When Does Digital Finance Deliver Inclusion? Regulatory Quality and Government Effectiveness in Developing Economies

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Abstract: *Purpose – This study tests whether digital finance expands meaningful financial inclusion in developing economies and whether Regulatory Quality and Government Effectiveness condition that relationship.*
Design/methodology/approach – An unbalanced panel of 411 observations from 49 low- and middle-income economies (2014–2024) combines IMF and World Bank data. Two-way fixed-effects models use country-clustered standard errors. Inclusion is a principal-component index of formal saving and credit use; digital finance is observed mobile- and internet-banking transactions.
Findings – Digital finance has a positive but imprecise average association with inclusion. Regulatory Quality and Government Effectiveness are positively associated with inclusion, but both interactions are negative ($\beta = -0.072$, $p = 0.033$; $\beta = -0.054$, $p = 0.030$). Digital-finance gains are concentrated in weaker institutional settings. Lagged models preserve the pattern.
Originality – The study identifies institutional substitution that is obscured when governance is only a control. It distinguishes rule quality from implementation capacity and separates digital activity from inclusion outcomes.
Practical implications – Digital channels may yield their largest incremental gains where conventional institutions are weakest. Governance nevertheless remains essential for consumer protection, competition and sustainable financial use.

Index Terms - Digital Finance; Financial Inclusion; Regulatory Quality; Government Effectiveness; Mobile Money; Developing Economies; Institutional Quality

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Introduction

Digital financial services have changed the geography and economics of financial intermediation (Gomber et al., 2018; Sahay et al., 2020). Mobile-money platforms, agent networks and mobile and internet banking allow providers to serve customers beyond the conventional branch network (Arner et al., 2016; Khera et al., 2022). Their relevance is especially pronounced in developing economies, where distance, documentation requirements, low and irregular incomes, and a large informal sector have historically limited participation in formal finance (Allen et al., 2016; Demirgüç-Kunt et al., 2022). By lowering the fixed cost of small-value transactions and permitting remote account access, digital finance can widen the feasible market for payments, saving and credit (Jack and Suri, 2014;Ozili, 2018).

Recent data reinforce the scale of this transformation. The IMF Financial Access Survey reports that digital transactions in emerging market and developing economies more than quadrupled between 2017 and 2024, while the Global Findex 2025 documents substantial growth in account ownership and formal saving alongside persistent gaps by gender and income (IMF, 2025; World Bank, 2025a). Yet technological diffusion has not generated uniform inclusion. Countries with comparable levels of mobile connectivity and provider activity continue to differ markedly in active account use, savings mobilisation, access to credit and financial resilience. This variation raises a policy question that the technology-centred account cannot answer: when does digital finance deliver inclusion?

This paper argues that the answer depends partly on the institutional environment. Regulatory quality shapes the predictability and proportionality of rules governing entry, agent networks, customer identification, interoperability, competition, data protection and consumer redress. Government effectiveness captures a related but distinct capacity: whether public authorities can implement policies, coordinate agencies, provide enabling infrastructure and credibly enforce commitments. Digital channels may therefore be complements to institutional quality. Technology reduces transaction costs, but capable institutions help ensure that lower-cost access becomes trusted and sustained financial use rather than inactive registration, fraud exposure or costly short-term borrowing.

The distinction matters because prior cross-country studies commonly treat institutional quality as a control, combine heterogeneous governance dimensions into a single index, or use broad measures of financial development that capture banking depth rather than inclusion. A recent study tests institutional quality as a moderator of the relationship between fintech and financial development in 30 emerging and developing countries (Hassouba et al., 2026). That contribution makes the institutional contingency explicit but leaves three issues unresolved. First, financial development is not equivalent to financial inclusion: a deeper financial system can coexist with exclusion of low-income households and small firms. Second, composite governance scores obscure whether good rule design and implementation capacity perform different roles. Third, using overlapping indicators for fintech and inclusion can generate a partly mechanical association.

The present study addresses these limitations by separating observed digital-finance activity from formal financial-use outcomes and by testing Regulatory Quality and Government Effectiveness as distinct moderators. It assembles an annual panel from the IMF Financial Access Survey (FAS), Worldwide Governance Indicators (WGI) and World Development Indicators (WDI) for developing economies over 2014–2024. Financial inclusion is operationalized through deposit-account, deposit, borrower and loan usage; digital finance is represented by active mobile-money accounts, transaction intensity, transaction value, agents and mobile/internet-banking activity. The empirical strategy uses country and year fixed effects, country-clustered standard errors and marginal-effect analysis, supplemented by lagged specifications and alternative outcome measures.

