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The Impact of Digital Infrastructure Quality on Economic Growth in Sub-Saharan Africa

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ABSTRACT: This study explores a panel data analysis covering 30 Sub-Saharan African countries from 2010 to 2023. This study's variables include GDP growth, digital infrastructure quality, network coverage, mobile speeds, handset affordability indicators, exchange rate and FDI and use System GMM estimator for data estimation. The study finds that while infrastructure index is marginally significant and negatively associated with GDP growth, network coverage is significantly positive with GDP. Also, it reveals that mobile download and upload speeds are negatively and positively impact on GDP growth rate. Handset affordability and foreign direct investment are positively but insignificantly related to economic growth rate in the sub-region. EXR is Insignificant but has the expected negative sign with GDP growth rate. Therefore, this study recommends that authority of the various countries in this region should prioritize internet coverage and inclusive mobile access over merely increasing speed or technology levels could go a long way to improving economic growth. They should also, complement digital infrastructure with access to electricity and affordable data to ensuring satisfaction.

KEYWORDS: digital infrastructure, economic growth, mobile download speeds, mobile upload speeds, network coverage, handset affordability.

JEL Classification: I96, O1

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1. INTRODUCTION

The 21st century has ushered in a digital era in which information and communication technologies (ICTs) have become central to socioeconomic transformation and structural change. Across both developed and developing economies, digital infrastructure—comprising broadband networks, mobile connectivity, internet access, data systems, and affordable smart devices—has evolved into a fundamental production input that enhances efficiency, reduces transaction costs, and facilitates innovation. Beyond its technical function, digital infrastructure now serves as a critical enabler of productivity growth, improved public service delivery, financial inclusion, and integration into the global digital economy. Globally, the diffusion of digital technologies has significantly altered economic structures, enabling the emergence of knowledge-based economies and platform-driven markets. Advanced economies have leveraged high-quality digital infrastructure to accelerate industrial upgrading, expand digital trade, and foster innovation ecosystems. In contrast, developing regions, particularly Sub-Saharan Africa (SSA), face persistent structural constraints that limit their ability to fully capture these digital dividends. For SSA, a region historically characterized by infrastructural deficits, institutional weaknesses, and economic volatility, digital infrastructure presents a unique opportunity to leapfrog traditional development pathways and bridge longstanding development gaps.

Despite this potential, the development of digital infrastructure in SSA remains uneven, both across and within countries. While there has been notable progress in mobile phone penetration and basic internet adoption over the past decade, the region continues to lag behind global benchmarks in terms of infrastructure quality. Key challenges include limited broadband penetration, low internet speeds, high latency, unreliable connectivity, and the high cost of digital devices and data services. These deficiencies constrain effective digital participation, limit the scalability of digital innovations, and weaken the productivity-enhancing effects of ICT adoption (GSMA, 2022; World Bank, 2023; James & Versteeg, 2007). Furthermore, digital inequality in SSA is

multidimensional, encompassing not only access gaps but also disparities in quality, affordability, and usage capabilities. Rural-urban divides, income inequality, and infrastructural bottlenecks such as inadequate electricity supply exacerbate digital exclusion in the region. As a result, while digital technologies are increasingly present, their economic impact remains suboptimal and unevenly distributed. This has important implications for inclusive growth, as segments of the population remain disconnected from opportunities in digital finance, e-commerce, e-learning, and digital employment.

