



FINANCIAL TECHNOLOGY, FINANCIAL DEEPENING AND FINANCIAL INCLUSION: EVIDENCE FROM EAST AFRICAN COMMUNITY MEMBER COUNTRIES

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Abstract

This study examined whether financial deepening mediates the relationship between financial technology and financial inclusion in the eight East African Community member countries. Financial technology was operationalized through penetration rate, usage rate, and transaction volume, while financial deepening was measured by credit to the private sector. The study adopted a positivist philosophy and an explanatory longitudinal panel design using 80 country-year observations for 2014-2023. Random-effects generalized least-squares models and a four-step mediation procedure assessed the direct and indirect pathways. Penetration rate significantly predicted financial inclusion and financial deepening. When both variables entered the final model, the penetration coefficient declined from 9.645 to 8.291 but remained

significant, while financial deepening was also significant ($\beta = 5.317$, $p = 0.025$), confirming partial mediation. Usage rate significantly predicted financial deepening but had no significant initial or final direct effect on inclusion; consequently, mediation was not established. Transaction volume significantly predicted both financial inclusion and financial deepening. In the combined model its coefficient declined from 7.687 to 6.795 and remained significant, while financial deepening was significant ($\beta = 6.094$, $p = 0.003$), confirming partial mediation. The findings show that fintech expands inclusion partly by strengthening formal credit intermediation, but this channel depends on the dimension of fintech considered. Policies should integrate digital-finance infrastructure with credit-market development, interoperable data systems, and inclusive lending mechanisms.

Keywords: Financial Technology, Financial Deepening, Financial Inclusion, Private-sector Credit, Mediation, East African Community

INTRODUCTION

Background

Financial technology has transformed the production and delivery of payments, transfers, savings, credit, and insurance through mobile platforms, data analytics, automated decision systems, and digital distribution networks (Sangwan et al., 2020; Demir et al., 2022). These technologies can reduce geographic and transaction-cost barriers that exclude low-income households, informal firms, and remote communities from formal finance (Kouladoun et al., 2022; Ediagbonya & Tioluwani, 2023). Across Africa, mobile money and related platforms have widened account access and created new channels for financial participation (Chinoda & Mashamba, 2021; Kanga et al., 2022). Yet access to a digital interface does not necessarily mean that financial systems mobilize savings, allocate credit, or supply a sufficiently broad set of services.

Financial deepening describes the expansion, diversification, and increasing capacity of financial institutions and markets to intermediate resources (Olowu et al., 2018; Paun et al., 2019). It is commonly reflected in the volume of credit extended to the private sector relative to economic activity. Deeper systems are better positioned to convert deposits, data, and transaction histories into credit for households and firms, thereby linking technological access to productive participation (Ran et al., 2020; Taddese & Abebaw Degu, 2023). Fintech may contribute to this process by lowering origination costs, generating digital footprints, improving risk assessment, and connecting previously invisible clients to formal institutions (Banna et al., 2022; Zreik et al., 2023).

The relationship between fintech and inclusion may therefore operate through both direct and indirect channels. Directly, digital platforms increase service reach and convenience. Indirectly, their penetration and transaction activity can strengthen intermediation and expand private-sector credit, which in turn improves access to financial products (Misati et al., 2021; Liu & Walheer, 2022). This mediation proposition is important in East Africa, where mobile-finance innovation coexists with shallow credit markets, uneven banking capacity, and wide country differences in institutional stability and infrastructure (Ozili, 2023; Kamau & Aduda, 2024).

Fintech is also multidimensional. Penetration rate measures the breadth of digital-financial access, usage rate captures transaction frequency, and transaction volume represents the economic intensity of digital activity (Liu & Walheer, 2022). These dimensions may create different intermediation effects. Broad access can enlarge the pool of potential borrowers, while larger transaction volumes can generate information and liquidity relevant to credit assessment. Frequency alone may remain confined to low-value transfers and may not necessarily deepen formal finance (Sangwan et al., 2020; Ediabonyia & Tioluwan, 2023).

Problem Statement

Financial inclusion has improved in parts of East Africa, but formal credit access and financial-system depth remain uneven. Some member countries possess dense mobile-money and agent networks, whereas others face limited connectivity, fragile institutions, low banking penetration, and constrained private-sector lending (World Bank, 2023; Ozili, 2023). This divergence implies that digital access may expand without a commensurate increase in the financial system's capacity to mobilize and allocate resources. If fintech remains detached from intermediation, users may transact digitally while continuing to lack savings, insurance, and productive credit.