The paper contributes in four ways. First, it develops an institutional-complementarity explanation of digital inclusion that distinguishes regulatory formulation from state implementation capacity. Second, it sharpens measurement by preventing the principal explanatory indicators from reappearing in the outcome index. Third, it examines whether institutional conditioning differs across saving, borrowing and conventional access, rather than assuming that all dimensions of inclusion respond identically. Fourth, it provides policy-relevant evidence on whether digitalization strategies can succeed in isolation or require simultaneous investment in supervision, consumer protection, interoperability and administrative capability.

The remainder of the paper proceeds as follows. Section 2 reviews the literature and develops hypotheses. Section 3 describes the data, measurement and empirical strategy. Section 4 presents the results. Section 5 discusses theoretical and policy implications. Section 6 concludes.

Literature Review and Hypothesis Development

2.1 Digital finance and meaningful financial inclusion

Financial inclusion is commonly understood as the ability of individuals and firms to access and use appropriate, affordable and responsibly delivered financial services (Demirgüç-Kunt et al., 2008; World Bank, 2023). Access, however, is not identical to use; access indicates the availability of an account or service, whereas usage reflects realized financial participation (Allen et al., 2016; IMF, 2020). The existence of an account, agent or service point therefore indicates an opportunity to transact, while deposit mobilization, borrowing and payment activity indicate substantive participation. This distinction is especially material in digital markets because registrations can expand rapidly even when accounts remain inactive or are used only for cash-in/cash-out transactions (Demirgüç-Kunt et al., 2022; World Bank, 2025a).

Digital finance can promote inclusion through several mechanisms. Remote delivery and agent networks reduce travel, search and waiting costs (Jack and Suri, 2014; Aron, 2018). Automated processing lowers the marginal cost of small-value transactions and can make previously uneconomic customers commercially serviceable (Ozili, 2018; Sahay et al., 2020). Digital records can reduce information asymmetry and support savings, payments and credit

products for customers without conventional collateral or formal employment histories (Gomber et al., 2018; Khera et al., 2022). Network effects can further increase service utility as merchants, employers and government programmes adopt interoperable payment channels (Arner et al., 2016; Gabor and Brooks, 2017). Evidence from mobile money shows gains in transaction efficiency, risk sharing and consumption smoothing, and in particular settings, poverty reduction and occupational change (Jack and Suri, 2014; Suri and Jack, 2016; Aron, 2018). Cross-country evidence also associates digital finance with wider financial access and usage, although estimated magnitudes depend on measurement and country composition (Andrianaivo and Kpodar, 2012; Ozili, 2018; Khera et al., 2022; IMF, 2025).

The relationship is not necessarily monotonic or uniformly beneficial. Limited digital literacy, unreliable connectivity, opaque fees, weak data protection, fraud and aggressive digital credit can reduce effective use or welfare. Market concentration may lock consumers into closed networks, while algorithmic decision systems can reproduce existing disadvantages. The inclusive effect should therefore be evaluated through outcomes that reflect substantive participation, not technology adoption alone. On balance, the cost and reach mechanisms suggest the following baseline hypothesis.

H1. Digital-finance development is positively associated with meaningful financial inclusion in developing economies.

2.2 Regulatory quality as a boundary condition

Regulatory quality describes the ability of the state to formulate and implement sound policies that permit and promote private-sector development (Kaufmann and Kraay, 2024; World Bank, 2025b). In digital finance, the relevant architecture includes proportionate licensing, agent regulation, e-KYC rules, interoperability, competition policy, disclosure, data governance, operational resilience and accessible consumer redress. Predictable and proportionate rules can lower uncertainty for providers while reducing the risks that deter consumer adoption.

Institutional theory suggests that formal rules influence both the legitimacy of new organisational forms and the incentives facing market participants (North, 1990; Williamson, 2000). For providers, coherent licensing and supervisory expectations reduce regulatory uncertainty and facilitate investment. For consumers, enforceable safeguards can increase trust, particularly where services are intangible and information asymmetries are severe. Regulatory quality may therefore have a direct relationship with inclusion and may also alter the productivity of digital-finance infrastructure. The same transaction technology can generate different usage outcomes depending on whether users expect fair treatment, secure data and effective recourse.

