

DIGITAL ECONOMY AND INCLUSIVE GROWTH IN AFRICA: EVIDENCE FROM A FOUR-COUNTRY PANEL ANALYSIS

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Abstract

The rapid expansion of the digital economy across sub-Saharan Africa has generated considerable optimism about its potential to reduce poverty and inequality. However, the relationship between digital growth and inclusive economic outcomes remains empirically contested. This study examines whether digital economy expansion translates into inclusive growth across four African economies, Nigeria, Kenya, Rwanda, and South Africa, using panel data sourced from the World Bank Development Indicators and the International Telecommunication Union for the period 2005–2022. Employing fixed effects panel regression and the Generalized Method of Moments (GMM) to address endogeneity, the analysis tests the central hypothesis that digital growth does not necessarily produce inclusive growth, and that urban populations disproportionately capture digital dividends relative to rural populations. The results reveal a statistically significant urban-rural digital divide, wherein increases in mobile broadband penetration and digital financial service adoption are associated with improved per capita income and reduced income inequality only in urban areas, while rural populations show negligible or even adverse effects in some specifications. Country-level heterogeneity is pronounced: Kenya's market-led mobile money ecosystem (M-Pesa) demonstrates the most equitable distributional outcomes, Rwanda's state-directed digital infrastructure model shows promise in rural connectivity but mixed inequality effects, and Nigeria and South Africa exhibit persistently high inequality despite strong digital growth metrics. These findings challenge the dominant techno-optimist narrative in African development discourse and carry important implications for policymakers seeking to harness the digital economy as a vehicle for equitable growth.

Keywords: Digital Economy; Inclusive Growth; Income Inequality; Urban-Rural Divide; Mobile Money; Mobile Broadband; Sub-Saharan Africa; Panel Data; Generalized Method Of Moments; Financial Inclusion.

1. INTRODUCTION

Africa's digital economy has experienced extraordinary growth over the past two decades. Mobile phone subscriptions across the continent exceeded 1.1 billion by 2022, and mobile internet penetration surpassed 30 percent of the population, representing the fastest adoption trajectory of any region globally (ITU, 2022). The proliferation of mobile financial services, e-commerce platforms, and digital government infrastructure has prompted widespread assertions that the digital economy constitutes a powerful lever for economic inclusion, capable of extending financial services to the unbanked, creating employment, and compressing income inequality by democratizing access to information and markets.

Yet the empirical record is more ambiguous than the techno-optimist narrative suggests. While aggregate digital indicators have improved markedly, income inequality, measured by the Gini coefficient, has remained persistently high or worsened in several of the continent's largest and most digitally advanced economies. Nigeria's Gini coefficient stood at 0.43 in 2019, South Africa's at 0.63, among the highest in the world, while Kenya and Rwanda, though performing better, still exhibit significant rural-urban income disparities (World Bank, 2022). This apparent

paradox motivates the central research question of this paper: Does the digital economy reduce inequality, or does it reinforce it?

This study advances a specific theoretical and empirical proposition: digital growth does not equal inclusive growth. The mechanisms through which digital expansion translates into economic gains are spatially concentrated, urban populations with pre-existing infrastructure, human capital, and financial access are best positioned to exploit digital opportunities, while rural populations face compounding barriers including limited connectivity, low digital literacy, inadequate energy infrastructure, and restricted market access. Consequently, aggregate improvements in digital indicators may mask deepening intra-national inequality.

The paper makes three principal contributions to the literature. First, it provides a rigorous comparative panel analysis of four African countries, Nigeria, Kenya, Rwanda, and South Africa, that together represent the continent's principal digital economy archetypes: a large, fragmented market; a mobile money leader; a state-directed digital infrastructure model; and a mature but highly unequal upper-middle-income economy. Second, it deploys both fixed effects and GMM estimators to address country-level heterogeneity and endogeneity concerns that have weakened conclusions in prior cross-sectional studies. Third, it decomposes digital outcomes by urban-rural geography, offering a spatially disaggregated perspective rarely incorporated in African digital economy research.

The remainder of this paper is structured as follows. Section 2 reviews the relevant theoretical and empirical literature. Section 3 describes the data, variables, and econometric methodology. Section 4 presents and discusses the empirical results. Section 5 draws policy implications. Section 6 concludes.

