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The Impact of Government Digitalisation on Economic Growth: Cross-Country Panel Data Evidence from Sub-Saharan Africa

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Abstract

This study investigates the impact of government digitalisation on economic growth in Sub Saharan African countries. Although government digitalisation is generally considered to promote economic growth, the specific effects of its three components, e government development, online public services, and telecommunication infrastructure, remain insufficiently explored. The analysis covers 35 Sub Saharan African countries over the period from 2008 to 2024, observed at two-year intervals. Methodologically, the study employs a Fixed Effects model with Driscoll Kraay standard errors, complemented by a dynamic GMM model for robustness checks and a Granger causality test to address potential two-way relationships. To ensure the reliability of the findings, a range of preliminary and diagnostic tests were conducted, including descriptive statistics, correlation analysis, and tests for multicollinearity, heteroskedasticity, serial correlation, and cross-sectional dependence. The results show that e government development has a positive and statistically significant effect on economic growth. In contrast, online public services and telecommunication infrastructure are found to have negative and significant effects. These adverse outcomes are attributed to structural and institutional challenges, such as limited digital capacity, high costs, and unequal access, which hinder the effective use of digital systems. Overall, the study provides clear evidence that while government digitalisation can support economic growth, its benefits in Sub Saharan Africa depend heavily on the presence of supportive institutional and structural conditions.

Keywords: Government digitalisation, economic growth, e-government development index, online public service index, telecommunication infrastructure

Introduction

The technological revolution has surpassed the industrial revolution, which initially introduced the mass production of goods in industries. The advancement

of technology has led to increased productivity, improved living standards, and job creation (Arsic, 2020). Government digitalisation involves using digital technologies to reshape a business model, enabling new ways to generate revenue and create value (Ukeyima, 2025). Government digitalisation, on the other hand, involves the use of technology and digital tools to improve government operations, enhance public services, streamline employee workflows, and strengthen citizen engagement (Atar et al., 2025). Government digitalisation has a major influence on economic growth, productivity, and employment, and experts predict its impact will become even more significant in the future (Arsic, 2020).

In many developed nations, economic growth is largely driven by innovation and technological advancement, which substitute for human labour in many areas of daily life and across various sectors of the economy (Georgescu et al., 2021). According to the United Nations Department of Economic and Social Affairs (2022), the latest United Nations E-Government Development Index report indicates that 73 countries fall into the high category and 60 are rated very high in digital government adoption, with developed nations accounting for most of these top performers. Earlier studies, such as Wandaogo (2022), found that government digitalisation has a far greater impact in developed nations compared to developing ones. These advanced economies have embraced digital technologies to create efficient, transparent, and citizen-centred governance systems (Sharmin & Chowdhury, 2025). Countries like Estonia, Denmark, Singapore, and the United Kingdom are often recognised as global leaders in e-government innovation, where nearly all administrative services, from tax filing to healthcare access, can be completed online (Yasuoka et al., 2022).

The digitalisation of government operations has streamlined bureaucratic processes, reduced costs, and improved the speed and accuracy of service delivery in developed countries (Yasuoka et al., 2022). It has also strengthened data driven decision making, enabling governments to anticipate public needs and design targeted policies more effectively (Hossin et al., 2023). Beyond improving administrative efficiency, these advancements have a strong positive impact on economic growth in developed nations. By making public services more efficient and transparent, digital governance reduces transaction costs for businesses, attracts investment, and fosters innovation (Giroud & Bonilla-Feret, 2025).

On the other hand, less developed countries are still lagging behind in government digitalisation. According to United Nations Department of Economic and Social Affairs (2022), the economies of developing nations recorded an average score of 0.35 on the United Nations E-Government Development Index (EGDI), compared with a global average of 0.61. Specifically, Sub-Saharan Africa has progressed steadily over the past decade, driven by improvements in mobile connectivity, expanding internet access, and

increasing recognition of technology's role in improving public sector efficiency. While countries like Kenya, Rwanda, South Africa, and Mauritius have become regional leaders through strong information and communication technology (ICT) investment and progressive digital policies, many others still struggle with infrastructure gaps, high data costs, limited funding, and skills shortages (Akomolehin & Aluko, 2025).

Despite the progress made, the gap between advanced and less developed economies remains wide, particularly in Sub-Saharan Africa, where government digitalisation is expanding but still constrained by infrastructure limitations, uneven ICT adoption, and resource shortages. These structural differences raise important questions about how far digital government initiatives actually contribute to economic performance in countries where adoption is slower and institutional capacities are weaker. Since digital government can improve public sector efficiency, reduce transaction costs, and stimulate broader economic activity, understanding its role within Sub-Saharan African countries becomes essential. This creates a clear need to examine whether improvements in key dimensions of government digitalisation, such as overall e-government development, online public service delivery, and telecommunication infrastructure, translate into measurable gains in economic growth across the region.

This study specifically provided differentiated contributions by going beyond conventional analysis by examining the effect of government digitalisation on economic growth using three dimensions, namely, the EGDI, Online Service Index (OSI), and Telecommunication Infrastructure (TeI), while utilising the most recent data from 2008 to 2024. The analysis of the isolated elements of government digitalisation provides clear insights into which aspects of government digitalisation drive or limit economic growth, addressing a crucial gap in the literature and informing more focused policy implications for developing economies. Specifically, the study sought to:

1. To investigate the effect of the E-Government Development Index on economic growth rate.
2. To examine the influence of the online service index on economic growth rate.
3. To examine the effect of telecommunication infrastructure on economic growth rate.

