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The Role of Digitalization in Driving African Economic Expansion

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Abstract
This paper examines how digital technology usage influences economic growth in Africa, using a dynamic panel framework estimated via the System Generalised Method of Moments (System GMM) to address endogeneity and reverse causality. Using panel data for 30 African countries from 2012 to 2023, the analysis links growth in real GDP to labour and physical capital accumulation, alongside digital usage captured through the Networked Readiness Index (NRI) usage pillars for individuals, businesses, and government. The results show a statistically significant and economically meaningful association between individual ICT usage and GDP growth, while business and government usage pillars are not significant in aggregate. A further decomposition into selected pillar components suggests that (i) use of virtual social networks and (ii) the importance of ICTs to government vision are the two indicators most consistently associated with growth. These findings imply that the growth dividend from digitisation in Africa is most visible when digital tools diffuse broadly among citizens and when public-sector vision signals commitment to ICT-enabled transformation, while firm-level benefits may be constrained by complementary deficits in infrastructure, skills, and innovation capacity. Policy implications emphasise strengthening digital skills, improving the enabling environment, and aligning science, technology, and innovation policies with demand-side digital adoption.

Keywords: *Digital usage; Economic growth; Internet access; Digital financial services; Digital literacy; Financial development; Government policies; Mobile phone usage; Technological adoption.*

1. Introduction

Over the last two decades, digital issues have moved from sector-specific concerns to core items on bilateral, regional, and global agendas. Digitalisation is commonly defined as the use of communication devices and applications including radio, television, mobile phones, computers, network hardware and software, satellite systems, and associated applications (Kabongo and Okpara, 2014). Multilateral forums increasingly address digital health (WHO), e-commerce (WTO), and telecommunications infrastructure (ITU), among other policy domains. Although few African states historically articulated digital foreign policy in a single official document, many have begun developing principles and implementation approaches as building blocks of such strategies.

Digital technologies reshape economic activity by transforming how firms produce, coordinate, and reach markets, and by changing how citizens communicate and access services. Platforms supporting e-commerce and business process outsourcing have altered firm operations and enabled participation in global value chains (Lacity et al., 2016; Liu and Aron, 2014). Social media has broadened communication and created new channels for information diffusion and entrepreneurship, while e-government platforms have expanded the interface between state and citizenry (Zhao et al., 2015). The COVID-19 pandemic further highlighted the macroeconomic relevance of digital adoption: social distancing and mobility restrictions accelerated

remote work, virtual education, and online service delivery, raising the perceived value of digital infrastructure and digital skills (Brynjolfsson et al., 2020; De et al., 2020; Willcocks, 2020).
In Africa, digitisation may relax structural barriers to development. A common claim is that digital technologies enable "leapfrogging", allowing late adopters to bypass earlier technological stages and catch up with advanced economies (Steinmueller, 2001). Digitisation may also operate through multiple growth channels: lowering information and transaction costs, improving market matching, enabling financial inclusion, and increasing exposure to knowledge and productivity-enhancing practices. The relationship between digital technology and growth is therefore often hypothesised to be positive (Gniniguè and Ali, 2022; Solomon and van Klyton, 2020). Yet the literature also notes potential downsides, including job displacement risks for low- and middle-skilled workers ("technological unemployment"), as well as broader social effects on attention, reading, and social interaction (Brynjolfsson and McAfee, 2014; Katz, 2012; Turkle, 2016). Even so, developing economies seeking deeper integration into global markets and stronger investment inflows often view digital adoption as an important competitiveness lever (David, 2019).

Despite rapid diffusion of mobile connectivity and digital services across Africa, empirical evidence on the growth effects of digitisation remains incomplete for three reasons. First, many studies do not fully address endogeneity and reverse causality, both of which are plausible because higher-income countries may adopt digital technologies faster, and growth itself can finance infrastructure and skills. Second, prior work often uses broad or infrastructural proxies for ICT (such as access measures), without isolating "usage", which may be more tightly linked to productivity and economic outcomes. Third, the mechanisms through which digitisation affects growth, including human capital upgrading, productivity improvements at the firm level, enhanced access to finance, and institutional strengthening, are not always tested directly in African panels (Adeleye and Eboagu, 2019; Majeed, 2020; Solomon and van Klyton, 2020).