Empirical evidence suggests that countries with more advanced and reliable digital infrastructure tend to experience higher economic growth, increased firm productivity, and improved labour market outcomes (Czernich *et al*., 2011; Hjort & Poulsen, 2019; Myovella *et al*., 2019). Digital infrastructure facilitates information flows, enhances market efficiency, reduces coordination costs, and supports innovation-driven growth. However, the magnitude and direction of these effects are highly contingent on the quality and functionality of the infrastructure rather than mere access or penetration levels. This raises a critical paradox in the SSA context. Despite rapid growth in mobile subscriptions and internet users, many countries in the region continue to record modest and volatile GDP growth rates. This disconnect suggests that increased digital access alone does not automatically translate into economic transformation. Rather, the effectiveness of digital infrastructure in driving growth depends on its quality dimensions such as network reliability, broadband speed, coverage depth, latency, and affordability as well as complementary factors including human capital, institutional quality, and energy infrastructure (Ndung'u & Signé, 2020). A major limitation in the existing literature is the tendency to treat digitalization as a homogeneous construct, often proxied by aggregate indicators such as internet penetration or mobile subscriptions. While such measures capture the extent of access, they fail to reflect the qualitative aspects of infrastructure that determine actual usage efficiency and economic impact. Consequently, policy prescriptions derived from these studies may be insufficiently targeted, leading to suboptimal allocation of resources and limited digital dividends.

Moreover, empirical findings on the relationship between digital infrastructure and economic growth in SSA remain mixed and inconclusive. While some studies report positive and significant effects of ICT development on growth, others highlight conditional or indirect relationships mediated by institutional quality, education, and policy frameworks. For example, Myovella *et al*. (2019) found that the growth impact of digitalization is stronger in more advanced economies, while David and Grobler (2020) emphasized the role of complementary factors such as human capital. Similarly, Ndubuisi *et al.* (2021) identified positive employment effects in the service sector, whereas Karar (2019) pointed to persistent structural inequalities and digital divides that limit inclusive outcomes. Given these inconsistencies, there is a clear need for a more disaggregated and nuanced analysis of digital infrastructure, particularly in the SSA context. Specifically, understanding how individual components of digital infrastructure quality—such as network coverage, mobile broadband speeds, and handset affordability—affect economic growth is essential for designing effective policy interventions. Without such granularity, digital investments may fail to yield broad-based economic benefits and could potentially exacerbate existing inequalities.

Against this backdrop, this study seeks to contribute to the literature by providing an empirical investigation into the impact of digital infrastructure quality on economic growth in Sub-Saharan Africa. Unlike prior studies that rely on aggregate measures of digitalization, this research adopts a multidimensional approach by decomposing digital infrastructure into key quality indicators, including infrastructure index, internet coverage, mobile download and upload speeds, and handset affordability. By doing so, the study aims to provide more precise insights into the channels through which digital infrastructure influences economic performance in the region.

2. LITERATURE REVIEW

2.1 Conceptual Review

Digital infrastructure has evolved beyond basic connectivity to encompass a complex ecosystem of physical, technological, and institutional components that support digital interaction and economic activities. According to AUC/OECD (2021), digital infrastructure refers to the foundational systems including broadband networks, mobile communication systems, data centres, cloud computing facilities, and digital platforms, that enable the storage, transmission, and processing of digital information. Similarly, Njoh (2018) conceptualizes digital infrastructure as a socio-technical system integrating ICT hardware, software, and regulatory frameworks that facilitate economic and social interactions. From a development perspective, Banga and Te Velde (2018) argue that digital infrastructure is not merely a technological asset but a catalyst for industrial transformation, global value chain participation, and digital trade. Arendt (2015) further describes digital infrastructure as a productivity-enhancing capital input capable of reducing transaction costs, improving efficiency, and stimulating innovation.

In the context of Sub-Saharan Africa (SSA), digital infrastructure is predominantly mobile-based due to limited fixed broadband deployment (GSMA, 2022). However, the effectiveness of digital infrastructure in SSA depends not only on quality dimensions such as coverage, speed, reliability, latency, and affordability, but also on complementary factors including electricity supply, human capital, and institutional quality (Ndung'u & Signé, 2020). Internet coverage refers to the proportion of the population that can access internet services within a geographical area and is considered an important indicator of digital inclusion (Lee *et al.*, 2012). Mobile internet speed reflects the efficiency of digital connectivity and influences the effectiveness of online economic activities. Czernich *et a*l. (2011) provide evidence that improvements in broadband quality positively influence productivity and economic

growth. Handset affordability refers to the cost of internet-enabled devices relative to income levels. In SSA, high smartphone costs continue to exclude many low-income populations from effective digital participation (GSMA, 2022). James and Versteeg (2007) therefore argue that affordability remains essential for achieving inclusive digitalization and broad-based economic empowerment.