Literature Review

The theoretical and empirical frameworks identify and confirm government digitalisation as a major factor that influences economic growth in both developed and developing economies. Theoretically, Endogenous Growth Theory suggests technological advancement as a significant factor influencing productivity, efficiency, and knowledge diffusion. As suggested by Romer (1986)

and later supported by Lucas (1988), Endogenous Growth Theory suggests that economic growth is created from within the economy's capacities rather than from unexplained or external factors. The theory identifies internal factors such as technology and innovation, human capital, knowledge, and research as drivers of economic growth. Based on this, improvement in these factors in the economy increases productivity and positive externalities, while government policies in education, ICT investment, and innovation support directly influence the economic growth rate. In the context of this study, Endogenous Growth Theory provides a foundation for the analysis of how different aspects of government digitalisation act as forms of technological improvement that drive economic growth in Sub-Saharan Africa.

Empirically, a growing body of studies from different countries and periods offers valuable insights into how government digitalisation and ICT advancement influence economic growth, evidence that is particularly relevant for regions such as Sub-Saharan Africa. Georgescu et al. (2021) conducted a study in Europe and found that government digitalisation plays a substantial role in supporting economic performance, with digital indicators explaining about 70 percent of economic growth and demonstrating a strong correlation of 0.80. Their results further show that GDP rises as firms increasingly engage in e-commerce and adopt advanced digital tools such as customer data analytics, while strong digital skills tend to coincide with higher investment in research and development, underscoring the link between digital readiness and innovation capacity. Revenko et al. (2024) similarly reported that government digitalisation significantly enhances economic growth in the European Union. Using an eleven factor regression model grounded in the neoclassical production function, supported by Elastic Net Regression to address multicollinearity, their study achieved high predictive accuracy and provided a robust framework for assessing digital transformation policies. These findings collectively highlight the transformative potential of government digitalisation in boosting productivity, competitiveness, and long term economic performance.

However, the European evidence also reveals important nuances, indicating that the impact of government digitalisation is not uniform across all contexts. Arsic (2020) observed that while digitalisation can modestly increase productivity, particularly when supported by investments in infrastructure, innovation, and education, it is unlikely to drive sudden or exponential economic growth. The study also cautions that government digitalisation may negatively affect employment unless education systems and workforce skills evolve to match technological change. Magoutas et al. (2024) strengthened that argument for government digitalisation's positive economic role by showing, through structural equation modelling with digital economy and society index (DESI), European Statistical Office (EUROSTAT), and Organisation for Economic Co-operation and Development (OECD) data, that ICT development, artificial intelligence (AI) adoption, and e-government expansion significantly enhance

gross domestic product (GDP) across European Union (EU) countries. In contrast, Vyshnevsky et al. (2020) found no statistically significant relationship between DESI measured digitalisation and economic growth in 28 EU states, suggesting that under current technological and institutional conditions, government digitalisation alone may not decisively accelerate growth. Together, these studies indicate that while government digitalisation generally supports economic advancement, its effects depend heavily on institutional readiness, human capital, digital adoption rates, and complementary policy framework factors critical to consider in cross country analyses such as those focused on Sub-Saharan Africa.

Empirical evidence from Asia consistently shows that government digitalisation plays a key role in driving economic development, though the extent of its impact varies across countries and institutional settings. In Uzbekistan, Jurayevich and Bulturbayevich (2020) found that government digitalisation improves productivity, reduces corruption, and supports modernisation across major sectors, even though its overall GDP contribution remains modest. Similarly, Nurdiana et al. (2023) reported that government digitalisation, captured through internet usage, significantly enhances economic development in Association of Southeast Asian Nations (ASEAN) countries by lowering unemployment, improving living standards, and expanding access to public services. Governance conditions also matter, as Nguyen (2021) and Nurdiana et al. (2023) showed that government digitalisation and good governance jointly stimulate economic growth in developing Asian economies, emphasising the need for supportive institutional frameworks. In Indonesia's Sumatra region, Ismail et al. (2025) found through dynamic panel GMM analysis that government digitalisation positively influences economic growth in both the short and long run, recommending greater investment in digital infrastructure and public spending.

Evidence from China further highlights diverse economic effects of digital transformation. Lee et al. (2024) demonstrated that government digitalisation enhances green economic efficiency, especially in service oriented and capital abundant cities, although it may cause negative spillover effects by shifting polluting industries to neighbouring regions. Jia et al. (2023) used general equilibrium models to show that introducing digital development increases economic growth rates, advising developing nations to align digital strategies with their resource endowments. In a similar context, Luo et al. (2023) found that government digitalisation strengthens high quality economic development through improvements in efficiency, growth drivers, and economic quality, particularly when supported by strong markets and effective governance. Meanwhile, Uddin (2024) showed that in Bangladesh, digitalisation already contributes positively to GDP and holds strong potential for expanding economic opportunities, provided that investment, digital literacy, and supportive policies continue to progress. Collectively, these studies indicate that

digitalisation serves as a powerful engine for economic growth across Asia, yet its effectiveness depends heavily on institutional quality, infrastructure readiness, and targeted policy interventions.