This paper contributes by (i) using the NRI framework to distinguish ICT usage by individuals, firms, and government, and (ii) estimating a dynamic growth model using System GMM for a sample of African countries from 2012 to 2023. The objective is not to claim that digitisation is a sufficient condition for growth, but to identify which usage dimensions exhibit the strongest statistical association with GDP growth after accounting for dynamics, controls, and endogeneity concerns.

2. Literature Review: Digitalisation and Economic Growth

2.1 Theoretical perspectives

Two theoretical traditions are especially relevant.

Endogenous growth theory (Romer, 1990; Lucas, 1988) argues that growth is driven largely by internal factors, especially technological change, innovation, and human capital. Within this view, digital technologies can raise the economy's long-run growth path by improving productivity, enabling new products and organisational forms, and supporting knowledge accumulation. For African economies, this implies that digital adoption may yield larger benefits where complementary investments in human capital and innovation ecosystems are present.

Digital divide theory focuses on disparities in access to and use of digital technologies across regions and socio-economic groups. In Africa, differences in infrastructure quality, affordability, skills, and content availability contribute to uneven diffusion. From this perspective, digitisation may increase inequality or produce limited aggregate growth if adoption is narrow, or if usage is not productivity-enhancing.

2.2 Empirical evidence and channels

Empirical work presents two broad interpretations of ICT's growth effects.

A more traditional view emphasises **capital deepening**: falling ICT prices stimulate investment, raising the capital-labour ratio and productivity (van Ark et al., 2008). A complementary "non-traditional" view emphasises ICT as a general-purpose technology enabling **network externalities**, spillovers, and innovation via new forms of interaction and coordination (Cardona et al., 2013; Paunov and Rollo, 2016; Stiroh, 2002). In firm-level settings, Chowdhury (2006) highlights ICT-driven information diffusion between enterprises and consumers. However, Evangelista et al. (2014) observe that ICT investments may show delayed productivity effects, and in the short run can be negative for SMEs due to learning curves and capability mismatches.

Meta-analytic evidence tends to find modest positive average effects. Cardona et al. (2013), surveying studies from 1990 to 2007, report a small positive elasticity (around 0.05) for ICT's impact on economic performance, while also noting difficulties in verifying spillover mechanisms empirically. Cross-country dynamic panel work also supports links between ICT, innovation infrastructure, and income levels (Castellacci, 2011).

For Africa specifically, several studies find positive links between digitalisation and growth. Gniniguè and Ali (2022) identify remittance-related channels; Yoo (2005) stresses infrastructure investment; and Solomon and van Klyton (2020) find that social media and ICT use in the public sector are associated with growth across African countries. Public-sector digitisation may improve service delivery and governance quality, which can indirectly support economic expansion (Majeed, 2020). Evidence from outside Africa similarly supports a positive association between digitisation and growth outcomes (Qu et al., 2017).

Beyond aggregate growth correlations, research points to specific mechanisms:

1. **Productivity effects at firm and sector levels.** Digital adoption is linked to higher productivity, particularly in manufacturing and routine-intensive tasks (Gal et al., 2019). Sectoral evidence from Germany suggests productivity gains from digital technology use (Ferschli et al., 2021).
2. **Human capital formation.** Digitalisation can support skill acquisition and innovation capacity (Ivanová et al., 2021; Pitaikina and Vlazneva, 2018).
3. **Financial development and inclusion.** Digital systems can reduce information asymmetry and improve financial intermediation by lowering data acquisition and processing costs (Bai et al., 2016; Gao and Huang, 2020).
4. **Institutional and governance pathways.** ICT may reduce bureaucratic frictions and improve transparency, thereby supporting economic outcomes (Albiman and Sulong, 2016).

At the same time, structural constraints may limit digital dividends in Africa. Persistent gaps in skills, infrastructure, and affordability can weaken the link between digitalisation and macro outcomes (Banga and Velde, 2018; Melia, 2020; Yoon, 2020). Firms may face platform restrictions, payment limitations, and weak hosting and logistics ecosystems, constraining scale and international integration. Finally, digitisation may be associated with labour-market disruptions, requiring policy adaptation and reskilling strategies (Rifkin, 2015; Valenduc and Vendramin, 2017; UNCTAD, 2017).