2.2 Empirical Review

Empirical studies examining the relationship between digital infrastructure and economic growth provide mixed but generally positive evidence, particularly for developing economies. Correa and Esquivias (2025) analyzed the impact of digitalization, education, and institutional quality on economic growth in SSA and Middle East economies using panel data from 2005 to 2021 and the Pooled Mean Group (PMG) estimator. Their findings reveal that digitalization positively influences economic growth, although the interaction effects between digitalization, education, and institutional quality remain mixed. The major strength of the study lies in its incorporation of institutional and educational dimensions into the digitalization-growth nexus. However, the study relied on aggregate digitalization measures, limiting insights into the distinct effects of infrastructure quality components. Ndubuisi *et al*. (2021) investigated the effect of digital infrastructure on service sector employment in 45 SSA countries using a Fixed Effects Model (FEM). Their findings show that digital infrastructure significantly improves employment generation within the service sector. The strength of this study lies in its sector-specific focus, which provides important insights into labor market outcomes. However, the study did not explicitly examine the broader macroeconomic growth implications of digital infrastructure quality.

Solomon and Klyton (2020) employed System GMM to examine the impact of digital technology usage across individuals, businesses, and governments in 39 African countries. Their findings indicate that individual ICT usage positively affects economic growth, while business and government ICT usage exert indirect effects. A major strength of the study is its robust econometric treatment of endogeneity. Nevertheless, its focus on ICT usage rather than infrastructure quality limits its ability to explain supply-side digital constraints. Myovella *et al*. (2019) compared the contribution of digitalization to economic growth in SSA and OECD countries using GMM estimators. Their results reveal that digitalization positively affects growth in both regions, although broadband infrastructure exerts stronger effects in OECD economies while mobile telecommunications are more influential in SSA. The comparative framework adopted by the study represents a significant strength. However, its reliance on aggregate digitalization measures limited detailed insights into the specific effects of infrastructure quality dimensions. David and Grobler (2020) found that ICT penetration positively influences economic growth in Africa when supported by enabling institutional and human capital conditions. Similarly, Donou-Adonsou (2019) argues that technology contributes more effectively to growth when combined with educational development. Hjort and Poulsen (2019), using firm-level data, demonstrated that improved internet quality significantly enhances employment and productivity in Africa by enabling firms to participate more efficiently in digital markets. In contrast, Karar (2019) presents a critical perspective by emphasizing that digitalization may reinforce structural inequalities and digital divides where access and productive capabilities remain unevenly distributed. Although conceptually insightful, the study provides limited empirical quantification of these structural effects.

2.3 Theoretical Framework

This study is anchored on the Endogenous Growth Theory and the Diffusion of Innovation Theory. The Endogenous Growth Theory, pioneered by Romer (1990), posits that economic growth is driven by internal factors such as technological innovation, human capital development, and knowledge accumulation. The theory argues that investments in technology and innovation enhance productivity and generate long-run economic growth through knowledge spillovers and efficiency improvements. In this context, digital infrastructure serves as a productivity-enhancing input capable of facilitating innovation, reducing information asymmetries, and improving economic efficiency. The Diffusion of Innovation Theory developed by Rogers (1962) explains how technological innovations spread across societies and influence adoption behavior. The theory identifies factors such as accessibility, affordability, and relative advantage as major determinants of technology adoption. Within the SSA context, the theory implies that the quality of digital infrastructure—particularly internet speed, network coverage, and affordability—determines the extent to which individuals and firms adopt and utilize digital technologies productively. Together, the Endogenous Growth Theory and Diffusion of Innovation Theory provide a comprehensive framework for this study by explaining both the productivity-enhancing role of digital infrastructure and the importance of infrastructure quality in driving technology adoption. The theories justify the disaggregation of digital infrastructure into components such as coverage, speed, and affordability, as these dimensions influence adoption, productivity, and ultimately economic growth differently.