Existing research establishes associations among fintech, financial development, and inclusion, but the transmission mechanism is insufficiently resolved. Studies show that digital technologies promote inclusion (Chinoda & Mashamba, 2021; Kouladoum et al., 2022), while financial-sector development supports growth and access (Paun et al., 2019; Taddese & Abebaw Degu, 2023). Other work indicates that financial innovation enhances deepening in Kenya (Misati et al., 2021). However, evidence that explicitly tests private-sector credit as the pathway through which separate fintech dimensions influence inclusion across the EAC remains limited.

Methodological and measurement gaps reinforce the problem. Much of the evidence is cross-sectional, single-country, or based on one fintech indicator, making it difficult to distinguish access breadth, usage frequency, and transaction intensity or to account for

persistent country heterogeneity (Muthengi, 2022; Liu & Walheer, 2022). A longitudinal regional mediation analysis is therefore required. This study assessed whether financial deepening mediates the effects of penetration rate, usage rate, and transaction volume on financial inclusion in EAC member countries during 2014-2023.

LITERATURE REVIEW

Theoretical Review

Financial Inclusion Theory explains why expanded access to affordable and appropriate formal services can enable excluded households and firms to participate more fully in economic activity (Polillo, 2011; Kling et al., 2022). The theory emphasizes more than account ownership: institutions must provide useful payment, savings, insurance, and credit services. Fintech lowers delivery barriers, but financial deepening determines whether the system can extend the range and volume of services available through digital channels (Ozili, 2023; Kling et al., 2022).

The Diffusion of Innovations Theory explains how fintech penetration and transaction practices spread through a social system (Rogers, 1962). Relative advantage, compatibility, complexity, trialability, and observability influence adoption, while network effects and visible benefits can accelerate diffusion (David-West et al., 2021; Kanga et al., 2022). As digital platforms diffuse, they expand customer reach and create transaction records. These changes can strengthen formal intermediation by supplying institutions with information and lower-cost distribution channels.

Information Asymmetry Theory provides the central explanation for the mediation pathway. Credit markets are constrained when providers possess less information about borrowers' identity, cash flow, and repayment capacity (Akerlof, 1970). Digital transaction histories can reduce this information gap, support alternative credit scoring, and lower screening and monitoring costs. Financial deepening therefore represents the institutional mechanism through which fintech-generated information and reach can become formal credit and, subsequently, broader inclusion (Banna et al., 2022; Zreik et al., 2023).

Empirical Review and Hypotheses

African evidence generally links fintech diffusion to inclusion. Chinoda and Mashamba (2021) reported a positive relationship between fintech and financial inclusion, while Kanga et al. (2022) found that fintech diffusion was associated with financial inclusion and income outcomes. Kouladoun et al. (2022) similarly identified digital technologies as significant inclusion drivers in Sub-Saharan Africa. These findings support a direct pathway but do not by themselves establish how the institutional capacity of the financial system transmits the effect.

Studies of financial deepening show that broader intermediation can support access and economic activity. Paun et al. (2019) associated financial-sector sophistication with sustainable growth, and Ran et al. (2020) demonstrated that financial deepening has important distributional implications. Taddese and Abebaw Degu (2023) found that financial-sector development affected economic growth in Sub-Saharan Africa. In Kenya, Misati et al. (2021) showed that financial innovation enhanced financial deepening and growth, providing evidence that technology and intermediation are connected.

Fintech can strengthen the connection by producing data, lowering transaction and origination costs, and creating alternative channels for serving clients without conventional collateral or branch access (Banna et al., 2022; Zreik et al., 2023). Transaction volume may be especially relevant because it reflects economically meaningful activity and generates richer cash-flow histories. Penetration can widen the potential client base, whereas frequency without sufficient value or product diversity may not create an independent inclusion effect (Liu & Walheer, 2022; Ediagbonya & Tioluwani, 2023).

The study tested three null sub-hypotheses: H02a, financial deepening does not significantly mediate the relationship between penetration rate and financial inclusion; H02b, financial deepening does not significantly mediate the relationship between usage rate and financial inclusion; and H02c, financial deepening does not significantly mediate the relationship between transaction volume and financial inclusion in EAC member countries.

METHODOLOGY

The study adopted a positivist research philosophy and an explanatory longitudinal panel design. The unit of analysis was the country-year. A balanced panel covered Burundi, Democratic Republic of Congo, Kenya, Rwanda, Somalia, South Sudan, Tanzania, and Uganda from 2014 to 2023, producing 80 observations. Secondary data were obtained from World Bank databases, national central banks, national statistics agencies, and official financial-sector reports. The 2014-2023 period was selected because it captures a full decade of rapid fintech expansion in East Africa while providing the longest recent interval for which the study could assemble sufficiently complete and comparable annual data across all eight countries from the identified official sources. The ten-year span also provides meaningful within-country variation in fintech, financial deepening, and financial inclusion while preserving a balanced panel for consistent estimation.