There is also a plausible countervailing mechanism. Burdensome or poorly calibrated rules can raise compliance costs, protect incumbents or restrict low-cost experimentation. The theoretical prediction is therefore about quality, not regulatory intensity. A positive interaction is expected when rules are coherent, predictable and proportionate.

H2. Regulatory quality is positively associated with meaningful financial inclusion in developing economies.

H3. Regulatory quality positively moderates the relationship between digital-finance development and financial inclusion, such that the relationship is stronger at higher levels of regulatory quality.

2.3 Government effectiveness and implementation capacity

Well-designed rules do not implement themselves. Government effectiveness captures the quality of public services and the civil service, the quality of policy formulation and implementation, and the credibility of government commitments (World Bank, 2025b). This capacity can influence digital inclusion through national identification systems, payment infrastructure, telecommunications coordination, supervisory staffing, public financial-literacy programmes and complaint resolution.

The distinction from regulatory quality is analytically useful. A country may enact sophisticated fintech legislation yet lack the technical staff, inter-agency coordination or enforcement systems needed to give it effect. Conversely, an effective public administration may support payment and identification infrastructure even while formal sector-specific rules develop incrementally. Government effectiveness should therefore have both a direct association with inclusion and a complementary relationship with digital finance.

H4. Government effectiveness is positively associated with meaningful financial inclusion in developing economies.

H5. Government effectiveness positively moderates the relationship between digital-finance development and financial inclusion, such that the relationship is stronger at higher levels of government effectiveness.

2.4 Conceptual synthesis and empirical differentiation

The proposed model integrates transaction-cost and institutional perspectives. Digital finance expands the technological opportunity set by lowering the cost of reaching and serving customers. Regulatory quality reduces uncertainty and opportunism through credible rules, while government effectiveness supplies the implementation capability that makes rules and infrastructure operational. Inclusion results when these resources are complementary. Empirically, this argument requires separate measures of technology, realized financial use and the two institutional dimensions. It also requires marginal-effect analysis because the coefficient on digital finance in an interaction model is conditional on the moderator rather than an unconditional average effect.

Data and Methodology

3.1 Research design, sample and data sources

The study uses an explanatory, unbalanced country-year panel. The initial population comprises economies classified by the World Bank as low-, lower-middle- or upper-middle-income. The observation window is 2014–2024 because internationally comparable mobile-money reporting becomes materially broader during this period and the latest available FAS and WGI releases extend through 2024. Regional aggregates and territories without comparable governance observations are excluded. A country enters the main estimation

sample when it has at least four annual observations for the principal digital-finance indicator and non-missing values for the dependent variable, moderators and core controls.

The IMF FAS supplies annual, primarily regulatory-source measures of access to and use of formal and digital financial services. The WGI provide Regulatory Quality and Government Effectiveness estimates. WDI supplies macroeconomic, demographic and connectivity controls. ISO3 economy codes and calendar years are used for merging, with a documented concordance for renamed economies and territories. The analysis will report the number of countries and observations at each filtering stage rather than presenting the maximum theoretical coverage as the realized sample.

3.2 Variable definition and measurement

Table I. Variable definitions and sources.

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Construct	Operational measure	Role	Source
Financial inclusion	First PCA component of ln(1+x) deposit accounts/1,000 adults, deposits/GDP and loans/GDP	Dependent	IMF FAS
Digital finance	ln(1+x) mobile- and internet-banking transactions/1,000 adults	Independent	IMF FAS
Regulatory Quality	WGI continuous estimate; higher is better	Moderator	World Bank WGI
Government Effectiveness	WGI continuous estimate; higher is better	Moderator	World Bank WGI
Economic development	ln real GDP per capita (constant 2015 US$)	Control	World Bank WDI
Inflation	Consumer-price inflation, annual %	Control	World Bank WDI
Connectivity	Individuals using the internet, % of population	Control	World Bank WDI
Urbanisation	Urban population, % of total	Control	World Bank WDI
Trade openness	Exports plus imports, % of GDP	Control	World Bank WDI
Alternative outcomes	Borrowers/1,000 adults; branches and ATMs/100,000 adults	Robustness	IMF FAS

Source: Authors own work.