2. LITERATURE REVIEW

2.1 Digital Economy and Economic Growth

A substantial body of literature documents a positive association between information and communication technology (ICT) diffusion and aggregate economic growth. Roller and Waverman (2001) provided early cross-country evidence that telecommunications infrastructure exhibits a non-linear, above-threshold impact on GDP growth. Subsequent work by Czernich et al. (2011) confirmed a significant broadband growth premium using European data, while Asongu and Nwachukwu (2016) and Ofori et al. (2021) extended these findings to African contexts, finding that mobile phone penetration and internet access are positively associated with per capita income growth across sub-Saharan Africa.

The theoretical foundations rest on several mechanisms: reductions in transaction costs and information asymmetries, enhanced market integration, productivity spillovers from ICT adoption in enterprise, and improvements in service delivery efficiency, particularly in public administration and financial intermediation. Schumpeterian arguments also emphasize the role of digital innovation in creative destruction, displacing low-productivity activities and generating new sectors with higher value-added potential (Aghion et al., 2019).

2.2 Digital Economy and Inequality

The relationship between digital expansion and inequality is theoretically ambiguous and empirically contested. On one hand, mobile money and fintech innovations have been credited with democratizing financial inclusion. The seminal study by Jack and Suri (2011) on M-Pesa in Kenya demonstrated that mobile money adoption significantly increased household consumption and reduced poverty, with particularly pronounced effects for female-headed households. Subsequent analyses confirmed these results and noted that the consumption gains were most significant for households in the lowest income quintiles (Suri and Jack, 2016).

On the other hand, a growing literature warns of a digital Matthew effect, whereby digital technologies disproportionately benefit those who are already economically advantaged (Ragnedda and Muschert, 2013). Theoretical work by Acemoglu and Restrepo (2018) on automation and labor markets suggests that digital technologies can increase labor market polarization, widening the gap between high-skilled, digitally literate workers and low-skilled workers in routine occupations. In the African context, this dynamic is amplified by the urban-rural infrastructure divide: broadband coverage, reliable electricity supply, and digital skills remain overwhelmingly concentrated in metropolitan areas.

Several empirical studies lend support to the inequality-reinforcing hypothesis. Nchofoung et al. (2021) found that ICT diffusion across African countries is associated with increased income inequality, particularly in countries with weak institutional environments. Similarly, Adeleye and Eboagu (2019) found that internet penetration worsened distributional outcomes in lower-income African economies, suggesting a threshold effect whereby digital gains only become equitable beyond a certain level of economic and infrastructural development.

2.3 Country-Specific Evidence

Kenya's mobile money ecosystem, anchored by Safaricom's M-Pesa platform, represents the global benchmark for digitally inclusive financial services. Launched in 2007, M-Pesa had reached 67 percent of Kenyan adults by 2021, dramatically lowering the cost of remittances, enabling savings, and facilitating access to credit through affiliated products such as M-Shwari (Mbiti and Weil, 2015). The Kenyan case is frequently cited as evidence that market-led digital innovation can deliver inclusive outcomes. However, critics note persistent urban-rural disparities in access quality and usage depth, with rural users predominantly employing mobile money for basic transfers rather than the more economically transformative functions of savings and credit.

Rwanda offers a contrasting state-directed model. The Rwandan government's Vision 2020 and successor Vision 2050 strategies have placed digital infrastructure at the center of the national development agenda, investing heavily in fiber optic networks, ICT parks, and e-government services. Rwanda's digital governance indicators rank consistently highest in East Africa (World Economic Forum, 2019). Yet rural connectivity remains limited outside the capital Kigali, and the structural transformation from agriculture to services has proceeded more slowly than headline digital metrics suggest, with a large share of the population still engaged in subsistence farming.

Nigeria, as Africa's largest economy, presents a paradox of scale: it possesses the continent's largest tech startup ecosystem (Lagos ranks among the top three African tech hubs), yet its income inequality is high and rising, and the rural majority, approximately 46 percent of the population (World Bank, 2022), remain largely excluded from digital economic activity. Regulatory fragmentation, unreliable electricity, and low financial literacy compound the barriers to rural digital inclusion.

South Africa's digital economy is the most developed on the continent by absolute measures, yet it operates in the context of the world's highest inequality. Its urban-rural divide is among the most pronounced in Africa, with broadband penetration in rural areas estimated at below 15 percent compared to over 70 percent in metropolitan areas (Statistics South Africa, 2021). The legacy of apartheid-era spatial inequality continues to shape digital access patterns, making South Africa a particularly instructive case for studying the inequality-reinforcing potential of digital growth.