Financial inclusion was measured using a composite index of availability, accessibility, and utilization. Fintech penetration represented the proportion of adults with mobile-money or digital-financial access; usage rate represented the frequency of digital transactions per active

user; and transaction volume captured the annual value of digital-financial transactions. Financial deepening was operationalized as credit to the private sector relative to gross domestic product, a standard indicator of formal intermediation capacity (Paun et al., 2019; Taddese & Abebaw Degu, 2023).

Descriptive statistics characterized the variables. Panel diagnostics assessed normality, multicollinearity, heteroskedasticity, serial correlation, stationarity, and model specification. The Hausman test supported random-effects generalized least squares. Mediation was evaluated separately for each fintech indicator using a four-step procedure based on Baron and Kenny (1986): the fintech indicator had to predict inclusion; it had to predict financial deepening; financial deepening had to predict inclusion; and the fintech coefficient had to decline when both the indicator and mediator entered the final equation. Partial mediation was inferred when the direct effect declined but remained significant and the mediator was significant.

RESULTS AND DISCUSSION

Descriptive Results

Financial inclusion averaged 41.03 and ranged from 5.60 to 83.70, reflecting substantial cross-country and temporal inequality. Penetration averaged 0.537, usage rate 0.241, and transaction volume 978 million local-currency units. Credit to the private sector averaged 14.66% of GDP, with values from 0 to 48.53% and a coefficient of variation of 0.79. The wide credit range confirms pronounced differences in the ability of EAC financial systems to intermediate resources.

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
Private-sector credit (% GDP)	80	0.000	48.530	14.660	11.640	0.79

Penetration was more widely distributed than sustained usage, while transaction volume showed the greatest relative dispersion. Financial deepening also varied substantially: the zero minimum reflects severe credit constraints in some observations, whereas the maximum indicates considerably more developed intermediation elsewhere. The patterns support a

mediation test because the EAC combines meaningful fintech diffusion with sufficient variation in private-sector credit and inclusion.

Mediation Results

For penetration, the first three mediation conditions were satisfied. Penetration significantly predicted inclusion ($\beta = 9.645$, $p < 0.001$) and financial deepening ($\beta = 0.289$, $p < 0.001$); financial deepening also significantly predicted inclusion ($\beta = 10.744$, $p < 0.001$). In the final model, penetration declined to 8.291 but remained significant, and financial deepening was significant ($\beta = 5.317$, $p = 0.025$). Overall explanatory power increased from $R\text{-squared} = 0.551$ for penetration alone to 0.695 in the combined model. H02a was rejected, confirming partial mediation.

The usage-rate pathway did not meet the initial mediation condition. Usage rate had a positive but insignificant direct effect on inclusion ($\beta = 12.109$, $p = 0.152$), although it significantly predicted financial deepening ($\beta = 0.930$, $p < 0.001$). In the final model, usage remained insignificant ($\beta = 2.347$, $p = 0.785$), while financial deepening was strongly significant ($\beta = 10.495$, $p < 0.001$). Because there was no significant total effect to mediate, H02b was not rejected. The evidence indicates that usage frequency is related to credit-market depth but does not independently translate into inclusion.

For transaction volume, all mediation conditions were met. Transaction volume significantly predicted inclusion ($\beta = 7.687$, $p < 0.001$) and financial deepening ($\beta = 0.146$, $p = 0.003$), while the mediator significantly predicted inclusion. In the final model, the transaction-volume coefficient declined to 6.795 but remained significant, and financial deepening was significant ($\beta = 6.094$, $p = 0.003$). The combined model explained 62.38% of variation in inclusion. H02c was rejected, confirming partial mediation.

Table 2. Summary of Four-Step Mediation Estimates

Path	Step/equation	Fintech beta	Mediator beta	p-value(s)	R- squared	Inference
Penetration	Fintech -> inclusion	9.645	-	<0.001	0.551	Significant
Penetration	Fintech -> deepening	0.289	-	<0.001	0.090	Significant
Penetration	Fintech + mediator - > inclusion	8.291	5.317	<0.001; 0.025	0.695	Partial mediation
Usage rate	Fintech -> inclusion	12.109	-	0.152	0.242	Not significant

Path	Step/equation	Fintech beta	Mediator beta	p-value(s)	R-squared	Inference
Usage rate	Fintech -> deepening	0.930	-	<0.001	0.835	Significant
Usage rate	Fintech + mediator -> inclusion	2.347	10.495	0.785; <0.001	0.343	No mediation
Transaction volume	Fintech -> inclusion	7.687	-	<0.001	0.596	Significant
Transaction volume	Fintech -> deepening	0.146	-	0.003	0.356	Significant
Transaction volume	Fintech + mediator -> inclusion	6.795	6.094	<0.001; 0.003	0.624	Partial mediation

Note. The mediator is financial deepening, measured by credit to the private sector.