3.2.1 Financial-inclusion outcomes

The principal dependent variable is a Financial Inclusion Usage Index constructed from deposit accounts per 1,000 adults, outstanding deposits as a percentage of GDP and

outstanding loans as a percentage of GDP. Each component is transformed using ln(1+x), standardized and combined by principal-components analysis (PCA). Borrowers per 1,000 adults is excluded from the primary index because its lower reporting coverage would reduce the common estimation sample, but it is retained as an alternative outcome. Higher index scores indicate greater realized formal saving and credit use.

Individual components and borrowers per 1,000 adults are retained as secondary outcomes. Commercial-bank branches and ATMs per 100,000 adults are analyzed separately to test whether digital activity is associated with conventional access. No digital-finance variable appears in the dependent index, preventing mechanical overlap between the explanatory and outcome constructs.

3.2.2 Digital-finance development

The primary digital-finance measure is the number of mobile- and internet-banking transactions per 1,000 adults. This activity-based indicator captures realized use rather than infrastructure availability. The variable is transformed as ln(1+x) and standardized in the estimation sample. Robustness models replace it with mobile-money transactions per 1,000 adults, active mobile-money accounts per 1,000 adults and mobile-money transaction value relative to GDP.

3.2.3 Institutional moderators and controls

Regulatory Quality and Government Effectiveness enter separately in the primary models. Each governance measure, the logged digital-finance indicator and all controls are standardized in the common estimation sample before interaction terms are formed. Controls are log real GDP per capita, consumer-price inflation, internet use, urbanization and trade openness. The two governance variables correlate at 0.842 in the estimation sample; consequently, the model containing both moderators is supplementary rather than the principal basis for inference.

3.3 Empirical specification

The baseline two-way fixed-effects model is:

$$FI_{it} = \beta_1 DF_{it} + \beta_2 INST_{it} + \beta_3 (DF_{it} \times INST_{it}) + \gamma X_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

where FI_{it} is financial inclusion in country i and year t; DF_{it} is digital-finance development; $INST_{it}$ is either Regulatory Quality or Government Effectiveness; X_{it} is the vector of controls; μ_i and λ_t are country and year fixed effects; and ε_{it} is the error term. Standard errors are clustered by country. H3 and H5 concern β_3, but substantive interpretation relies on the conditional marginal effect $\partial FI/\partial DF = \beta_1 + \beta_3 INST$ and its confidence interval across the observed institutional distribution.

Models are introduced sequentially: controls only; the direct digital-finance effect; separate Regulatory Quality and Government Effectiveness interaction models; and a supplementary combined model. Coefficients are identified from within-country change after country and year fixed effects. Heteroskedasticity-robust standard errors are clustered by country; reported p-values use the large-sample normal approximation. Conditional effects are

calculated from the full variance-covariance matrix and displayed with 95 per cent confidence intervals.

3.4 Identification limitations and robustness strategy

The fixed-effects specification estimates associations from within-country changes after absorbing common year shocks; it does not by itself establish causal effects. Reverse causality is plausible because financially inclusive markets may attract digital providers, and policy reforms may jointly affect institutions and digital finance. The paper therefore avoids causal language unless stronger identification is supported.

Robustness tests use one-year-lagged digital finance and institutions; substitute mobile-money measures; replace the moderators with Rule of Law and Control of Corruption; estimate individual saving, credit and physical-access outcomes; and examine lower-middle-income, upper-middle-income and Sub-Saharan African subsamples. These tests assess sensitivity, not causality, because lagging variables does not eliminate time-varying omitted factors or reverse causation.

3.5 Missing data, reproducibility and research ethics

Missing observations are not recorded as zeros. The primary treatment must be observed in at least four years per country, and each estimation country contributes at least three complete observations. Available-case estimation yields a common sample for the primary models. Data versions, transformations and scripts are retained in a reproducibility package. The study uses public aggregate secondary data and processes no identifiable personal information.

The study uses public aggregate secondary data and does not process identifiable personal information. Data downloads, concordances, transformations and model code will be preserved in a reproducibility package. Dataset versions and access dates will be reported because both FAS and WGI are periodically revised.