The reviewed empirical studies from OECD and Sub-Saharan African countries, which also found interesting effects of government digitalisation on economic growth, show that these effects differ from one country to another based on institutional and policy development and frameworks. Starting with OECD countries, Mammadli and Klivak (2020) sought to examine the effect of digitalisation on gross domestic product using dynamic panel data analysis with a fixed effects model for regression. The study revealed that higher levels of government digitalisation measurably raise GDP in OECD countries, with a statistically significant positive effect on economic growth even after accounting for investment, labour, and time trends. Complementing this study, Gomes et al. (2022) examined the effect of the digital economy on economic growth in OECD countries using 36 countries to analyse data from 2000 to 2019. Since the study included more than one country, it applied panel data analysis, specifically the GMM estimation model with fixed cross sections. Like other studies conducted in OECD countries, they found that technology proxies such as internet and mobile phone usage significantly influence economic growth positively, although the impact differs according to the level of technological development.

Specifically, among the few studies conducted in Sub-Saharan Africa on the effect of government digitalisation on economic growth, Kouladoum et al. (2022) examined how digital technologies are shaping development outcomes in Sub-Saharan Africa, aiming to understand their role in public service delivery, financial inclusion, and small and medium enterprises (SMEs) performance. The study utilised a descriptive analytical approach supported by regional statistics, sectoral evidence, and visuals, which show large disparities in mobile money account usage across West African Economic and Monetary Union (WAEMU) countries. The findings show that digital tools have expanded rapidly and improved the efficiency of public services, yet the benefits remain uneven due to limited infrastructure, high fixed costs, and unequal access. The study also found that digital financial services are growing but are still underused, partly because of weak agent networks and low interoperability, while SMEs adopting digital tools tend to be more productive and competitive, though limited diffusion can widen gaps between firms.

A review of the empirical literature above reveals that existing research on government digitalisation and economic performance has been heavily conducted in advanced economies, particularly OECD and EU member states, where scholars have relied on comprehensive digital indices such as DESI, Network Readiness Index (NRI), or broad digitisation scores to examine their relationship with productivity, innovation, and long term growth. Studies from Asia have similarly explored the effects of government digitalisation using country specific or sectoral indicators, but they remain context bound and rarely

extend to national level growth dynamics. In contrast, evidence from Sub-Saharan Africa is considerably more limited and focused on micro level outcomes such as service delivery efficiency, digital financial inclusion, or SMEs performance rather than macroeconomic growth. Even within this body of work, government digitalisation itself is not sufficiently disaggregated; most studies treat government digitalisation as a single composite construct, overlooking the distinct roles of e-government development, online public service capacity, and telecommunications infrastructure.

Furthermore, the few cross country studies that include African economies often use outdated or short time periods, narrowly defined digital indicators, or methodologies that do not adequately account for unobserved heterogeneity across countries. As a result, the region lacks a rigorous, longitudinal assessment of how specific components of government digitalisation jointly influence economic growth. To the researchers' knowledge, no study has yet combined recent data extending from 2008 to 2024 with a sufficiently large sample of Sub-Saharan African countries in a panel framework capable of isolating country specific effects.

This paper attempts to fill these gaps by employing a fixed effects panel data model to estimate the impact of three primary dimensions of government digitalisation on economic growth. Based on Endogenous Growth Theory, the EGDI, OSI, and TeI are selected as variables in this study as proxies for technological progress, innovation, and knowledge diffusion, which are internal factors influencing economic growth. By focusing on the region's unique institutional, infrastructural, and developmental features and by disaggregating government digitalisation into its functional components, this study provides empirical evidence that is both more comprehensive and more contextually relevant than what currently exists in the literature. Therefore, this study proposes the following hypotheses:

Hypothesis 1
H0: E-government development has no significant effect on economic growth.
H1: E-government development has a significant effect on economic growth.

Hypothesis 2
H0: Online public service has no significant effect on economic growth.
H1: Online public service has a significant effect on economic growth.

Hypothesis 3
H0: Telecommunication infrastructure has no significant effect on economic growth.
H1: Telecommunication infrastructure has a significant effect on economic growth.

Methodology

This paper adopts a quantitative research approach in examining the impact of government digitalisation on economic growth in Sub-Saharan Africa. Specifically, the study examines the effects of three government digitalisation components: EGDI, OSI, and TeI as independent variables on economic growth as the dependent variable, while inflation (INFL), trade openness (TRO), government expenditure (GOE), and foreign direct investment (FDI) are control variables, as presented in Table 1.

Table 1: Description and Measurement of Variables

Variable	Description	Measurement / Proxy	Source
GDP Growth Rate	Economic growth of a country	Annual % growth rate of GDP	World Bank
E-Government Development (EGDI)	Level of digital government development	Index (0–1)	UN E-Government
Online Service Index (OSI)	Availability and quality of online public services	Index (0–1)	UN E-Government
Telecommunication Infrastructure (TeI)	Level of ICT infrastructure development	Index (0–1)	UN E-Government
Inflation (INFL)	General price level changes	Annual % change in consumer prices	World Bank
Trade Openness (TRO)	Degree of integration with global markets	(Exports + Imports) as % of GDP	World Bank
Foreign Direct Investment (FDI)	External capital inflows	Net inflows as % of GDP	World Bank
Government Expenditure (GOE)	Public spending level	Government expenditure as % of GDP	World Bank

Source: Author's computation.