The contrast among the three pathways is theoretically meaningful. Penetration expands the number of people and firms visible to the formal financial system, creating opportunities for institutions to extend credit. Transaction volume supplies evidence of cash-flow intensity and commercial activity that can support risk assessment and product design. These mechanisms are consistent with Information Asymmetry Theory because digital reach and data reduce informational barriers between providers and prospective clients (Akerlof, 1970; Banna et al., 2022).

Usage frequency alone is a weaker measure of economic integration. Repeated low-value transfers can occur without savings accumulation, formal borrowing, or access to diverse products. Its strong association with financial deepening indicates that use develops alongside credit-market depth, but the absence of a significant total effect means that it does not independently explain inclusion in this specification. The finding demonstrates why fintech indicators should not be treated as interchangeable (Liu & Walheer, 2022).

Partial rather than full mediation for penetration and transaction volume shows that private-sector credit is one important channel, not the only one. Fintech also improves inclusion directly through payments, transfers, lower service costs, convenience, and geographic reach. At the same time, the significance of credit in both final models confirms that the depth of the financial system determines how much digital innovation becomes broader formal participation. This result extends earlier evidence connecting financial innovation with deepening (Misati et al., 2021) and digital technology with inclusion (Kouladoun et al., 2022).

Table 3. Hypothesis Decisions

Hypothesis	Decision	Conclusion
H02a: No mediation for penetration	Reject	Financial deepening partially mediates the penetration-inclusion relationship.
H02b: No mediation for usage rate	Do not reject	Mediation is not established because the initial direct effect is insignificant.
H02c: No mediation for transaction volume	Reject	Financial deepening partially mediates the transaction-volume-inclusion relationship.

CONCLUSION

The study concludes that financial deepening is a selective transmission mechanism between fintech and financial inclusion in East Africa. Private-sector credit partially carries the effects of penetration rate and transaction volume, but it does not mediate the usage-rate relationship because usage lacks a significant initial direct effect on inclusion. Digital reach and economically meaningful transaction activity therefore strengthen inclusion both directly and by improving the capacity of formal institutions to extend credit.

The findings contribute to financial-inclusion research by integrating technological adoption with institutional intermediation. Fintech cannot be evaluated solely through account access or activity counts; its inclusion effect also depends on whether the financial system can transform digital reach and information into useful credit and other formal services. The results also demonstrate that conclusions about mediation depend on the fintech dimension selected.

RECOMMENDATIONS

EAC governments and regulators should combine digital-infrastructure strategies with policies that deepen credit markets. Priorities include interoperable payment systems, reliable digital identification, effective credit-information sharing, secured-transactions frameworks, and proportionate data-protection and consumer-protection rules. Regional harmonization can support cross-border scale while allowing digital transaction histories to inform responsible lending.

Financial institutions and fintech providers should develop consent-based alternative credit-scoring systems that use transaction data without excluding thin-file or low-income clients. Products should connect payment accounts to savings, microcredit, working-capital finance, and insurance while maintaining transparent pricing, suitability assessment, cybersecurity, and accessible redress. Policymakers should monitor not only account registrations and transaction counts but also the extent to which digital ecosystems expand affordable private-sector credit.

LIMITATIONS & FUTURE STUDIES

The study has several limitations. First, the country-level balanced panel contains only 80 observations, which limits statistical power and the extent to which the findings can be generalized beyond the EAC. Second, reliance on secondary aggregate data may conceal household-, firm-, and country-level differences and may be affected by variation in reporting practices and indicator comparability across sources. Third, credit to the private sector captures only one dimension of financial deepening, while the fintech and financial-inclusion measures cannot fully reflect service quality, affordability, or informal financial activity. Finally, the observational random-effects models and the four-step mediation procedure establish statistical associations rather than definitive causal effects and may remain sensitive to omitted variables, reverse causality, and common regional or time-specific shocks.

Future studies should test the indirect effects using bootstrapped mediation, dynamic-panel or instrumental-variable methods, and country-specific data. Household- and firm-level research could identify whether mediation differs by gender, age, rural location, enterprise size, or type of digital transaction.

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