Results

The source merge identifies 118 eligible low- and middle-income economies and 1,227 potential country-years with governance data. Requiring at least four observations on mobile- and internet-banking transactions retains 63 economies and 686 country-years. Complete coverage of the three inclusion components is available for 568 observations in 53 economies; 450 also report the primary digital measure and both moderators. Requiring complete controls produces the common estimation sample of 411 observations from 49 economies. Coverage spans every year from 2014 to 2024. The sample includes 26 upper-middle-income, 19 lower-middle-income and four low-income economies; regionally, it contains 14 Sub-Saharan African, ten Latin American and Caribbean, nine European and Central Asian, seven East Asian and Pacific, six South Asian and three Middle Eastern and North African economies.

4.1 Descriptive statistics and measurement diagnostics

Table II reports the realized sample and measurement diagnostics. Transaction activity is strongly right-skewed, which supports the logarithmic transformation used in estimation. The

first principal component explains 73.2 per cent of the variance in the three inclusion indicators. Its loadings are positive for deposit accounts (0.493), deposits relative to GDP (0.604) and loans relative to GDP (0.626). The Kaiser-Meyer-Olkin statistic is 0.620 and Bartlett's test rejects an identity correlation matrix ($\chi^2(3) = 1{,}256.34$, $p < 0.001$). The index is therefore defensible as a parsimonious usage measure, although the moderate KMO motivates the component-specific robustness tests.

Table II. Descriptive statistics and measurement diagnostics

Variable	N	Mean	SD	Within SD	Minimum	Maximum
Financial inclusion index	411	0.219	0.835	0.228	-2.013	1.899
Digital transactions/1,000 adults	411	38466.125	74527.255	50856.590	0.046	540411.955
Regulatory Quality	411	-0.184	0.483	0.098	-1.331	1.067
Government Effectiveness	411	-0.169	0.507	0.131	-1.552	1.114
Real GDP per capita	411	4851.801	3304.688	511.212	422.924	15395.028
Inflation (%)	411	8.822	21.672	16.139	-3.749	221.342
Internet use (%)	411	56.380	24.082	10.530	6.000	98.021
Urban population (%)	411	55.842	17.619	1.511	15.963	92.274
Trade openness (%)	411	81.778	39.061	10.033	26.271	302.285

Notes: Descriptives use the common estimation sample (411 observations; 49 countries). Digital transactions are shown in levels; estimation uses ln(1+x) and standardisation. PCA diagnostics: variance explained = 73.2%; KMO = 0.620; Bartlett $\chi^2(3) = 1{,}256.34$, $p < 0.001$. Source: Authors own work.

4.2 Baseline and moderation estimates

Table III presents the two-way fixed-effects estimates. In Model 2, a one-standard-deviation increase in logged digital transaction activity is associated with a 0.083-standard-deviation increase in the inclusion index, but the estimate is not conventionally significant ($p = 0.102$); H1 receives only weak support. Regulatory Quality and Government Effectiveness have positive conditional main effects in their separate models ($\beta = 0.254$, $p = 0.009$; $\beta = 0.140$, $p = 0.023$), supporting H2 and H4. Contrary to H3 and H5, both interactions are negative: −0.072 ($p = 0.033$) for Regulatory Quality and −0.054 ($p = 0.030$) for Government Effectiveness. The within R^2 rises from 0.476 in the direct-effect model to 0.536 and 0.510, respectively. Inflation is the only control that is consistently associated with inclusion, with a negative coefficient. When both highly correlated governance variables and interactions enter together, neither interaction is individually precise, so the separate models remain the preferred specifications.

Table III. Two-way fixed-effects estimates of financial inclusion

Variable	(1)	(2)	(3)	(4)	(5)
Digital finance		0.083 (0.051)	0.018 (0.048)	0.033 (0.047)	0.009 (0.050)
Regulatory Quality			0.254*** (0.097)		0.237** (0.101)
Digital × Regulatory Quality			-0.072** (0.034)		-0.041 (0.060)
Government Effectiveness				0.140** (0.062)	0.033 (0.050)
Digital × Government Effectiveness				-0.054** (0.025)	-0.035 (0.049)
Log GDP per capita	0.377 (0.385)	0.345 (0.375)	0.277 (0.324)	0.288 (0.329)	0.262 (0.321)
Inflation	-0.189** (0.078)	-0.187** (0.077)	-0.173** (0.070)	-0.167** (0.076)	-0.168** (0.071)
Internet use	-0.004 (0.068)	-0.018 (0.068)	-0.019 (0.070)	0.012 (0.062)	-0.007 (0.066)
Urbanisation	0.161 (0.302)	0.159 (0.326)	0.186 (0.257)	0.090 (0.289)	0.167 (0.250)
Trade openness	-0.047 (0.103)	-0.040 (0.100)	-0.041 (0.096)	-0.040 (0.096)	-0.045 (0.093)
Within R^2	0.459	0.476	0.536	0.510	0.539
Observations	411	411	411	411	411
Countries	49	49	49	49	49