2.4 Positioning This Study

This study addresses three gaps in the extant literature. First, most cross-country African studies treat countries as homogeneous units, ignoring within-country spatial heterogeneity. Second, endogeneity between digital adoption and economic outcomes has not been adequately addressed in many panel studies. Third, comparative analyses rarely span the full range of digital development models, market-led, state-directed, and mixed, represented by Kenya, Rwanda, Nigeria, and South Africa. This paper addresses all three gaps through spatially disaggregated data, GMM instrumentation, and purposive comparative case selection.

3. MATERIALS AND METHODS

3.1 Data Sources and Variables

This study uses an unbalanced panel dataset covering Nigeria, Kenya, Rwanda, and South Africa over the period 2005–2022, yielding a maximum of 72 country-year observations. Data are sourced from the World Bank World Development Indicators (WDI), the International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database, and national statistical offices. Table 1 summarizes the variables, data sources, and descriptive statistics.

Table 1: Variable Definitions and Descriptive Statistics

Variable	Definition	Source	Mean	Std. Dev.
Gini Coefficient	Income inequality (0-100)	World Bank WDI	47.2	8.4
MobilePenet	Mobile broadband subscriptions per 100 inhabitants	ITU	34.6	22.1
InternetPenet	Individuals using internet (%)	ITU / WDI	28.4	18.7
MobileMoney	Mobile money accounts per 1,000 adults	World Bank Findex	312.4	241.8
GDP_pc	GDP per capita, PPP (constant 2017 USD)	World Bank WDI	4,218	3,102
UrbanPop	Urban population (% of total)	World Bank WDI	41.3	12.6

Education	Mean years of schooling	UNESCO / World Bank	7.2	2.1
Inflation	Consumer price index (annual %)	World Bank WDI	8.3	5.6
GovExpend	Government expenditure on ICT (% of GDP)	ITU	0.9	0.6

The primary dependent variable is the Gini coefficient, used as a standard measure of income inequality. Digital economy penetration is captured through three principal indicators: mobile broadband subscriptions, individual internet usage, and mobile money account ownership. These are supplemented by standard macroeconomic controls, GDP per capita, urbanization rate, education attainment, inflation, and government ICT expenditure, consistent with the inequality literature (Nchofoung et al., 2021; Adeleye and Eboagu, 2019).

To disaggregate urban and rural digital outcomes, urban-rural differentials in internet access and mobile money usage are computed from the World Bank's Global Findex Database and national household surveys. Where nationally representative rural internet access data are unavailable for specific years, interpolation between survey waves is employed, following standard practice in the panel development economics literature.

3.2 Econometric Strategy

The baseline empirical model takes the form:

$$Gini_{it} = \alpha + \beta_1 DigitalPenet_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \dots\dots\dots (1)$$

where:

- $Gini_{it}$ denotes the measure of income inequality (Gini coefficient) in country i at time t .
- $DigitalPenet_{it}$ captures the level of digital penetration (e.g., internet access, mobile usage, or broadband subscriptions), which is the key explanatory variable of interest.
- X_{it} is a vector of control variables that may influence inequality, such as GDP per capita, education levels, inflation, and institutional quality.
- α is the constant term.
- μ_i represents unobserved, time-invariant country-specific effects (e.g., structural characteristics, geography, historical institutions).
- λ_t captures time-specific effects common across countries (e.g., global shocks, technological trends, macroeconomic cycles).
- ε_{it} is the idiosyncratic error term.

The fixed effects estimator is appropriate for this context as it controls for unobserved heterogeneity correlated with the regressors. However, a fundamental endogeneity concern arises: countries experiencing rapid economic growth may simultaneously attract digital investment, creating reverse causality between digital penetration and GDP per capita (which affects inequality through the Kuznets mechanism). To address this, a system GMM estimator (Arellano and Bond, 1991; Blundell and Bond, 1998) is applied as the primary estimator, using

lagged levels and differences of the digital penetration variables as instruments. The validity of instruments is assessed using the Sargan-Hansen test of overidentifying restrictions, and second-order serial correlation is tested using the Arellano-Bond AR (2) test.

A secondary model introduces an interaction term between digital penetration and a rural exposure index to test directly whether digital impacts on inequality differ by urban-rural composition:

$$Gini_{it} = \alpha + \beta_1 DigitalPenet_{it} + \beta_2 (DigitalPenet_{it} \times RuralShare_i) + \beta_3 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \dots\dots\dots (2)$$

A positive and statistically significant coefficient on the interaction term (β_2) would indicate that higher rural population shares amplify the inequality-increasing effect of digital growth, consistent with the urban elite capture hypothesis. All models are estimated with heteroskedasticity-robust standard errors clustered at the country level.