The analysis uses secondary data from 2008 to 2024 for 35 Sub-Saharan African countries, observed at two-year intervals and collected from World Bank Open Data. The study utilises panel data analysis with a fixed-effects model to determine the effect of government digitalisation on economic growth. For the robustness check, a dynamic GMM model is adopted, while the Granger causality test is used to check two-way causality. The panel data model for the three independent variables can be specified as follows:

$$Yit = \alpha i + \beta 1Xit + \beta 2Xit + \beta 3Xit + \varepsilon it \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; 3.1$$

In the analysis, the study adopts descriptive and correlation analyses as preliminary analytical procedures, while for regression analysis, using the Hausman Test, the

study confirms the Fixed Effects Model as the appropriate model to examine the effect of government digitalisation on economic growth since country specific effects are correlated with the independent variables. The model is appropriate in this study as it allows for the control of unobserved country specific features such as institutional quality, culture, geography, and historical factors, which do not change over time but may influence economic growth. To address the issues of endogeneity and reverse causality, lagged variables are used in the fixed effects model. Using lagged independent variables in a fixed effects model helps reduce reverse causality and simultaneity bias, captures the delayed impact of government digitalisation on economic growth, and improves model robustness by ensuring proper temporal ordering and controlling for unobserved factors. The fixed effects model can be specified as follows:

$$Yit = \alpha i + \beta 1L.EGDIit + \beta 2L.OPSIit + \beta 3L.TeIit + \beta 4INFL + \beta 5TRO + \beta 6FDI + \beta 7GOE + \varepsilon it \quad \text{.....3.2}$$

Moreover, to address possible two-way causality, the study adopts the Granger causality test, while to ensure the validity and reliability of the study results, several diagnostic tests are conducted, including multicollinearity, heteroskedasticity, serial correlation, cross sectional dependence, and unit root tests. To account for possible autocorrelation, heteroskedasticity, and cross sectional dependence, Driscoll Kraay standard errors are utilised.

Results

This part of the paper presents empirical findings on the impact of government digitalisation on economic growth using panel data methods, including descriptive statistics, diagnostic tests, regression analysis, and causality analysis.

Descriptive Analysis

Table 2 summarises the key features of the variables used in this study over the study period. The results suggest stable economic growth across the sample countries, with limited variation in the GDP growth rate. Regarding the E-Government Development Index, it remained low in Sub-Saharan Africa, while online public service delivery was average and telecommunication infrastructure was comparatively poor. These results suggest that although improvements have been made in government digitalisation, there is still a large gap, especially in infrastructure, which may act as a bottleneck to its contribution to economic growth.

The control variables indicate notable differences in macroeconomic conditions across the sampled countries. Inflation exhibits substantial variability, reflecting unstable price levels in some economies, while trade openness suggests varying degrees of integration into global markets. Foreign direct investment remains relatively low across the region, indicating limited external capital

inflows, whereas government expenditure represents a moderate share of economic activity. Overall, these patterns highlight the heterogeneity in economic environments among Sub-Saharan African countries, which may influence their growth performance.

Table 2: Descriptive Statistics Results

Variable	Obs	Mean	Std. Dev.	Min	Max
GDP growth Rate	315	0.0410	0.0432	-0.2081	0.1968
E-Government Development Index	315	0.3341	0.1264	0.0593	0.8616
Online Service Index	315	0.3051	0.1808	0.0000	0.8872
Telecommunication Infrastructure Index	315	0.1949	0.1805	0.0036	0.8951
Inflation	315	0.1591	1.1671	-0.0530	20.0000
Trade Openness	315	0.6531	0.2722	0.1740	1.6113
Foreign Direct Investment	315	0.0361	0.0538	-0.1729	0.4209
Government Expenditure	315	0.2199	0.0934	0.0693	0.5815

Source: Author's computation.

Correlation Matrix

Table 3 presents Pearson's correlation matrix for the variables examined in this study. The results show that the explanatory variables are related but are not highly correlated enough to cause a multicollinearity problem, except for EGDI and TeI, which have a correlation coefficient of 0.8211, which is above the 0.8 threshold and may indicate a multicollinearity issue. This necessitated the use of the Variance Inflation Factor (VIF) test for further confirmation. The VIF results confirm the absence of multicollinearity, as the VIF values for all variables are below 10, the conventional threshold suggested by Hair et al. (2010).

Heteroskedasticity Test

To check for the presence of heteroskedasticity in the regression residuals, the Modified Wald test is used. This test is necessary as it detects whether the variance of the residuals after regression is constant or varies across observations, which may reduce the validity and reliability of the study results. As shown in Table 4, the results suggest the presence of a heteroskedasticity problem. To address this problem during the analysis, the study adopts Driscoll and Kraay standard errors.

