments so that access converts into sustained participation.

4.4 Limitations and Suggestions for Further Research

The study relied on country-level aggregates for eight countries over ten years, which limits the ability to observe within-country distributional effects and to establish causal direction. Future research should test country-specific dynamics, use household-level or transaction-level data, and distinguish between types of digital activity. Longer panels and quasi-experimental designs would help address possible reverse causality between fintech development and financial inclusion.

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