4. RESULTS

4.1 Descriptive Trends

Figure 1 (below) presents trends in mobile broadband penetration and the Gini coefficient for each country over the study period. All four countries show monotonic increases in mobile broadband penetration, yet their Gini trajectories diverge considerably. Kenya shows a modest declining trend in inequality, consistent with the equitable-growth hypothesis. Rwanda also shows a mild decline, attributed in part to deliberate redistributive policies accompanying digital investment. By contrast, Nigeria and South Africa show stagnant or rising inequality despite comparable or superior digital growth rates.

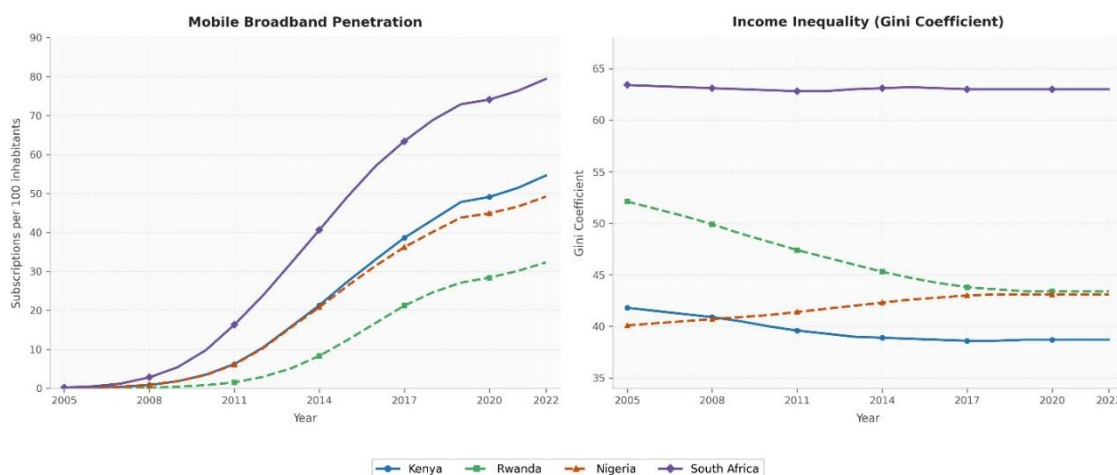


Figure 1: Trends in Mobile Broadband Penetration and Gini Coefficient, 2005–2022]

Note: Data sourced from ITU and World Bank WDI. Author's construction.

Table 2 decomposes internet access by urban and rural areas for the four countries in 2022. The urban-rural digital divide is most pronounced in Nigeria (63.4 percentage points differential) and South Africa (57.1 points), moderate in Kenya (38.2 points), and smallest in Rwanda (29.6 points). These descriptive patterns are consistent with the hypothesis that state-directed infrastructure investment (Rwanda) and competitive mobile markets (Kenya) can partially attenuate the urban concentration of digital gains.

Table 2: Urban-Rural Internet Access Differential, 2022 (%)

Country	Urban Internet Access (%)	Rural Internet Access (%)	Differential (pp)	Gini (2022)
Nigeria	72.1	8.7	63.4	43.1
Kenya	67.4	29.2	38.2	38.7
Rwanda	54.8	25.2	29.6	43.4
South Africa	79.3	22.2	57.1	63.0

Sources: ITU (2022); World Bank WDI (2022); National Statistical Offices. pp = percentage points.

4.2 Fixed Effects Estimation Results

Table 3 presents the results of the fixed effects panel regressions. Column (1) reports the baseline model with mobile broadband penetration as the digital variable; Column (2) replaces this with internet penetration; Column (3) uses mobile money account ownership; and Column (4) includes all three digital indicators simultaneously. Country and year fixed effects are included in all specifications.