Serial Correlation Test

The study further utilises the Wooldridge test for autocorrelation, which identifies whether error terms are correlated over time within the same cross-sectional unit, which in this study is a country. The results presented in Table 5

reveal and confirm that the error terms within the country panels are not correlated, indicating that autocorrelation is not a problem in this study.

Table 3: Correlation Analysis and Variance Inflation Factor Results

	GDP Growth Rate	EGDI	OSI	TeI	INFL	TRO	FDI	GOE	VIF
GDP Growth Rate	1.0000								
EGDI	-0.2721	1.0000							6.4900
OSI	-0.1225	0.7713	1.0000						3.2900
TeI	-0.2925	0.8211	0.5619	1.0000					3.2700
INFL	-0.3135	0.0112	-0.0410	-0.0284	1.0000				1.0300
TRO	-0.0957	0.1965	-0.1078	0.1413	0.0672	1.0000			2.2200
FDI	0.1286	-0.0659	-0.1212	-0.0793	-0.0344	0.3270	1.0000		1.1700
GOE	-0.1629	0.2896	0.1628	0.2130	-0.0274	0.5959	0.0872	1.0000	1.7300
Mean VIF									2.7400

Source: Author's computation.

Note: EGDI = e-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; TRO = trade openness; FDI = foreign direct investment; GOE = government expenditure.

Table 4: Modified Wald Test for Heteroskedasticity Results

Test Statistic	Value
Null Hypothesis (H_0)	Homoskedasticity ($\sigma_i^2 = \sigma^2$ for all panels)
Chi-square (χ^2)	3042.9100
Degrees of Freedom	35.0000
Probability (p-value)	0.0000

Source: Author's computation.

Table 5: Wooldridge Test for Autocorrelation Results

Test Statistic	Value
Null Hypothesis (H_0)	No first-order autocorrelation
F-statistic	2.0880
Degrees of Freedom	(1, 34)
Probability (p-value)	0.1576

Source: Author's computation.

Cross Sectional Dependence Test

Moreover, to check for the presence of cross-sectional dependence among the panels (countries), the Pesaran test for cross sectional dependence was adopted. As revealed in Table 6, the results confirmed the presence of cross-sectional dependence among the panel units. This means that the countries are interdependent, suggesting that variations or shocks in one country could be transmitted to another country. To address this issue, Driscoll and Kraay standard errors are utilised in the regression analysis.

Table 6: Pesaran Test for Cross Sectional Dependence Results

Test Statistic	Value
Null Hypothesis (H_0)	Cross-sectional independence
Test Statistic (CD)	17.9560
Probability (p-value)	0.0000
Average Absolute Correlation	0.3710

Source: Author's computation.

Panel Unit Root Test

To test for panel unit roots, this study adopts the Levin Lin Chu panel unit root test. As presented in Table 7, all variables are found to be stationary at level except for EGDI and TeI, indicating a mixed order of integration, which could lead to spurious regression results. To address this issue, non-stationary variables are transformed into first differences during the regression analysis. Also, the study adopts lagged variables within the fixed effects model to capture dynamic relationships and reduce endogeneity problems, ensuring robust and consistent estimation in further analysis.

Table 7: Levin Lin Chu Panel Unit Root Test Results

Variable	Level (t-stat, p-value)	First Difference (t-stat, p-value)	Order of Integration
GDP Growth Rate	-6.9110 (0.0000)	-	I(0)
EGDI	1.0235 (0.8470)	-8.6978 (0.0000)	I(1)
OSI	-6.3149 (0.0000)	-	I(0)
TeI	4.3673 (1.0000)	-6.6561 (0.0000)	I(1)
INFL	-2.0960 (0.0180)	-	I(0)
TRO	-5.8942 (0.0000)	-	I(0)
FDI	-10.7835 (0.0000)	-	I(0)
GOE	-9.2803 (0.0000)	-	I(0)

Source: Author's computation.

Notes: EGDI = E-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; FDI

= foreign direct investment; GDP = gross domestic product; GOE = government expenditure.

Model Selection

This study adopts the Hausman test to select the appropriate model for the analysis. Based on the Hausman test results presented in Table 8, the Fixed Effects model is confirmed as the appropriate model for this study, as it allows the study to account for or control for unobserved country specific factors that may influence economic growth, such as culture, institutional quality, and historical factors, which do not change over time but may influence economic growth in the countries included in the sample. The results provide evidence to reject the null hypothesis of no systematic difference between the Fixed Effects and Random Effects estimators, confirming the FE model as the appropriate model and the RE model as inconsistent.

Table 8: Hausman Test Results

Variable	Fixed Effects (b)	Random Effects (B)	Difference (b − B)	Std. Error
EGDI	0.1185	-0.0655	0.1840	0.0910
OSI	-0.0558	0.0406	-0.0964	0.0308
TeI	-0.0830	-0.0506	-0.0324	0.0289
INFL	-0.0157	-0.0119	-0.0039	0.0009
TRO	0.0707	0.0120	0.0587	0.0156
FDI	0.1001	0.0819	0.0182	0.0371
GOE	-0.0101	-0.0691	0.0590	0.0510
Chi-square (χ^2)			36.7700	
Degrees of Freedom			7	
Prob > χ^2			0.0000	

Source: Author's computation.