A key methodological issue in this literature concerns measurement. Evidence suggests that **usage** and "digital empowerment" may matter more for productivity and employment outcomes than mere access

(Evangelista et al., 2014). This motivates a framework that explicitly separates individual, business, and government usage, rather than relying solely on infrastructure proxies.

3. Methodology

3.1 Measuring digitalisation through the Networked Readiness Index

This study uses the Networked Readiness Index (NRI) as a structured indicator of digitisation. The NRI measures the extent to which countries leverage ICT to enhance competitiveness, capturing regulatory frameworks, access, usage, and diffusion within society (Milenkovic et al., 2016). It has been published since 2002 in the context of global ICT readiness assessments. The NRI's design aligns with diffusion of innovation theory (Rogers, 2003), where early adopters may gain synergistic benefits from technology use.

The NRI 2023 framework evaluates economies across four pillars (Technology, People, Governance, Impact). For African economies, the NRI indicates heterogeneity in readiness: Mauritius, South Africa, and Kenya are often identified among the continent's stronger performers, while many countries continue to face persistent digital divide constraints.

The principal advantage of the NRI is breadth: it includes multiple African economies and provides comparable measures that can be decomposed. A limitation is that aggregation across many indicators can obscure which specific usage elements drive outcomes. To address this, the paper focuses on the **usage sub-component**, and further distinguishes usage across three pillars:

- **Individual usage (sixth pillar):** includes mobile subscriptions per 100 people, internet use share, household computer ownership, household internet access, fixed and mobile broadband subscriptions, and use of virtual social networks.
- **Business usage (seventh pillar):** includes firm-level technology absorption, innovation capability, patents, ICT use for B2B transactions, B2C internet use, and extent of staff training.
- **Government usage (eighth pillar):** includes success of government ICT promotion, importance of ICTs to government vision, and an online government service index.

3.2 Empirical model

To estimate the impact of digital usage on growth, the study adopts a Cobb-Douglas-inspired dynamic panel growth specification in first differences with lagged output:

$$\Delta lnY_{it}=a_1 lnY_{it-1}+\beta_1 \Delta lnL_{it}+\beta_2 \Delta lnK_{it}+\beta_3 \Delta lnIND_{it}+\beta_4 \Delta lnBUS_{it}+\beta_5 \Delta lnGOV_{it}+a_6 ICTLAW_{it}+a_7 TER_{it}+a_8 ln FDIGDP_{it}+a_i+ \lambda t+u_{it}$$

where ΔlnY, ΔlnL, ΔlnK and ΔlnC refer to growth in output, labour, physical capital and ICT capital, respectively. The parameters β_1,β_2 and β_3 denote output elasticities with respect to the corresponding factor inputs. The proxy variables used for ICT using three sub components of NRI namely: individual usage pillar called IND(sixth pillar), business usage pillar named BUS(seventh pillar) and lastly government usage pilar named GOV(eight pillar). These indicators indicates penetration rates of ICT-enabled technology by the household, business, and government sectors. We also include three control variables to capture the differences in the production technology across multiple countries (Niebel, 2018): laws relating to ICT (ICTLAW), tertiary education gross enrolment rate (TER), and inward FDI (FDIGDP).

To investigate the effect of digitalisation on economic growth, we estimate above equation for a sample of 30 countries from 2012 to 2023. Our proxies for digitalisation are the three pillars of the usage sub-component of the NRI indicator, $\Delta lnIND$, $\Delta lnBUS$ and $\Delta lnGOV$, which are our main variables of interest.

The sample comprises 30 African countries observed from 2012 to 2023, selected based on NRI data availability and alignment with the 2023 reporting structure.

3.3 Hypotheses

Given the theoretical expectation that widespread citizen adoption creates network externalities and improves information access and human capital outcomes, three hypotheses are assessed:

Hypothesis 1

H_0:β_3=0 (The individual usage of ICT has no effect on economic growth)

H_1:β_3>0 (The individual usage of ICT has a positive effect on economic growth)

Hypothesis 2

H_0:β_4=0 (Business usage of ICT has no effect on economic growth)

H_1:β_4>0 (Business usage of ICT has a positive effect on economic growth)

Hypothesis 3

H_0:β_5=0 (Government usage of ICT has no effect on economic growth)

H_1:β_5>0 (Government usage of ICT has a positive effect on economic growth)

3.4 Estimation strategy: System GMM

Because the specification includes lagged output and potentially endogenous regressors, pooled OLS and fixed effects estimators can be biased. The Arellano and Bond (1991) difference GMM estimator addresses this by differencing variables and instrumenting with lagged levels, but can suffer from weak instruments when regressors are persistent (Bond et al., 2001). The System GMM estimator (Arellano and Bover, 1995; Blundell and Bond, 1998) improves performance by combining equations in levels and differences, using lagged differences as instruments for levels and lagged levels as instruments for differences.