Notes: The dependent variable is the PCA inclusion index. All continuous regressors are standardised. Country and year fixed effects are included in every model. Country-clustered standard errors are in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. Source: Authors own work.

4.3 Marginal effects

Figures 1 and 2 show that the negative coefficients represent attenuation rather than a general adverse effect of institutions. At the 10th percentile of Regulatory Quality (−1.282 standard deviations), the conditional digital-finance effect is 0.110 (95 per cent CI 0.015 to 0.205; $p = 0.023$). At the sample mean it is 0.018 ($p = 0.713$), and at the 90th percentile it is −0.075 ($p = 0.333$). For Government Effectiveness, the corresponding effects are 0.102 (95 per cent CI −0.009 to 0.212; $p = 0.071$), 0.033 ($p = 0.479$) and −0.036 ($p = 0.523$). Digital finance therefore has a statistically distinguishable incremental association mainly toward the weaker end of the regulatory-quality distribution; there is no evidence that it reduces inclusion at stronger institutional levels.

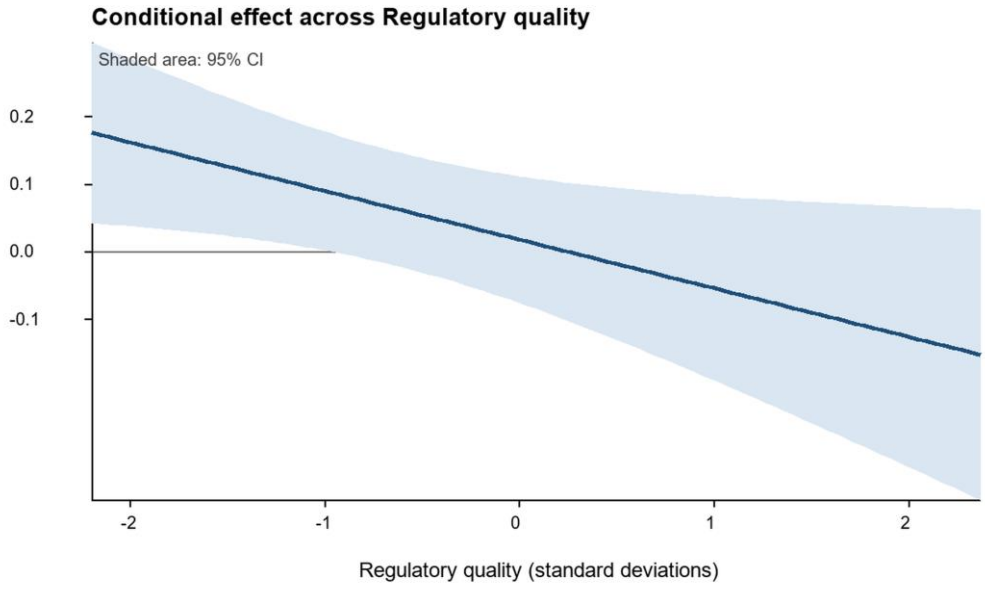

Figure 1. Conditional effect of digital finance by Regulatory Quality. Source: Authors own work.