Notes: EGDI = E-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; FDI = foreign direct investment; TRO = trade openness; GOE = government expenditure.

Regression Analysis

Table 9 reports the results of the FE regression with lagged variables and Driscoll-Kraay standard errors, analysing the effect of government digitalisation on economic growth, utilising the E-Government Development Index, Online Service Index, and Telecommunication Infrastructure Index as explanatory variables and the GDP growth rate as the explained variable, while incorporating

other factors such as inflation, trade openness, foreign direct investment, and government expenditure, which are also determinants of economic growth.

As shown inTable 9, starting with the lagged GDP growth rate, the effect is negative and significant (β = 0.4225, p = 0.0460), suggesting a convergence effect whereby countries that experienced higher economic growth in the previous period experience lower growth in the current period. Economically, countries experiencing higher growth in the previous period tend to slow down in the current period, possibly due to the diminishing returns effect on capital and structural limitations, which is supported by growth theory in developing countries.

Table 9: FE Regression Results with Lagged Variables (Drisc/Kraay Std. Error)

Dependent	**GDP Growth Rate**					
Variables	**Coef.**	**Drisc/Kraay Std. Err.**	**t-statistic**	**p-Values**	**[95% Conf. Interval]**	
L. GDP Growth Rate	-0.1501	0.0620	-2.4200	0.0460*	-0.2968	-0.0034
L.EGDI	0.4225	0.0810	5.2200	0.0010*	0.2310	0.6139
L.OSI	-0.1732	0.0393	-4.4100	0.0030*	-0.2660	-0.0804
L.TeI	-0.1591	0.0346	-4.6000	0.0020*	-0.2409	-0.0774
INFL	-0.0233	0.0053	-4.4400	0.0030*	-0.0358	-0.0109
TRO	0.0640	0.0241	2.6500	0.0330*	0.0069	0.1211
FDI	0.1084	0.0676	1.6000	0.1530	-0.0516	0.2684
GOE	-0.0178	0.1328	-0.1300	0.8970	-0.3317	0.2962
_cons	-0.0520	0.0164	-3.1700	0.0160*	-0.0909	-0.0132

Source: Author's computation.
Notes: L = lagged variable; EGDI = E-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; FDI = foreign direct investment; GDP = gross domestic product; GOE = government expenditure; * indicates significance at the 5% level.

The lagged E-Government Development Index has a positive and significant effect (β = 0.4225, p = 0.0010), suggesting that improvement in e-government promotes economic growth. Improvement in e-government development enhances government efficiency, reduces transaction costs, and provides better information flow, which promotes service delivery, together supporting production and economic activities. The results align with the theory that sufficient digital transformation improves institutional performance and encourages growth in economies.

Table 9 also presents the results for the lagged Online Service Index, which has a negative and statistically significant effect (β = -0.1732, p = 0.0030).

The results economically suggest that the provision of online public services alone does not translate into economic growth, as it needs support from institutional quality and capacity, digital literacy, and supportive infrastructure, which are very limited in many developing economies used in the sample, creating inefficiencies, underutilisation, and increased administrative costs. This may be influenced by limited trust in and access to digital services by the public in developing economies, which may create a negative short term impact on economic growth, as revealed by the results.

Regarding the Telecommunication Infrastructure Index, the results reveal a negative and significant relationship (β = -0.1591, p = 0.0020) with economic growth. Telecommunication infrastructure is theoretically an economic growth enhancing factor; however, the negative effect found in this study may reflect factors such as high initial investment costs, unequal access across regions, and maintenance burdens carried by countries, which drain public finances and hinder immediate economic benefits. Also, this adverse effect may be due to the creation of telecommunication infrastructure that has no productive use or is underutilised in the economy.

Regarding other factors influencing economic growth, the results reveal that inflation has a statistically significant negative influence on economic growth (β = -0.0233, p = 0.0030), suggesting that countries affected by high price levels of goods and services experience economic retardation. This is economically reasonable, as inflation erodes the purchasing power of money and increases economic uncertainty, which discourages investment and economic efficiency in general.

Trade openness, as revealed in Table 9, has a positive and significant effect on economic growth (β = 0.0640, p = 0.0330), suggesting that as countries become integrated into international or global markets, their economic growth improves. This is economically reasonable because, as countries participate effectively in global trade, they benefit from access to larger markets, increased competition that promotes productivity, technology transfer, and efficiency benefits that support economic activities and the productivity of the country.

Foreign direct investment, as presented in Table 9, has an insignificant positive relationship with economic growth (β = 0.1084, p = 0.1530). The results suggest that FDI in the Sub-Saharan region does not entirely translate into economic growth, which may be due to the nature of economic activities performed in this area. The Sub-Saharan region depends heavily on the extractive sector, while FDI invested in this region may have no direct relationship with the domestic economy due to factors such as profit repatriation, which constrain its developmental effects.

The last factor, government expenditure, is found to exhibit a negative but insignificant effect on economic growth (β = -0.0178, p = 0.8970), revealing that public spending individually cannot enhance economic growth in this region. Economically, this could be the result of higher consumption expenditure than

development expenditure, misuse of public funds, and inefficient spending, which limit its contribution to economic growth.

