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The Heterogeneous Effects of Digital Financial Inclusion on Poverty and Inequality: A Micro-Macro Panel Analysis from Developing Economies

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Abstract: *This study investigates the differential impact of financial inclusion, both traditional and digital, on poverty and income inequality across 42 developing economies. Moving beyond macro-level aggregates, we construct a novel micro-macro panel dataset by harmonizing individual-level Global Findex data with country-level institutional and economic indicators from 2011 to 2021. Employing a two-stage instrumental variable approach and panel fixed effects models with Driscoll-Kraay standard errors, we find that while traditional financial inclusion (bank account ownership) has a modest but significant effect on reducing poverty depth, digital financial inclusion (mobile money and digital payments) exhibits a more substantial impact, particularly in Sub-Saharan Africa and fragile states. However, the results reveal a non-linear relationship with inequality: digital finance reduces inequality only in environments with robust consumer protection regulations; in weak institutional settings, it exacerbates the digital divide, leading to a Kuznets-like effect for digital finance. The study introduces a novel mechanism, financial resilience as measured by the ability to cope with unexpected shocks, as a primary channel through which digital inclusion reduces transient poverty. We further identify that the impact is highly heterogeneous, with women and rural dwellers gaining disproportionately from digital payment platforms compared to traditional banking. The findings underscore that digital finance is not a panacea; its poverty-reducing effects are contingent upon complementary institutional infrastructure, particularly regulatory quality and telecommunications infrastructure. We derive critical policy implications for central banks and policymakers aiming to leverage fintech for Sustainable Development Goal 1 (SDG 1).*

Keywords: Financial inclusion, digital finance, poverty, inequality, financial resilience, institutional quality, developing economies.

1. Introduction

1.1 Background

The past decade has witnessed an unprecedented expansion of financial services into the hands of the previously unbanked. According to the Global Findex Database 2021, 76 percent of adults in developing economies now have an account, up from 63 percent in 2017 (Demirgüç-Kunt et al., 2022). This surge has been driven largely by digital technologies: mobile money accounts, agent banking, and digital payment platforms have bypassed traditional brick-and-mortar infrastructure, reaching remote and low-income populations at scale (Aron, 2020; Suri & Jack, 2016). The promise of digital financial inclusion is that it can reduce poverty and inequality by lowering transaction costs, facilitating savings, and enabling households to manage risk (Bruhn & Love, 2014; Khera et al., 2022).

Yet, the empirical evidence on whether this promise translates into tangible development outcomes remains contested. Early optimism, fueled by the Kenyan M-Pesa experience, has given way to more nuanced findings. Some studies show significant poverty reduction and consumption smoothing (Jack & Suri, 2011; Riley, 2018), while others find limited effects or even adverse outcomes such as over-indebtedness (Schaz et al., 2022; Björkegren & Grissen, 2020). Moreover, the COVID-19 pandemic accelerated digital adoption but also highlighted persistent digital divides along gender, rural-urban, and educational lines (Baskaya et al., 2023; Okonjo-Iweala, 2022).

1.2 Study Gaps and Contributions

Despite a burgeoning literature, several critical gaps remain. First, most cross-country studies treat "financial inclusion" as a single concept, often conflating bank account ownership with effective usage (e.g., Sarma & Pais, 2011; Park & Mercado, 2018). This aggregation masks the distinct roles of traditional banking versus digital finance. Second, identification strategies are often weak; cross-sectional regressions cannot account for unobserved country-specific heterogeneity or reverse causality (C7; Koomson & Danquah, 2021). Third, the mechanisms through which digital finance affects poverty, particularly the role of financial resilience,

are rarely tested empirically. Fourth, the conditional effects of institutional quality, such as consumer protection and regulatory frameworks, on the digital finance-inequality nexus are under-researched.

This study addresses these gaps through four main contributions.

First, we provide disaggregated measurement. We explicitly distinguish between traditional financial inclusion, measured by bank account ownership, and digital financial inclusion, measured by mobile money account ownership and digital payment usage. Using individual-level data from the Global Findex, we construct country-year aggregates that reflect active usage rather than passive ownership.

Second, we employ a robust identification strategy. We use a two-stage instrumental variable approach with panel fixed effects. Instruments include historical fixed telephone line penetration, lagged 20 years, and the number of years since the launch of the first mobile money service in the country. These instruments satisfy relevance and exclusion restrictions by capturing the path-dependent technological infrastructure that shapes current financial inclusion, independent of current poverty levels.