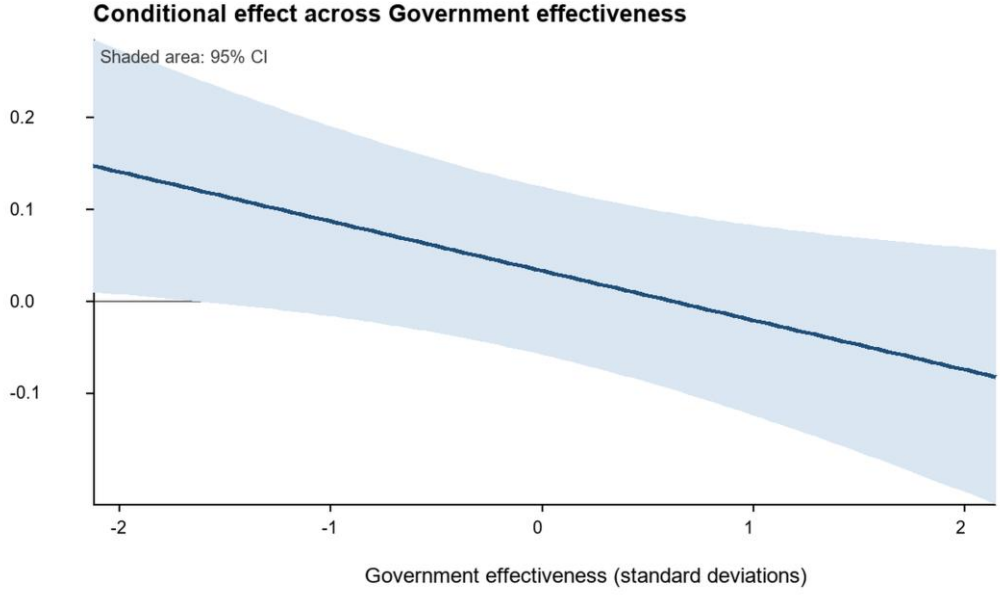

Figure 2. Conditional effect of digital finance by Government Effectiveness. Source: Authors own work.

4.4 Heterogeneity and robustness

The sensitivity checks qualify but do not overturn this interpretation. Using one-year-lagged regressors produces interaction coefficients of −0.080 for Regulatory Quality ($p = 0.018$) and −0.066 for Government Effectiveness ($p = 0.003$). Mobile-money transaction counts, active accounts and transaction values generally yield negative interaction signs, although most

estimates are imprecise in smaller samples. Rule of Law also produces negative interactions at the 10 per cent level, whereas Control of Corruption does not. Among individual outcomes, the clearest result is for borrowers: the Regulatory Quality interaction is −0.095 (p = 0.009), and the Government Effectiveness interaction is −0.071 (p = 0.075). Interactions for deposits, loans, branches and ATMs are not significant. The pattern is strongest in lower-middle-income economies and appears for Government Effectiveness in Sub-Saharan Africa; it is absent in the upper-middle-income subsample. These heterogeneous results suggest that digital channels primarily compensate for institutional and intermediation gaps in credit use, rather than uniformly changing every dimension of financial access.

Table IV. Selected robustness and heterogeneity estimates

Specification	Interaction	SE	p-value	N	Countries
Lagged digital finance × Regulatory Quality	-0.080**	0.034	0.018	366	49
Lagged digital finance × Government Effectiveness	-0.066***	0.023	0.003	366	49
Mobile-money transactions × Regulatory Quality	-0.043*	0.024	0.072	362	44
Mobile-money transactions × Government Effectiveness	-0.032	0.025	0.193	362	44
Borrowers outcome × Regulatory Quality	-0.095***	0.036	0.009	389	45
Borrowers outcome × Government Effectiveness	-0.071*	0.040	0.075	389	45
Lower-middle-income × Regulatory Quality	-0.050***	0.017	0.004	138	19
Lower-middle-income × Government Effectiveness	-0.029**	0.015	0.050	138	19
Sub-Saharan Africa × Regulatory Quality	-0.068*	0.037	0.067	115	14
Sub-Saharan Africa × Government Effectiveness	-0.072**	0.033	0.029	115	14

Notes: Each row is a separate two-way fixed-effects model with the full control vector and country-clustered standard errors. Subsample estimates have relatively few clusters and should be interpreted cautiously. *** p < 0.01; ** p < 0.05; * p < 0.10. Source: Authors own work.

Discussion

The results answer the paper's central question in a way that differs from the original institutional-complementarity prediction. Digital transaction activity is positively but imprecisely associated with formal financial use on average. Better Regulatory Quality and Government Effectiveness have positive direct associations with inclusion, yet neither

amplifies the marginal association of digital finance. Instead, the negative interactions indicate institutional substitution: digital channels contribute most where conventional rules, administration and intermediation leave larger inclusion gaps. H2 and H4 are supported; H1 is weakly supported; H3 and H5 are rejected in favour of the opposite conditional pattern.