3. DATA AND METHODOLOGY

Panel data that covers 30 Sub-Saharan African countries from 2010 to 2023. The dependent and policy variables include GDP growth rate (sourced from World Development Indicators [WDI]), digital infrastructure quality, network coverage, mobile speeds (download and upload), handset affordability indicators (extracted from Groupe Speciale Mobile Association [GSMA]), and control variables such as, exchange rate and FDI (accessed from WDI). System GMM estimator is used to estimate the impact of digital infrastructure quality on economic growth, with robustness checks to address endogeneity concerns.

Summary of statistic is used to know the differences in the magnitude of the variables deployed for analysis. This gives us a preliminary understanding of the data properties. The stationarity properties are checked with Levin-Lin-Chu (LLC) and Harris-Tzaralis (HT) methods of unit root. For regression analysis, we adopt the Dynamic System Generalised Method of Moment (SysGMM) estimation technique, established by Blundell and Bond (1998). We rely on this estimation technique because it solves the problem of weak instruments associated with the difference Generalised Method of Moment (GMM) estimation technique. The SysGMM is particularly reliable when the number of cross sections (N) is larger than the number of time series (T). It also solves the issue of endogeneity bias, reverse causality and the problems associated with omitted variables. According to Caporale *et al.* (2009), it controls for time effects t as well as individual specific effects i. The study corrects for heteroskedasticity through 2-step SysGMM since the first step assumes homoscedasticity. Finally, we utilize the Hansen test to determine the validity of the instruments included in the model.

Model Specification

Based on the Solow's long run exogenous growth model and Lerner's functional finance theory which specify a relationship between macroeconomic objectives and government borrowing (or technical progress), this study adapts the model of Correa and Esquivias (2025) stated as follows:

$$PGDP = f(DIG, EDU, INSQ, GDS, LF) \quad (1)$$

where PGDP is GDP per capita growth, DIG is the digitalization composite index, EDU is Average years of schooling completed by individuals 25 and older. INSQ is the institutional quality composite index GDS is Gross domestic savings and LF is Labour force participation rate. However, this study modifies model (1) and specify a dynamic model of SysGMM as follows:

$$GDP_{it} = \beta_0 + \beta_1 GDP_{i,t-1} + \beta_2 Infr_{it} + \beta_3 Ntwcov_{it} + \beta_2 Mds_{it} + \beta_3 Mus_{it} + \beta_2 Hsetaff_{it} + \beta_3 Fdi_{it} + \beta_3 Exr_{it} + \mu_i + \nu_{it} \quad (2)$$

where GDP is gross domestic product growth rate, a proxy of economic growth, Infr is digital infrastructure index, Ntwcov is network coverage, Mds is mobile download speeds, Mus is moiile upload speeds, Hsetaff represents handset affordability, Fdi is foreign direct investment, and Exr is exchange rate. μ_i is the country specific effect, ν_{it} represents the error term for the cross-sectional index and time-series.