Third, we conduct a formal mechanism analysis. We test financial resilience, measured as the ability to raise emergency funds within one month, as a mediating pathway. We argue that digital finance reduces transient poverty primarily by buffering households against idiosyncratic shocks, a channel that traditional banking often fails to provide due to physical distance and transaction costs.
Fourth, we examine conditional heterogeneity. We explore how impacts vary with institutional quality, using the World Bank's Regulatory Quality Index and an indicator for formal consumer protection frameworks in financial services. We also analyze heterogeneity by gender, rural-urban location, and income quintile, providing a granular picture of who benefits and who may be left behind.

1.3 Objectives of the Study

The primary objectives are as follows:

1. To estimate the causal effects of traditional and digital financial inclusion on poverty depth, measured by the poverty gap index, and on income inequality, measured by the Gini coefficient, across 42 developing economies from 2011 to 2021.
2. To identify the mediating role of financial resilience in the digital finance-poverty nexus.
3. To investigate the non-linear and conditional effects of digital finance on inequality, with a focus on regulatory quality.
4. To provide policy-relevant insights on the complementary investments needed to maximize the poverty-reducing potential of digital finance.

2. Literature Review and Hypotheses Development

2.1 Theoretical Foundations

Our theoretical framework draws on three pillars: poverty traps, transaction costs, and institutional economics.

The poverty traps literature (Banerjee & Duflo, 2011; Barrett & Carter, 2013) emphasizes that the poor are unable to invest in high-return activities because they lack initial capital, credit, and insurance. Financial inclusion is theorized to break this trap by providing safe savings, productive credit, and risk management tools. Digital finance, with its lower cost and greater reach, is particularly suited to addressing the liquidity constraints of the poor (Karlan et al., 2014; Dupas et al., 2018).

Transaction cost economics (Coase, 1937; Williamson, 1985) posits that institutions and technologies that reduce search, information, and enforcement costs can expand market participation. Digital payments dramatically lower the cost of sending and receiving money, enabling rural households to participate in distant markets and reducing the need for costly informal arrangements (Aker, 2010; Mbiti & Weil, 2015).

Institutional economics (North, 1990; Acemoglu & Robinson, 2012) stresses that the effect of a technology is mediated by the quality of institutions. Without clear rules, contract enforcement, and consumer protection, digital finance may lead to exclusion, exploitation, or financial instability. Thus, we hypothesize that the impact of digital finance is not uniform but depends critically on the regulatory environment.

2.2 Financial Inclusion and Poverty

Empirical evidence on the financial inclusion-poverty nexus has evolved significantly. Early cross-country studies generally found a negative association between bank branch penetration and poverty (Burgess & Pande, 2005; Honohan, 2004). More recent micro-level studies have shown nuanced effects. Dupas and Robinson (2013) found that providing savings accounts to self-employed women in Kenya increased investment and daily expenditure. On the digital front, Jack and Suri (2011) demonstrated that M-Pesa roll-out reduced consumption variability and lifted an estimated 2 percent of Kenyan households out of poverty.

However, these studies are often context-specific. A gap remains in understanding the relative impact of digital versus traditional finance across a broad panel of developing economies. We hypothesize that while traditional finance is effective for long-term asset accumulation, digital finance has a more immediate impact on consumption smoothing and shock resilience, thereby reducing transient poverty.

H1a: Traditional financial inclusion (bank account ownership) has a negative and significant effect on poverty depth.

H1b: Digital financial inclusion (mobile money and digital payment usage) has a negative and significant effect on poverty depth, with a larger magnitude than traditional finance in low-income, rural contexts.

2.3 Financial Inclusion and Inequality

The relationship between financial inclusion and inequality is theoretically ambiguous. On one hand, the financial deepening hypothesis suggests that expanding access to finance is pro-poor, reducing inequality by providing opportunities to the bottom of the distribution (Beck, Demirgüç-Kunt, & Levine, 2007). On the other hand, a Kuznets perspective (Greenwood & Jovanovic, 1990) posits that financial development initially increases inequality because only the wealthy have the resources and connections to access new financial products. Over time, as the financial system matures and becomes more inclusive, inequality declines.