System GMM requires: (i) no second-order serial correlation in differenced errors; (ii) valid instruments (assessed by Hansen tests); and (iii) validity of additional system instruments (assessed by Difference-in-Hansen tests). A known limitation is instrument proliferation, which can weaken specification tests; therefore, the implementation relies on a collapsed instrument set and limited lags, consistent with standard guidance (Roodman, 2009a; 2009b). The main results use two-step System GMM with the Windmeijer correction for finite-sample bias in standard errors (Windmeijer, 2005).

3.5 Data sources and variables

Data are drawn from the NRI database, World Bank Development Indicators, and Penn World Tables. Key variables include: real GDP, employment growth (persons engaged), capital stock growth (constant prices), growth in the NRI usage pillars, ICT laws indicator, tertiary gross enrolment rate, and log net inward FDI inflows as a share of GDP.

4. Results

4.1 Descriptive statistics

Across the 2012 to 2023 panel, mean GDP growth (measured as \Delta \ln Y) is approximately 0.036, with meaningful within-country variation. Employment growth averages roughly 0.028, while physical capital

stock growth is higher on average (around 0.059). Digital usage growth differs by pillar: individual usage shows positive mean growth (about 0.044), business usage growth is smaller (about 0.009), and government usage growth is slightly negative on average (about -0.007), indicating that improvements in public-sector usage are uneven across the sample period and countries.

4.2 System GMM estimates: aggregate pillars

The core estimates compare pooled OLS, fixed effects, and System GMM. The System GMM specification passes standard diagnostic checks: the Arellano-Bond tests indicate expected first-order serial correlation in differences but no second-order serial correlation, and the Hansen and Difference-in-Hansen tests support instrument validity within conventional thresholds.

Key findings from the System GMM model that includes the three usage pillars are as follows:

1. **Lagged income and convergence.** The lagged GDP coefficient is negative but statistically insignificant, suggesting limited evidence of conditional convergence within this sample, consistent with the interpretation that poorer African economies are not necessarily growing faster than richer ones during the period studied.
2. **Capital accumulation.** Physical capital stock growth exhibits a positive and statistically significant relationship with GDP growth. The estimated elasticity is approximately 0.81, implying that a 1 percent increase in physical capital stock growth is associated with an increase in GDP growth of roughly 0.81 percent, holding other factors constant. This aligns with standard growth model expectations and reinforces the centrality of capital accumulation for African growth trajectories.
3. **Employment growth.** Employment growth is not statistically significant in the System GMM specification. This may reflect measurement limitations, structural labour market dynamics, or the possibility that output expansion over the period was more capital-driven than employment-driven.
4. **Digital usage pillars.** Among the three pillars, **individual ICT usage** is the only dimension that is positive and statistically significant, at the 10 percent level. The estimated coefficient is about 0.254, implying that a 1 percent increase in the individual usage index is associated with roughly a 0.25 percent increase in GDP growth on average. This supports Hypothesis 1. By contrast, the coefficients on business usage and government usage are statistically insignificant, offering no support for Hypotheses 2 and 3 in aggregate.
5. **Usage sub-index.** When the usage pillars are replaced by the overall usage sub-index, the coefficient is not statistically significant. This suggests that aggregation can mask offsetting effects and that separating usage by sector provides clearer identification of the growth-relevant component.
6. **Control variables.** ICT laws, tertiary enrolment, and FDI inflows are not statistically significant in the reported System GMM estimates. A plausible interpretation is that (i) regulatory frameworks may not have adapted rapidly enough to the evolving digital economy, reducing the effectiveness of formal ICT laws, and (ii) tertiary enrolment may not capture the quality and relevance of training for ICT-enabled growth, consistent with arguments that skill content and institutional capacity matter more than enrolment rates alone. The insignificance of FDI could reflect heterogeneous FDI composition or time-varying shocks that dilute a stable macro relationship over the sample.