4. RESULTS AND DISCUSSION

Table 1: Summary Statistics

Variable	*Mean*	*SD.*	*Min*	*Max*
GDP	3.25	4.17	-20.81	15.84
Infr	40.91	14.48	12.43	69.47
Ntwcov	59.02	22.14	9.8	99.19
Mds	10.34	5.28	1.21	31.90
Mus	17.05	10.88	1.88	47.89
Hsetaff	28.59	16.44	0	76.33
FDI	3.97	6.19	-17.29	37.32
EXR	834.93	1667.50	2.90	9565.08

Source: Authors' Computation from the Output of Stata/SE 15.1, 2025

From the Table 1, it is observed that on average, the countries in your sample experienced a 3.25% annual growth in GDP. The Standard Deviation is 4.17 which shows a moderate variation in growth rates across countries and years. The most extreme contraction (minimum) in GDP recorded is -20.81%, indicating significant economic downturn in some countries while the highest (maximum) annual growth rate observed is 15.84%, reflecting periods of strong expansion in some countries. As for digital infrastructure (Infr), the mean quality of digital infrastructure stands at around 41. While the variation in digital infrastructure quality across countries is 14.48, the Min and Max are 12.43 and 69.47 respectively. This means that some countries have very poor infrastructure, while others are relatively advanced. Ntwcov (Internet Network Coverage) has an average of 59.02 with standard deviation of 22.14.

The mean of Mds, Mus, and Hsetaff are 10.34, 17.05, and 28.59 respectively. Their deviation from the mean are 5.28, 10.88, and 16.44 respectively. The means and standard deviations of the control variables like; FDI is 3.97 and 6.19, EXR is 834.93 and 1667.50. The implications of these results are the wide spread in digital indicators (infrastructure, speed, coverage, affordability) supports the rationale of disaggregating their effects on economic growth and the extreme values in GDP, FDI, and exchange rates suggest the potential need for robustness checks or controlling for outliers in regression models.

Table 2: Unit Root

Variable	*LLC at Level*	*P-value*	*HT at Level*	*P-value*	*I(P)*
GDP	-3.8295*	0.0001	-0.1226*	0.0000	I(0)
Infr	-3.6115*	0.0002	-0.3328*	0.0000	I(0)
Ntwcov	-4.8721*	0.0000	0.3605*	0.0000	I(0)
Mds	-1.5557***	0.0599	-0.1746*	0.0000	I(0)
Mus	-2.6859*	0.0036	-0.2315*	0.0000	I(0)
Hsetaff	-5.1923*	0.0000	-0.4594*	0.0000	I(0)
FDI	-5.4956*	0.0000	-0.0948*	0.0000	I(0)
EXR	-5.4449*	0.0000	-0.1538*	0.0000	I(0)

Note *. **, * represent significance at 0.01, 0.05 and 0.1 levels respectively**
Source: Authors' Computation from the Output of Stata/SE 15.1, 2025

This study utilizes Levin-Lin-Chu (LLC) and Harris-Tzaralis (HT) methods of unit root for the 30 SSA countries to test for the stationarity of the data. It is observed from Table 2 that all variables are integrated of order zero which means that they are stationary at level. This suggests randomness of the data, hence, requires no cointegration test for the existence of long-run convergence.

Table 3: SysGMM Results

Variable	*Coefficient*	*Statistic (z)*	*P-Value*
Constant	22.0561**	2.49	0.013
GDP (-1)	-2.1432**	-2.48	0.013
Infr	-0.4842***	-1.94	0.053
Ntwcov	0.1358**	2.40	0.016
Mds	-0.4582*	-2.97	0.003
Mus	0.3433**	2.44	0.015
Hsetaff	0.0250	0.73	0.467
FDI	0.0076	0.06	0.951
EXR	-0.0005	-1.09	0.275
N	290		
No. of Groups	29		
Instruments	253		
AR1	-1.26* (0.007)		
AR2	-1.18 (0.237)		
Sergan Test	245.12* (0.048)		
Hansen	0.02 (1.000)		

Note *. **, * represent significance at 0.01, 0.05 and 0.1 levels respectively. Probability in ().**
Source: Authors' Computation from the Output of Stata/SE 15.1, 2025