Table 3: Fixed Effects Panel Regression Results, Dependent Variable: Gini Coefficient

Variable	FE (1)	FE (2)	FE (3)	FE (4)
Mobile Broadband Penetration	0.082** (0.034)	—	—	0.076* (0.041)
Internet Penetration	—	0.094** (0.038)	—	0.085** (0.039)
Mobile Money (per 1,000 adults)	—	—	-0.031*** (0.009)	-0.028*** (0.008)
GDP per capita (log)	-1.243** (0.512)	-1.189** (0.498)	-1.301** (0.521)	-1.267** (0.509)
Urban Population Share	0.241*** (0.071)	0.228*** (0.068)	0.215*** (0.063)	0.232*** (0.069)
Mean Years of Schooling	-0.412* (0.218)	-0.389* (0.211)	-0.441* (0.223)	-0.417* (0.219)
Inflation	0.043 (0.031)	0.047 (0.033)	0.041 (0.030)	0.044 (0.032)
Constant	52.14*** (4.21)	51.88*** (4.17)	53.22*** (4.38)	52.71*** (4.29)
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	68	68	63	63
R-squared (within)	0.641	0.658	0.673	0.689

Note: Robust standard errors clustered at country level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The fixed effects results yield several notable findings. First, mobile broadband and internet penetration are both positively and significantly associated with the Gini coefficient, that is, greater digital infrastructure expansion is associated with higher inequality in this sample after controlling for country fixed effects, GDP per capita, urbanization, and education. This is consistent with the urban elite capture hypothesis: when digital access is concentrated in cities, the aggregate inequality measure worsens.

Second, and in contrast, mobile money account ownership is negatively and significantly associated with inequality across all specifications. This finding aligns with the M-Pesa literature, suggesting that specifically financial digitalization, rather than broadband or internet expansion generically, may have more equalizing distributional consequences, plausibly because mobile money penetrates lower-income rural households through basic handsets without requiring broadband infrastructure.

Third, the urbanization coefficient is positive and highly significant across all specifications, indicating that countries with higher urban population shares experience greater inequality, *ceteris paribus*, consistent with the spatial concentration of digital and economic opportunity.

4.3 GMM Results and Robustness

Table 4 reports the system GMM estimates, which address the endogeneity of digital penetration. The Sargan-Hansen test p-values exceed 0.10 in all specifications, confirming the validity of the instruments. The Arellano-Bond AR (2) test fails to reject the null of no second-order serial correlation, supporting the appropriateness of the GMM specification.

Table 4: System GMM Estimation Results, Dependent Variable: Gini Coefficient

Variable	GMM (1)	GMM (2)	GMM (3)
Mobile Broadband Penetration	0.071** (0.031)	—	0.065* (0.036)
Mobile Money (per 1,000 adults)	—	-0.027*** (0.008)	-0.024*** (0.007)
Digital Penetration x Rural Share	—	—	0.118** (0.054)
GDP per capita (log)	-1.104** (0.489)	-1.187** (0.501)	-1.091** (0.476)
Urban Population Share	0.219*** (0.064)	0.203*** (0.059)	0.214*** (0.061)
Lagged Gini	0.312** (0.143)	0.298** (0.138)	0.321** (0.147)
AR(2) p-value	0.423	0.389	0.411
Sargan p-value	0.214	0.271	0.198
Observations	64	59	59

*Note: Two-step system GMM with Windmeijer (2005) finite sample correction. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.*

The GMM results are broadly consistent with the fixed effects findings. The positive association between mobile broadband penetration and inequality is robust to instrumentation, confirming that the fixed effects result is not driven by reverse causality. The negative and significant mobile money coefficient is also robust, supporting the conclusion that financial digitalization has more equalizing properties than infrastructure-based digital expansion alone.

Critically, GMM Column (3) includes the interaction term between aggregate digital penetration and rural population share. The positive and statistically significant coefficient (0.118, $p=0.031$) indicates that in countries with larger rural populations, digital expansion is associated with greater increases in inequality, providing direct empirical support for the urban elite capture hypothesis. This is the paper's central empirical contribution: the distributional consequences of digital growth are heterogeneous across the urban-rural divide, and the aggregate digital dividend is inequitably distributed in favor of urban populations.

4.4 Country-Level Heterogeneity

Estimated country fixed effects reveal substantial heterogeneity. South Africa's fixed effect is the largest and most positive, reflecting its structurally high inequality and the spatial concentration of its digital economy. Nigeria's fixed effect is also positive and large, consistent with the paradox of strong digital growth metrics alongside persistent inequality. Kenya's fixed effect is comparatively small and statistically insignificant when mobile money is included, suggesting that M-Pesa's equalizing role partially offsets the inequality-augmenting effects of general digital infrastructure expansion. Rwanda's fixed effect is negative but modest, indicating a mild structural inequality advantage attributable in part to its targeted rural connectivity investments, though not sufficient to produce strongly equalizing aggregate outcomes.