5.1 Theoretical implications

The findings refine institutional accounts of fintech by separating institutional level effects from marginal technology effects. Stronger governance can raise the overall level of financial inclusion through predictable rules, credible implementation and better public services. At the same time, the incremental contribution of a low-cost digital channel can be larger where those conventional supports are weaker. This is consistent with a diminishing-returns or "room to improve" mechanism: countries with stronger institutions may already have deeper formal saving and credit markets, leaving less unmet demand for digital delivery to unlock. The result therefore does not imply that weak institutions cause successful fintech. It implies that, conditional on country and year effects and observed controls, expansions in digital activity coincide with larger inclusion changes in institutionally constrained settings. Compared with Hassouba et al. (2026), which studies financial development, the present evidence shows why outcome definition matters: governance may complement fintech in deepening financial systems while digital delivery substitutes for institutional gaps in extending use to underserved markets.

5.2 Policy implications

Policy should distinguish expansion from quality. In weaker institutional settings, enabling interoperable payment rails, proportionate customer identification, agent networks and reliable connectivity can quickly widen formal use. Those gains should not become an argument for regulatory neglect. Fraud prevention, transparent pricing, data protection, competition policy and accessible redress are essential to keep rapid adoption from producing exclusion through over-indebtedness or loss of trust. In stronger institutional settings, the estimates suggest that further transaction growth alone is unlikely to generate large inclusion gains; policy may need to focus on affordability, product suitability, digital capability and persistent demographic or geographic gaps. The positive direct governance coefficients also indicate that institutional reform and digital investment are complementary policy objectives even when their statistical interaction is negative.

5.3 Limitations and future research

Several limitations constrain interpretation. First, FAS reporting is uneven and the common sample is selected toward economies with sustained digital-transaction reporting. Second, national aggregates cannot reveal whether gains accrue to women, rural residents, informal firms or previously unbanked households. Third, WGI estimates are partly perception-based and contain measurement uncertainty not modelled here. Fourth, fixed effects and lagged specifications reduce some confounding but do not establish causality; policy changes, provider entry and inclusion may evolve jointly. Fifth, digital transactions may reflect intensive use by existing customers as well as extensive inclusion. Future work should combine FAS with household-level Global Findex data, exploit phased regulatory reforms or

infrastructure rollouts, and examine consumer welfare, service quality and distributional outcomes alongside aggregate use.

Conclusion

This study asks when digital finance is associated with meaningful financial inclusion in developing economies. It combines IMF and World Bank data for 411 country-year observations from 49 low- and middle-income economies over 2014–2024 and estimates two-way fixed-effects models with country-clustered standard errors. The dependent index captures formal deposit-account use, deposits and loans without reusing digital indicators in the outcome.

Digital transaction activity has a positive but statistically imprecise average association with inclusion. Regulatory Quality and Government Effectiveness are each positively associated with the inclusion index, but their interactions with digital finance are negative and significant. At weak Regulatory Quality, a one-standard-deviation increase in logged digital transactions is associated with an approximately 0.11-standard-deviation increase in inclusion; the marginal association attenuates toward zero as institutional quality rises. Lagged models and several alternative measures preserve the direction of this result, with the clearest component-level evidence appearing for borrower use.

The contribution is an institutional-substitution interpretation: digital delivery can compensate for gaps in conventional institutions and intermediation, even though stronger governance raises inclusion directly and remains vital to safe, competitive and sustainable finance. Policymakers in institutionally constrained settings should pair up enabling digital infrastructure with proportionate oversight, consumer protection and redress. In stronger settings, transaction expansion alone may be insufficient, requiring attention to affordability and persistent distributional barriers. Because the evidence is observational and aggregate, the estimates should be read as conditional associations rather than causal effects.

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APPENDIX A. PRESPECIFIED MODEL SEQUENCE

Table V. Prespecified model sequence

Model	Outcome	Key regressors	Purpose
M1	FI usage index	Controls; country and year FE	Baseline
M2	FI usage index	Digital finance + controls	H1
M3	FI usage index	Digital finance + Regulatory Quality + interaction	H2–H3
M4	FI usage index	Digital finance + Government Effectiveness + interaction	H4–H5
M5	FI usage index	Both moderators and interactions	Supplementary
M6+	Individual FI outcomes	Preferred interaction model	Outcome heterogeneity

Source: Authors own work.