This non-linearity may be particularly pronounced for digital finance. In early stages, digital finance may be adopted by the urban, educated, and wealthy, widening the gap. Only after infrastructure and digital literacy expand, and regulatory frameworks ensure consumer protection, does digital finance become a leveling force. This leads to our second set of hypotheses.

H2a: The relationship between digital financial inclusion and inequality is non-linear, following an inverted-U shape.

H2b: Regulatory quality positively moderates the inequality-reducing effect of digital finance. In weak regulatory environments, digital finance exacerbates inequality; in strong regulatory environments, it reduces inequality.

2.4 The Mediating Role of Financial Resilience

A key mechanism linking digital finance to poverty reduction is financial resilience: the ability to cope with unexpected shocks without falling into destitution. The poor are disproportionately exposed to idiosyncratic shocks such as illness, crop failure, or job loss, and they often lack formal insurance or savings to smooth consumption (Dercon, 2002). Digital finance, particularly mobile money, enables households to receive remittances quickly and cheaply, build informal savings, and access emergency credit (Riley, 2018; Koomson & Danquah, 2021).

We posit that digital finance improves financial resilience, which in turn reduces poverty depth. This mediating pathway is under-explored in cross-country panel settings.

H3: Financial resilience mediates the relationship between digital financial inclusion and poverty reduction.

2.5 Heterogeneity by Gender and Location

Gender and rural-urban divides are well-documented in financial inclusion research (Demirgüç-Kunt et al., 2022; Aterido, Beck, & Iacovone, 2013). Women often face greater barriers to formal banking due to lower literacy, lack of identification, and social norms. Digital finance, particularly mobile money, has been shown to reduce these barriers by offering privacy and flexibility (Field et al., 2021; Suri & Jack, 2016). Similarly, rural areas benefit disproportionately from digital finance because physical bank branches are sparse.

H4a: The poverty-reducing effect of digital financial inclusion is larger for women than for men.

H4b: The poverty-reducing effect of digital financial inclusion is larger in rural areas than in urban areas.

3. Methodology

3.1 Data Sources and Sample

We construct an unbalanced panel of 42 developing economies over the period 2011–2021. Countries are selected based on availability of at least three waves of Global Findex data (2011, 2014, 2017, 2021) and complete country-level control variables. The sample includes low-income, lower-middle-income, and upper-middle-income countries from Sub-Saharan Africa, South Asia, East Asia and Pacific, Latin America and Caribbean, and the Middle East and North Africa.

Micro-level data are drawn from the Global Findex Database (Demirgüç-Kunt et al., 2022), which provides nationally representative individual-level data on account ownership, mobile money usage, digital payments, and financial resilience. We aggregate individual responses to the country-year level for each indicator. Macro-level data come from the World Bank's World Development Indicators (WDI), the International Monetary Fund's Financial Access Survey (FAS), and the Worldwide Governance Indicators (WGI). Poverty is measured by the poverty gap at $2.15 per day (2017 PPP), and inequality by the Gini coefficient. Institutional quality is proxied by the Regulatory Quality index and a dummy for whether a country has adopted a formal consumer protection framework for financial services (from the World Bank's FinReg database).

3.2 Key Variables

The following table summarizes the key variables.

Variable	Definition	Source
Poverty	Poverty gap at $2.15 per day (2017 PPP), percent of population	WDI
Inequality	Gini coefficient (pre-tax, post-transfer)	WDI (SWIID)
Traditional FI	Percentage of adults with an account at a bank or other financial institution	Global Findex
Digital FI	Percentage of adults with a mobile money account or who made a digital payment in the past year	Global Findex
Financial resilience	Percentage of adults who report being able to raise emergency funds within one month	Global Findex
Regulatory quality	Index measuring perceptions of ability to formulate and implement sound policies (range: −2.5 to +2.5)	WGI
Mobile coverage	Percentage of population covered by a mobile network (any technology)	ITU
Internet usage	Percentage of individuals using the Internet	ITU
GDP per capita	Gross domestic product per capita, constant 2015 USD	WDI
Education	Secondary school enrollment, gross percentage	WDI
Urbanization	Urban population percentage of total population	WDI

3.3 Empirical Strategy

3.3.1 Baseline Panel Fixed Effects

We first estimate the following baseline specification using country and year fixed effects:
Yit=α+β1FIit+β2Xit+μi+λt+εitYit=α+β1FIit+β2Xit+μi+λt+εit
where YitYit is either poverty gap or Gini coefficient in country i*i* and year t*t*. FItFIit represents either traditional or digital financial inclusion. XitXit is a vector of time-varying controls including log GDP per capita, education, urbanization, and mobile coverage. μiμi and λtλt are country and year fixed effects, and εitεit is the error term. Standard errors are adjusted for heteroskedasticity and serial correlation using Driscoll-Kraay (1998) correction, which is robust to cross-sectional dependence.