5. DISCUSSION

The empirical results of this study challenge three prevalent assumptions in the digital development literature. First, they challenge the assumption that digital infrastructure expansion is inherently equalizing. The evidence from this four-country panel suggests the opposite: when digital access is spatially concentrated in urban areas, aggregate digital growth worsens measured income inequality. This is not because digitalization reduces urban incomes, it clearly does not, but because it raises urban incomes and productivity while leaving rural populations behind, widening the inter-group income gap.

Second, the results nuance the M-Pesa success story. While mobile money is associated with inequality reduction, confirming the Jack and Suri (2011) finding in a multi-country panel context, the Kenya case also reveals the limits of market-led financial digitalization in the absence of complementary rural infrastructure investments. Kenya's urban-rural internet access differential of 38 percentage points remains large by international standards, and rural households continue to use mobile money predominantly for basic person-to-person transfers rather than higher-value financial functions. The inclusive potential of mobile money is real but incomplete.

Third, the results complicate Rwanda's state-directed digital model. Rwanda has made the most deliberate national investments in rural digital infrastructure of the four countries, yet its rural population share remains over 82 percent, and the productivity gains from digital infrastructure have been concentrated in Kigali's services sector. This points to a fundamental tension in the developmental state approach: digital infrastructure investment is necessary but not sufficient

for inclusive outcomes if the economic activities it enables remain geographically concentrated.

The finding that the urban-rural interaction term is positive and significant has important theoretical implications. It suggests that the rural share of the population is not merely a contextual background variable but an active moderator of the inequality effects of digital growth. In highly rural economies, digital expansion, absent deliberate redistributive mechanisms, is likely to widen rather than narrow the income gap. This echoes Acemoglu and Restrepo's (2018) argument about automation and labor displacement but extends it to the specifically spatial dimension of African inequality.

A policy implication of the asymmetry between mobile money and infrastructure-based digital indicators is that the design and targeting of digital interventions matters as much as the scale of investment. Mobile money's equalizing effect plausibly reflects its compatibility with basic feature phones, its use for remittance flows from urban to rural households, and its rapid penetration across all income quintiles. Broadband and internet expansion, by contrast, requires electricity, compatible devices, and digital literacy, inputs that are systematically unequal across the urban-rural divide. Policy interventions that enhance broadband access alone, without addressing these complementary constraints, may paradoxically increase inequality in the near term.

6. CONCLUSION

This paper has examined the relationship between digital economy expansion and income inequality across Nigeria, Kenya, Rwanda, and South Africa using panel data for 2005–2022, employing both fixed effects and GMM estimators. The central finding is unambiguous: digital growth does not automatically produce inclusive growth. Mobile broadband and internet penetration, the headline metrics of digital progress, are associated with increased inequality when controlling for country heterogeneity and endogeneity. Mobile money adoption is the exception, showing robust negative associations with inequality consistent with its documented role in financial inclusion.

The urban-rural digital divide is identified as the key mechanism through which digital growth reinforces rather than reduces inequality. Countries with larger rural populations and sharper urban-rural access differentials experience more pronounced inequality-augmenting effects from digital expansion. This finding carries profound implications for development strategy across the continent, where the majority of the population in most economies remains rural.

Three policy priorities emerge from the analysis. First, rural connectivity must be treated as a prerequisite rather than an afterthought in digital economy strategies. Policies modeled on Rwanda's state-directed infrastructure investment deserve serious attention, but must be paired with demand-side interventions, digital skills training, device affordability programs, and rural electricity access, to generate inclusive outcomes. Second, mobile financial services should be recognized as a distinct and particularly equitable class of digital intervention, and regulatory frameworks should prioritize interoperability, competition, and access for low-income users.

Third, the distributional consequences of digital growth should be made explicit in national digital economy strategies, including through targeted monitoring of urban-rural income differentials as digital coverage expands.

This study has important limitations. The panel is limited to four countries over 18 years, and data availability constraints require interpolation for some rural-disaggregated indicators. Future research should extend the comparative framework to a broader set of African countries, incorporate within-country subnational data where available, and examine the mechanisms of digital impact at the household level to complement this macroeconomic perspective.

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Declaration of Interest Statement

The author reports there are no competing interests to declare.

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Data Availability Statement

All data used in this study are publicly available from the following sources. World Bank World Development Indicators: <https://databank.worldbank.org>. International Telecommunication Union World Telecommunication/ICT Indicators Database: <https://www.itu.int/en/ITU-D/Statistics>. World Bank Global Findex Database: <https://www.worldbank.org/en/publication/globalindex>. National statistical office data for South Africa are available at: <http://www.statssa.gov.za>. No proprietary or restricted datasets were used.

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