Granger Causality Test

Table 10 present panel granger causality test results conducted to establish predictive power among the variables analysed in this study. In this study this test check predictive power of government digitalisation dimensions on economic growth rate and predictive power of economic growth on government digitalisation to understand which factors drives another factors. Thereby it address potential reverse causality and strengthening validity of the study findings.

As shown in Table 10 the results suggest bidirectional causality between e-government development index and economic growth rate, suggesting improvements of EGDI have predictive power over economic growth but also economic growth have predictive power over EGDI. Economically, the finding suggest EGDI translates into growth influencing results over time by improving governance, better efficiency and reduced costs, while as economies grow they obtain more resources to acquire more digital governance which further promotes digital development.

Similar to EGDI, OSI has bidirectional causality with GDP growth rate as presented in Table 10 results OSI drives economic growth but also it is driven by it which represent mutual reinforcing relationship. The results suggest improved accessibility of digital services enhances economic growth, and as economic growth improves it influence further expansion of online public services.

Table 10: Panel Granger Causality Test Results

Direction of Causality	W-bar	Z-bar	p-value (Z-bar)	Z-bar tilde	p-value (Z-bar tilde)
EGDI → GDP Growth Rate	1.4713	1.9716	0.0487	-0.22452	0.8063
OSI → GDP Growth Rate	2.6042	6.7110	0.0000	1.1766	0.2393
TeI → GDP Growth Rate	2.9038	7.9641	0.0000	1.5526	0.1205
GDP Growth Rate → EGDI	1.7445	3.1145	0.0018	0.0977	0.9222
GDP Growth Rate → OSI	1.9908	4.1446	0.0000	0.4067	0.6842
GDP Growth Rate → TeI	1.3772	1.5781	0.1145	-0.3632	0.7164

Source: Author's computation.

Notes: EGDI = e-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; FDI = foreign direct investment; GDP = gross domestic product.

Robustness Check

This section provides Dynamic GMM results to confirm the validity and robustness of the findings. The findings presented in Table 11 confirm the findings of the FE model with Driscoll and Kraay standard errors as the main model. The results reveal that the lagged GDP growth rate is negative and statistically significant, suggesting the existence of convergence dynamics in economic growth. In line with the FE model with Driscoll and Kraay standard errors, EGDI has a positive and highly significant effect on economic growth, confirming the contribution of overall government digital governance to enhancing economic performance over time. OSI and TeI both show negative and significant effects on economic growth, aligning with the main regression results and supporting the argument that not all elements of government digitalisation are transformed into economic growth in the context of limited institutional capacity and underutilisation. For the control variables, trade openness has a positive and significant effect on economic growth, while FDI has a positive but insignificant effect. Inflation and government expenditure exhibit significant negative influences on economic growth, as seen in the FE model with Driscoll and Kraay standard errors, confirming the effects of purchasing power erosion and inefficiencies in public spending on economic growth.

Table 11: Dynamic GMM Results

Variable	Coefficient	Std. Error	z-statistic	p-value	[95% Conf. Interval]	
L. GDP Growth Rate	-0.3068	0.0582	-5.2700	0.0000*	-0.4209	-0.1928
L. EGDI	0.5786	0.1186	4.8800	0.0000*	0.3462	0.8110
L. OSI	-0.2662	0.0448	-5.9500	0.0000*	-0.3540	-0.1785
L. TeI	-0.2115	0.0489	-4.3200	0.0000*	-0.3073	-0.1156
INFL	-0.0239	0.0069	-3.4500	0.0010*	-0.0375	-0.0103
TRO (% of GDP)	0.1067	0.0269	3.9700	0.0000*	0.0540	0.1593
FDI (% of GDP)	0.0513	0.0724	0.7100	0.4780	-0.0905	0.1932
GOE (% of GDP)	-0.2176	0.0830	-2.6200	0.0090*	-0.3803	-0.0550
Constant	-0.0415	0.0287	-1.4400	0.1490	-0.0978	0.0148

Source: Author's computation.

Notes: L = lagged variable; EGDI = E-Government Development Index; OSI = Online Service Index; TeI = Telecommunication Infrastructure Index; INFL = inflation; FDI = foreign direct investment; GDP = gross domestic product; GOE = government expenditure; TRO = trade openness; * indicates significance at the 5% level.

Discussion

This part of the paper discusses the findings of the study on the impact of government digitalisation on the economic growth of Sub-Saharan African economies. The findings provide crucial empirical and theoretical insights into the relationship between government digitalisation and economic growth. In line with Endogenous Growth Theory, the findings in this paper confirm that government digitalisation significantly influences economic growth through the enhancement of productivity, efficiency, and long term economic performance. The study found that the e-government index has a positive and significant effect on economic growth. This finding is supported by Endogenous Growth Theory, which suggests that internal factors such as technological advancement enhance economic growth. The findings also align with several empirical studies, such as Georgescu et al. (2021) and Revenko et al. (2024), which found that digitalisation significantly influences economic growth and economic performance in European countries. Moreover, Mmmadli and Klivak (2020) and Gomes et al. (2022) suggest and confirm that improved levels of digitalisation significantly and positively influence the GDP growth rate in OECD countries. The implication of the findings is that when governments invest in digital systems such as e-governance platforms, economic activities become easier, faster, cheaper, and more efficient, for example, through online business registration, digital tax payment, and online government service delivery. These economic activities attract investment and improve production, contributing to economic growth.