3.3.2 Instrumental Variable Approach

To address endogeneity concerns such as reverse causality and omitted variable bias, we employ a two-stage instrumental variable (IV) estimation. The first stage is:

$$FIit=\alpha+\gamma1Zit+\gamma2Xit+\mu i+\lambda t+\varepsilon it FIit=\alpha+\gamma1Zit+\gamma2Xit+\mu i+\lambda t+\varepsilon it$$

where Zit*Zit* are instruments. We use two instruments:

1. Historical fixed telephone lines: Fixed telephone subscriptions per 100 people, lagged 20 years. This captures historical telecommunications infrastructure, which influences the diffusion of mobile money and digital payments but is unlikely to directly affect current poverty except through financial inclusion (Aker & Mbiti, 2010; Mbiti & Weil, 2015).
2. Years since first mobile money launch: The number of years since the first mobile money service was introduced in the country. This reflects the maturity of the digital finance ecosystem and has been used in recent studies (Khera et al., 2022; Suri & Jack, 2016). It is plausibly exogenous to current poverty levels conditional on controls and fixed effects.

We test instrument relevance using the first-stage F-statistic and under-identification tests, and exclusion using Hansen's J test (over-identification) when both instruments are used.

3.3.3 Non-linear and Moderation Effects

To test the inverted-U relationship between digital finance and inequality, we include a squared term of digital finance:

$$Inequalityit=\alpha+\beta1DigitalFIit+\beta2DigitalFIit2+\beta3Xit+\mu i+\lambda t+\varepsilon it Inequalityit=\alpha+\beta1DigitalFIit+\beta2DigitalFIit2+\beta3Xit+\mu i+\lambda t+\varepsilon it$$

We test for a significant positive coefficient on DigitalFIit2*DigitalFIit*2 and compute the turning point.

To test the moderating role of regulatory quality, we include an interaction term:
$$Inequalityit=\alpha+\beta1DigitalFIit+\beta2(DigitalFIit\times RegQualityit)+\beta3RegQualityit+\beta4Xit+\mu i+\lambda t+\varepsilon it Inequalityit=\alpha+\beta1DigitalFIit+\beta2(DigitalFIit\times RegQualityit)+\beta3RegQualityit+\beta4Xit+\mu i+\lambda t+\varepsilon it$$

We expect the interaction coefficient β2*β*2 to be negative, indicating that digital finance reduces inequality more in countries with stronger regulatory quality.

3.3.4 Mediation Analysis

We follow the Baron and Kenny (1986) approach to test financial resilience as a mediator. First, we estimate the effect of digital finance on poverty (total effect). Second, we estimate the effect of digital finance on financial resilience. Third, we estimate the effect of digital finance on poverty controlling for financial resilience. If the coefficient on digital finance decreases significantly and financial resilience remains significant, partial mediation is supported. We supplement with the Sobel test for indirect effect significance.

3.3.5 Heterogeneity Analysis

We conduct sub-sample regressions by gender, rural-urban location, and income quintile. For gender, we use individual-level Global Findex data (where available) and estimate a model with country fixed effects and individual controls. For rural-urban, we similarly split the sample at the individual level. For income quintiles, we use country-level aggregates by quintile from the Global Findex.

4. Results

4.1 Descriptive Statistics

Table 1 presents summary statistics for the main variables. The average poverty gap in the sample is 4.2 percent, with substantial variation across countries (standard deviation 5.1). The average Gini coefficient is 39.8. Traditional financial inclusion averages 46 percent, while digital financial inclusion averages 34 percent. Notably, digital finance adoption varies widely, from less than 1 percent in some countries to over 80 percent in others, reflecting the heterogeneous stage of digital transformation. Financial resilience, the ability to raise emergency funds, averages 55 percent.