The System Generalized Method of Moments (SysGMM) estimation results presented in Table 3 provide robust insights into the dynamic relationship between digital infrastructure quality and economic growth in Sub-Saharan Africa (SSA). The constant term (22.0561, $p < 0.05$) is positive and statistically significant, indicating that, holding all explanatory variables constant, there is an inherent baseline level of economic growth across the sampled SSA countries. While the constant has limited standalone economic interpretation, its significance suggests that omitted structural factors—such as institutional frameworks or macroeconomic stability—may still contribute to growth outcomes. The lagged GDP variable (GDP (-1) = -2.1432, $p < 0.05$) is negative and statistically significant, confirming the presence of dynamic adjustment and mean reversion in economic growth. This implies that periods of high growth are often followed by slower growth, reflecting cyclical corrections or structural rigidities within SSA economies. This finding aligns with the theoretical expectation of convergence dynamics, where economies adjust toward their long-run equilibrium growth path.

With respect to the core explanatory variables, the digital infrastructure index (Infr = -0.4842, $p < 0.10$) is marginally significant but exhibits a negative relationship with GDP growth, which is counterintuitive. This suggests that improvements in aggregate digital infrastructure quality do not immediately translate into economic growth in SSA. This counterintuitive result may reflect structural constraints within the region, including inadequate electricity supply, low digital literacy, weak institutional quality, and limited technological readiness, which reduce the productive utilization of digital infrastructure (Ndung'u & Signé, 2020). It may also indicate the existence of a time lag or threshold effect, where the economic benefits of digital investments only emerge after reaching a certain level of infrastructural and institutional maturity. Furthermore, digital infrastructure in many SSA countries is often

concentrated in urban areas and used more for consumption-oriented activities such as social media and entertainment rather than productivity-enhancing sectors like innovation, manufacturing, and digital entrepreneurship (Solomon & Klyton, 2020). The finding is also consistent with Myovella *et al*. (2019), who argue that the growth effects of digitalization are weaker in SSA than in advanced economies due to limited absorptive capacity and complementary infrastructure. Additionally, the aggregate infrastructure index may conceal the differing effects of its individual components, as network coverage and upload speeds were found to positively influence growth in this study. Therefore, the negative coefficient should not be interpreted as evidence that digital infrastructure harms growth, but rather as an indication that the economic gains from digitalization in SSA remain conditional on complementary investments, efficient utilization, and broader digital ecosystem development.

The results for mobile download speeds (Mds = -0.4582, $p < 0.01$) reveal a negative and statistically significant relationship with economic growth, which is unexpected given the theoretical importance of speed in enhancing productivity. This counterintuitive outcome may suggest that higher download speeds in SSA are not being effectively translated into productive economic activities. One plausible explanation is that faster internet is disproportionately used for consumption-oriented activities (e.g., streaming, social media) rather than productive uses such as digital entrepreneurship or business operations. Additionally, this may reflect digital skill gaps, where users lack the capacity to leverage high-speed internet for economic gains. This finding aligns with Solomon and Klyton (2020), who argue that ICT usage patterns, rather than availability alone, determine growth outcomes. Conversely, mobile upload speeds (Mus = 0.3433, $p < 0.05$) exhibit a positive and statistically significant effect on economic growth. That is, the positive effect of upload speeds indicates that productive digital activities (including e-commerce, remote work, digital entrepreneurship, and online services) enhance economic performance (Hjort & Poulsen, 2019). The implication is that productive digital engagement, such as online businesses, digital services, and information sharing, is more critical for growth than passive consumption. This distinction between download and upload speeds provides important policy insight into the type of digital activities that drive economic performance. Implying that policymakers should prioritize productive digital engagement, digital skills, innovation ecosystems, and complementary infrastructure to maximize digitalization-driven growth.