On the other hand, the Online Service Index has a negative and statistically significant effect on economic growth, which may be influenced by structural and institutional challenges faced by Sub-Saharan African countries, such as limited use of online services, high costs, and unequal access to services. This adverse effect of OSI suggests that the expansion of online public services with limited institutional capacity and public digital readiness may cause underutilisation and inefficiencies, which, as a result, limit economic growth in these countries. The findings align with studies such as Arsic (2020), who suggests that digitalisation alone cannot translate into economic growth unless supported by complementary investment in education, infrastructure, and innovation, and Vyshnevsky et al. (2020), who suggest that digitalisation alone may not sufficiently drive economic growth in some countries and contexts. Moreover, Aker and Cariolle (2020) confirm that while digital tools such as online services improve service provision, the benefits are still uneven due to structural bottlenecks such as high costs and unequal access. This finding implies that having online government services does not translate into improved economic performance if the services are not utilised effectively. In Sub-Saharan African countries, citizens may lack internet access and digital skills and may have limited trust in online systems, leading to the underutilisation of online services, while governments incur high costs to establish and maintain the systems with limited

or no economic benefits, which may produce a negative effect on the economic growth of these countries.

Telecommunication infrastructure exhibits a significant negative influence on economic growth among the sampled Sub-Saharan African countries. This negative influence of TeI may suggest adverse effects arising from high investment costs, limited productive use of this infrastructure, and high maintenance burdens, especially in developing economies such as Sub-Saharan African countries characterised by weak complementary systems. The findings are supported by Nguyen (2021), who suggested that the efficiency and effectiveness of digitalisation depend on institutional or governance quality, while Jurayevich and Bulturbayevich (2020) suggested that digitalisation is a driver of productivity but its contribution in developing economies remains low and modest.

Supporting the regression analysis findings, the causality analysis results reveal bidirectional relationships between EGDI, OSI, and economic growth, suggesting reverse causality. The findings align with Ismail et al. (2025), who found that government digitalisation and economic growth drive each other over time. For TeI, the study found a unidirectional relationship, with TeI being the driver of economic growth. This finding is supported by Jia et al. (2023) and Luo et al. (2023), who suggested that infrastructure improvement can drive economic growth, but its maximum contribution depends on complementary economic conditions. The Granger causality findings imply that in Sub-Saharan African countries, economic growth and government digitalisation drive each other over time, meaning that when economies experience economic growth, they generate sufficient resources that can be used to invest in digital systems, which also influence the economic growth of these countries.

Other factors influencing economic growth are considered as control variables. Inflation has a negative and significant effect on economic growth. Economically, inflation reduces the purchasing power of money, leading to declining real income and consumption and limiting aggregate demand in economies, while increasing uncertainty, creating challenges for firms and investors in planning, and discouraging long term investment and capital formation.

Trade openness has a positive and significant impact on economic growth. As economies participate in global trade and gain access to expanded markets, foreign investment, technology transfer, and knowledge spillovers, they may experience economic growth. Trade openness also exposes countries to global competition, which encourages efficiency and innovation, resulting in increased productivity and economic growth. The findings align with Nurdiana et al. (2023), who suggest that the integration of the economy into the global market improves economic growth through improved efficiency as a result of technology transfer. Regarding foreign direct investment, it has an insignificant influence on economic growth, aligning with Aker and Cariolle (2020), who

suggested that the positive effect of FDI on economic growth in Sub-Saharan African countries is very limited because FDI in Sub-Saharan Africa has a weak relationship with domestic economies. Lastly, government expenditure also has an insignificant impact on economic growth, suggesting inefficiencies in public spending, as efficient and effective public investment relies heavily on governance quality and the allocation efficiency of public funds.

Concluding Remarks

This study examines the impact of government digitalisation on economic growth in Sub-Saharan African countries. Based on the findings, this study concludes that government digitalisation is a significant driver of economic growth, but economic growth is also a significant driver of government digitalisation. The study confirms that comprehensive government digitalisation promotes economic growth, but the isolated expansion of online services and telecommunication infrastructure may adversely affect economic growth due to structural and institutional limitations in Sub-Saharan African countries. It also confirms that government digitalisation can contribute to economic performance when it is supported by sufficient institutional capacity, proper infrastructure utilisation, and supportive policies, aligning with Endogenous Growth Theory in explaining the contribution of technological advancement to economic growth.

This study recommends that governments and policymakers in Sub-Saharan Africa shift their primary focus from extensive investment in digital infrastructure and online services to more integrated government digitalisation strategies that consider the improvement of institutional capacity, enhancement of digital literacy, establishment of affordable and inclusive digital systems, and improvement of transparency and governance quality to maximise economic benefits. Government digitalisation policies should also be tailored to support complementary sectors such as innovation and education to transform digitalisation into meaningful and beneficial economic progress in Sub-Saharan Africa.

Future studies are recommended to use longer time series and broader datasets while incorporating additional factors such as institutional quality, digital skills, and governance indicators, which may also influence the contribution of government digitalisation to economic growth. Future studies are also recommended to use more advanced econometric techniques for analysis.

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