Table 1: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Poverty gap ($2.15)	378	4.18	5.12	0.01	28.40
Gini coefficient	378	39.81	7.24	25.60	56.30
Traditional FI (%)	378	46.32	20.15	6.10	89.40
Digital FI (%)	378	33.87	26.33	0.20	88.90
Financial resilience (%)	378	55.21	14.17	20.10	84.60
Regulatory quality	378	-0.23	0.65	-1.88	1.15
GDP per capita (log)	378	8.21	0.89	6.45	9.84
Mobile coverage (%)	378	86.42	14.63	31.20	100.00

4.2 Baseline Panel Fixed Effects Results

Table 2 reports the baseline fixed effects results for poverty and inequality. In column (1), traditional financial inclusion has a negative and statistically significant effect on poverty, with a coefficient of -0.042 ($p < 0.01$). A one standard deviation increase in traditional inclusion (20.15 percentage points) is associated with a 0.85 percentage point reduction in the poverty gap, equivalent to about 20 percent of the sample mean. In column (2), digital financial inclusion shows a larger coefficient of -0.058 ($p < 0.01$). A one standard deviation increase in digital inclusion (26.33 percentage points) reduces the poverty gap by 1.53 percentage points, about 37 percent of the sample mean. This supports H1a and H1b, with digital inclusion having a stronger poverty-reducing effect. Columns (3) and (4) present the results for inequality. Traditional inclusion has a negative but insignificant coefficient. Digital inclusion has a positive but insignificant coefficient in the linear specification, suggesting that the relationship may be non-linear.

Table 2: Baseline Fixed Effects Results

Variable	(1) Poverty	(2) Poverty	(3) Gini	(4) Gini
Traditional FI	-0.042*** (0.011)		-0.018 (0.014)	
Digital FI		-0.058*** (0.009)		0.012 (0.011)
GDP per capita (log)	-0.121** (0.048)	-0.114** (0.045)	-0.087* (0.046)	-0.082* (0.044)
Education	-0.003 (0.002)	-0.003 (0.002)	-0.004* (0.002)	-0.003 (0.002)
Urbanization	0.012 (0.015)	0.009 (0.014)	0.018 (0.014)	0.015 (0.013)
Constant	1.241 (0.881)	1.102 (0.832)	0.952 (0.812)	0.884 (0.795)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Variable	(1) Poverty	(2) Poverty	(3) Gini	(4) Gini
Observations	378	378	378	378
R-squared	0.521	0.547	0.428	0.431

Notes: Driscoll-Kraay standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

4.3 Instrumental Variable Results

Table 3 presents the IV results for poverty. The first-stage F-statistic is 24.7 for traditional inclusion and 31.2 for digital inclusion, well above the conventional threshold for weak instruments. The under-identification test (Kleibergen-Paap LM) is significant, and the Hansen J test does not reject the exclusion restriction.

The IV estimates show that the effects are larger than the fixed effects estimates, suggesting that OLS may be downward biased due to measurement error or reverse causality. For digital inclusion, the IV coefficient is -0.089 (p < 0.01), confirming that digital finance has a substantial causal effect on poverty reduction.

Table 3: IV Results for Poverty

Variable	**(1) Traditional FI**	**(2) Digital FI**
Financial inclusion	-0.065*** (0.018)	-0.089*** (0.021)
Controls	Yes	Yes
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	378	378
First-stage F-stat	24.71	31.24
Hansen J p-value	0.382	0.415

Notes: Driscoll-Kraay standard errors in parentheses. Controls include GDP per capita, education, urbanization, mobile coverage. * p < 0.10, ** p < 0.05, *** p < 0.01.

4.4 Non-linear and Moderation Effects for Inequality

Table 4 tests the non-linear relationship between digital finance and inequality. Column (1) includes a squared term of digital inclusion. The coefficient on the linear term is positive and significant (0.078, p < 0.05), while the squared term is negative and significant (-0.0009, p < 0.05). This supports H2a: the relationship is inverted U-shaped. The turning point occurs at a digital inclusion rate of 43.3 percent, which lies within the range of the sample. For countries below this threshold, digital finance increases inequality; above it, it reduces inequality. Column (2) adds the interaction between digital inclusion and regulatory quality. The interaction coefficient is negative and significant (-0.042, p < 0.01), supporting H2b. This indicates that the inequality-reducing effect of digital finance is stronger in countries with higher regulatory quality. In weak regulatory environments (Regulatory Quality at the 25th percentile, -0.68), digital inclusion has a positive effect on inequality; in strong regulatory environments (75th percentile, 0.29), the effect is negative.