Overall, the aggregate pillar evidence indicates that Africa's growth association with digitisation is strongest where digital tools diffuse widely among individuals, rather than being driven by firm- or government-usage indices when measured at a broad level.

4.3 System GMM estimates: selected pillar components

To identify which elements within each pillar drive the aggregate results, the analysis estimates System GMM models using selected components.

Individual usage components. Among the individual usage indicators, the **use of virtual social networks** is positive and statistically significant (at the 10 percent level). Mobile phone subscriptions are positive but not significant, and fixed broadband subscriptions are not significant. This pattern is consistent with the view that growth effects may arise not merely from subscription counts but from interactive usage that enables information flows, market coordination, and entrepreneurial activity. Social media may reduce marketing and coordination costs for small firms, support consumer discovery, and facilitate business formation and network building, as suggested by prior research on social media and firm performance and entrepreneurship.

Business usage components. The selected business usage components (such as innovation capacity and ICT use for B2B transactions) are statistically insignificant in these estimates. This does not necessarily imply that business digitisation is irrelevant, but it suggests that measured business usage may not translate into macro growth without complementary conditions such as reliable connectivity, digital skills, effective logistics, and a supportive innovation ecosystem. Where these complements are weak, firms may use ICT superficially or in ways that do not materially raise productivity.

Government usage components. Within government usage, the **importance of ICTs to government vision** is positive and statistically significant (at the 5 percent level), while the government online service index is positive but not significant. One interpretation is that strategic orientation and policy prioritisation may matter because it shapes long-horizon investments, regulatory credibility, and coordination across agencies. A stated ICT vision can also signal commitment to private actors and investors, thereby supporting adoption and complementary investments, even if immediate online service quality improvements are uneven.

5. Conclusion and implications

This paper analyses the relationship between digital technology usage and economic growth in Africa using a System GMM framework applied to panel data for 30 countries over 2012 to 2023. The central contribution is the disaggregation of digital usage into individual, business, and government components using the NRI usage pillars.

The main results are threefold.

First, **individual ICT usage** is positively and significantly associated with GDP growth, while business and government usage pillars are not significant when treated in aggregate. This suggests that the measurable growth dividend from digitisation in Africa is most evident when digital technologies become broadly embedded in citizen life, consistent with network externality and human capital channels.

Second, decomposing the pillars indicates that **use of virtual social networks** and **the importance of ICTs to government vision** are the two indicators most consistently linked to growth. Social media may support entrepreneurship, market coordination, and consumer engagement, while government ICT vision may influence the enabling environment through signalling, policy coherence, and institutional commitment.

Third, the results highlight that aggregate indices may obscure meaningful relationships. The overall usage sub-index is not significant, implying that analytically separating who uses ICT, and how, matters for understanding macro outcomes.

Policy implications

The evidence points to a policy logic centred on complements:

1. **Build digital skills and relevant human capital.** The growth effects of individual usage likely depend on how citizens translate connectivity into productivity, learning, and enterprise. Skills policies should target practical digital capabilities, not only enrolment expansion.
2. **Strengthen enabling infrastructure and affordability.** Where broadband quality, reliability, and cost remain binding constraints, deeper firm-level adoption may not occur or may not improve productivity measurably.
3. **Support firm digitisation through innovation ecosystems.** The insignificance of business usage measures may reflect gaps in innovation capacity, training, and complementary assets such as payments, logistics, and cybersecurity readiness.
4. **Align government vision with implementation.** The significance of ICT's role in government vision suggests that strategic clarity matters. Translating vision into credible policy and service delivery could catalyse broader adoption and spillovers.

Limitations and future research

The NRI's comprehensiveness is both strength and constraint. Aggregation across many indicators can hide specific mechanisms, while country coverage and consistency depend on index availability. Future work could deepen causal identification using natural experiments (such as broadband rollouts or mobile money regulatory changes), distinguish types of digital usage (productive versus consumptive), and test sector-specific productivity pathways. More granular measures of digital skills and institutional quality may also clarify when digitisation translates into sustained growth.

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