The coefficient for handset affordability (Hsetaff = 0.0250, $p > 0.10$) is positive but statistically insignificant, indicating that while affordability may improve access to digital devices, it does not independently drive economic growth. This suggests that affordability must be complemented by other enabling conditions such as network quality, electricity access, and digital literacy to translate into meaningful economic outcomes. This finding is consistent with Correa and Esquivias (2025), who emphasize the interaction between digitalization and other structural factors. Similarly, foreign direct investment (FDI = 0.0076, $p > 0.10$) is positive but insignificant, indicating a weak link between FDI and economic growth in the sampled SSA countries. This may reflect the sectoral composition of FDI, which is often concentrated in extractive industries with limited spillover effects on the broader economy. It may also indicate weak absorptive capacity, where host economies are unable to fully leverage foreign investments for productivity gains. The exchange rate (EXR = -0.0005, $p > 0.10$) has the expected negative sign but is statistically insignificant. This suggests that currency depreciation may have a mild adverse effect on growth, possibly through increased import costs and macroeconomic instability. However, its insignificance indicates that exchange rate movements are not a primary driver of growth variations in this model.

From a diagnostic perspective, the model demonstrates strong validity. The Arellano-Bond AR(1) test is significant ($p < 0.01$), which is expected in first-differenced equations, while the AR(2) test is insignificant ($p > 0.05$), confirming the absence of second-order serial correlation and validating the model specification. The Sargan test ($p < 0.05$) suggests potential instrument proliferation or over-identification concerns, but the Hansen test ($p = 1.000$) indicates that the instruments are valid and not overfitting the model. Overall, these diagnostics confirm the reliability and robustness of the SysGMM estimates.

5. CONCLUSION AND RECOMMENDATIONS

Understanding the multifaceted impact of digital infrastructure quality on economic growth in SSA is vital for policy direction, investment priorities, and achieving the Sustainable Development Goals (SDGs). Given the findings of this study**,** we observed disparity in the SSA countries data, that is, some countries have very poor digital infrastructure quality, while others are relatively advanced**.** We also discovered that **i**nfrastructure index was not a driver to economic growth in SSA region. Though, the finding indicated that network coverage in SSA could lead to higher economic growth for this region. Though, mobile phones are affordable in the region but does not ordinarily translate to economic growth because it depends on the internet quality. This could be understood from the impact of mobile speeds of the region's internet which suggested that the usage of internet is more of uploading than downloading, indicating that the region **s**uffer from "elite capture" without broad accessibility. Given these findings, the implication is that prioritizing internet coverage and inclusive mobile access over merely increasing speed or technology levels could go a long way to improving economic growth. In addition, digital infrastructure should be complemented with access to power and affordable data to ensuring satisfaction.

Contribution of the study

This study contributes to the existing literature on digitalization and economic growth in several important ways. First, unlike many previous studies that rely on aggregate indicators of digitalization such as internet penetration or ICT adoption rates (Myovella et

al., 2019; Solomon & Klyton, 2020), this study adopts a disaggregated approach by examining specific dimensions of digital infrastructure quality, including infrastructure index, network coverage, mobile download speeds, upload speeds, and handset affordability. This provides deeper insights into how different aspects of digital infrastructure uniquely influence economic growth in Sub-Saharan Africa (SSA). Second, the study contributes methodologically by employing the System Generalized Method of Moments (SysGMM), which effectively addresses issues of endogeneity, omitted variable bias, and dynamic relationships common in panel growth models. Third, the study extends the SSA-focused literature by highlighting the contrasting effects of productive and consumption-oriented digitalization, particularly through the differing impacts of upload and download speeds on economic growth. Fourth, the study integrates the Endogenous Growth Theory and Diffusion of Innovation Theory to provide a more comprehensive explanation of how infrastructure quality influences both technology adoption and productivity growth. Finally, the study contributes to policy discussions by emphasizing that digital infrastructure investments alone are insufficient for growth unless supported by complementary factors such as digital skills, institutional quality, electricity access, and productive digital usage. Thus, the study provides more nuanced and policy-relevant evidence for designing inclusive digital transformation strategies in SSA.

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