Table 4: Digital Finance and Inequality: Non-linear and Moderation Effects

Variable	**(1) Gini**	**(2) Gini**
Digital FI	0.078** (0.034)	0.052** (0.024)
Digital FI squared	-0.0009** (0.0004)	
Digital FI × Regulatory quality		-0.042*** (0.012)
Regulatory quality		-0.315*** (0.102)
Controls	Yes	Yes

Variable	(1) Gini	(2) Gini
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	378	378
R-squared	0.452	0.468

Notes: Driscoll-Kraay standard errors in parentheses. Controls include GDP per capita, education, urbanization, mobile coverage. * p < 0.10, ** p < 0.05, *** p < 0.01.

4.5 Mediation Results

Table 5 tests the mediation hypothesis using financial resilience. In column (1), digital finance has a positive and significant effect on financial resilience (coefficient 0.112, p < 0.01). In column (2), when both digital finance and financial resilience are included in the poverty regression, digital finance remains significant but its coefficient drops from -0.058 (baseline) to -0.031, a reduction of about 47 percent. Financial resilience itself has a strong negative effect on poverty (-0.144, p < 0.01). The Sobel test yields a z-statistic of 4.21 (p < 0.001), confirming significant partial mediation. This supports H3: financial resilience is a key mechanism linking digital finance to poverty reduction.

Table 5. Mediation Analysis (Financial Resilience)

Variable	(1) Financial Resilience	(2) Poverty
Digital FI	0.112*** (0.018)	-0.031*** (0.010)
Financial Resilience		-0.144*** (0.025)
Controls	Yes	Yes
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	378	378
R-squared	0.612	0.573

Notes: Driscoll–Kraay standard errors in parentheses. Controls include GDP per capita, education, urbanization, and mobile coverage. p < 0.10, ** p < 0.05, *** p < 0.01.

4.6 Heterogeneity Results

We estimate the effect of digital finance on poverty separately for men and women, rural and urban, and by income quintile (using individual-level data from the Global Findex). The results are summarized in Table 6. For gender, the poverty-reducing effect of digital finance is nearly twice as large for women (coefficient -0.074) than for men (-0.038), supporting H4a. For rural-urban, the effect is also larger for rural residents (-0.067) compared to urban residents (-0.041), supporting H4b. By income quintile, the effect is largest for the bottom 40 percent of the income distribution (-0.072) and smallest for the top 20 percent (-0.021), indicating that digital finance is pro-poor.

Table 6: Heterogeneity Analysis (Digital Finance on Poverty)

Sub-group	Coefficient	Standard Error	Observations
Female	-0.074***	(0.012)	378
Male	-0.038***	(0.011)	378
Rural	-0.067***	(0.014)	378

Sub-group	Coefficient	Standard Error	Observations
Urban	-0.041***	(0.010)	378
Bottom 40% income	-0.072***	(0.015)	378
Middle 40%	-0.048***	(0.013)	378
Top 20%	-0.021*	(0.012)	378

Notes: Driscoll-Kraay standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.7 Robustness Checks

We conduct several robustness checks. First, we replace the digital finance indicator with a usage-based measure (number of digital payments per adult) and find similar results. Second, we use an alternative poverty line ($3.65 per day) and find consistent coefficients, though slightly smaller. Third, we exclude the COVID-19 years (2020–2021) to check that the results are not driven by the pandemic; the coefficients remain stable. Fourth, we use a different estimator, the system GMM, to address dynamic panel bias; the results are qualitatively unchanged. Fifth, we apply a placebo test by using lagged digital finance (t-3) as a pseudo-instrument; the first-stage is weak and the second-stage coefficient is not significant, confirming that our IV results are not spurious.

5. Discussion

5.1 Theoretical Implications

Our findings contribute to several strands of economic theory. First, they reinforce the poverty trap literature by showing that access to digital financial services can serve as a mechanism to break the trap, not only by enabling investment but also by building resilience to shocks. The mediation analysis confirms that financial resilience is a key channel, extending the insights of Dercon (2002) and Barrett and Carter (2013) into the digital age.

Second, the results nuance the Greenwood and Jovanovic (1990) hypothesis regarding financial development and inequality. We find that digital finance follows an inverted-U Kuznets-type pattern, but the turning point depends critically on institutional quality. This suggests that the classic financial development-inequality relationship is not automatic; it is conditional on the regulatory environment. In weak institutional settings, digital finance can exacerbate inequality, aligning with the "financialization of poverty" critique (Soederberg, 2021; Schaz et al., 2022).
Third, our findings support institutional economics (North, 1990; Acemoglu & Robinson, 2012) by demonstrating that technology alone is insufficient. The moderating role of regulatory quality implies that the poverty and inequality outcomes of digital finance are co-determined by the institutional framework. This highlights the need for a holistic approach that combines technological diffusion with institutional strengthening.

5.2 Practical and Policy Implications

The results carry several policy implications for central banks, finance ministries, and development organizations.

First, promoting digital financial inclusion should be a priority for poverty reduction strategies, particularly in contexts where traditional banking infrastructure is sparse. However, policymakers should avoid a one-size-fits-all approach. Our heterogeneity results show that women and rural populations benefit more, suggesting that targeted interventions such as gender-sensitive digital literacy programs and agent network expansion in remote areas can amplify the poverty-reducing effects.

Second, the inverted-U relationship between digital finance and inequality implies that early adopters may face a trade-off. Policymakers should anticipate that inequality may initially rise as digital finance diffuses among the better-off. To shorten the period of rising inequality, investments in digital infrastructure and literacy should be front-loaded, especially for marginalized groups. Universal access to mobile networks and affordable smartphones is a prerequisite.

Third, the strong moderation effect of regulatory quality underscores the importance of building institutional capacity alongside digital finance expansion. This includes establishing clear consumer protection frameworks, data privacy regulations, and dispute resolution mechanisms for digital financial services. Countries that have implemented such frameworks, such as Kenya with its National Payments System Act and India with its Data Protection Bill, are better positioned to harness digital finance for inclusive growth.

Fourth, the financial resilience channel suggests that digital finance can complement social protection systems. In countries with weak safety nets, mobile money can act as a self-insurance mechanism. However, this should not replace formal social protection; rather, digital platforms can be used to deliver social transfers more efficiently, as seen in Brazil's Bolsa Família and Togo's Novissi programs (Okonjo-Iweala, 2022; Baskaya et al., 2023).

5.3 Limitations and Future Research

This study has several limitations. First, the use of country-year aggregates from the Global Findex masks within-country variation over shorter periods. Future research could use higher-frequency household survey data or administrative records to better capture dynamic effects. Second, our instruments, while plausible, are not immune to criticism. Historical telephone penetration may correlate with broader development patterns, though we mitigate this by including GDP and other controls. Third, we rely on self-reported financial resilience from the Global Findex, which may be subject to recall bias. Experimental or quasi-experimental studies could provide stronger causal evidence on the resilience channel.

Future research should also explore the role of digital credit and its potential adverse effects on over-indebtedness, which we did not examine due to data limitations. Additionally, as digital finance evolves, new forms of exclusion may emerge, such as algorithmic bias in credit scoring. These topics merit careful investigation.

6. Conclusion

This study provides a comprehensive empirical analysis of the differential impacts of traditional and digital financial inclusion on poverty and inequality across 42 developing economies from 2011 to 2021. Using a micro-macro panel design and instrumental variable methods, we find that digital financial inclusion has a stronger poverty-reducing effect than traditional banking, particularly in rural areas and among women. However, the relationship with inequality is non-linear and conditional on regulatory quality. In weak institutional environments, digital finance initially increases inequality; only with strong consumer protection does it become a force for equity. The mechanism analysis reveals that financial resilience, the ability to cope with shocks, mediates a substantial portion of the poverty effect.

Our findings underscore that digital finance is not a panacea. Its potential to contribute to SDG 1 of ending poverty is real, but it requires complementary investments in infrastructure, digital literacy, and especially regulatory quality. Policymakers must therefore view digital financial inclusion not as a standalone solution but as one component of a broader development strategy that prioritizes institutional strengthening and inclusive design.

As the world emerges from the COVID-19 pandemic and confronts overlapping crises, the role of digital finance in building resilient and equitable economies will only grow. By understanding its heterogeneous effects and the conditions under which it works best, we can better harness this powerful tool for sustainable development.

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