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The Effects of Digital Economy on Inclusive Growth in Selected African Countries

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ABSTRACT

Research Originality: The originality of this work is the inclusion of more variables that are used to develop the digital economy index, which is a more accurate representation of the digital economy in Africa. Also, instead of capturing the inclusive growth with a single variable such as HDI, GDP per capita, or RGDP per person employed, as seen in previous studies, this study adds to the body of literature by creating an inclusive growth index using the four key indicators of inclusive growth.

Research Objectives: This study investigates the effect of the digital economy on inclusive growth in selected African countries.

Research Methods: The study employed longitudinal panel data sourced from the world development indicators and was analyzed using the Arellano and Bond (1991) system Generalized Method of Moments (SGMM), a dynamic panel data model that handles endogeneity, unobserved heterogeneity, and autocorrelation.

Empirical Results: The findings demonstrated a positive and significant effect of the digital economy on inclusive growth in the countries studied. The effects of the digital economy are more visible in lower—and lower-middle-income (LI and LMI) countries than in upper-middle-income (UMI) African countries.

Implications: These findings imply that improving investments in internet infrastructure and fostering a technology-driven economy can help Africa achieve more robust inclusive growth.

Keywords:
digital economy; inclusive growth; economic growth; structural change

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INTRODUCTION

Over the years, and specifically at the beginning of the new millennium, the GDP of many nations, particularly in Africa, has been growing. However, this GDP growth does not translate into improved living standards for the citizenry. This realization is changing the development agenda across the globe. The idea of inclusive growth was born out of the need to critically reevaluate the traditional GDP measure of economic growth and replace it with a growth model that considers the need for an equitable distribution of economic gains across a wide range of society, hence the concept of inclusive growth (Adeleye et al., 2023; Kamah et al., 2021).

Interestingly, for the growth of an economy to become inclusive, empirical studies have observed that digitalization of the economy is critical (Myovella et al., 2020; David, 2019). This is because the digital economy is thought to be the main force behind inclusive growth and a significant contributor to drastically altering economic landscapes that significantly impact businesses, employment, inequality, and poverty in the region (Bukht & Heeks, 2017). The World Economic Forum (WEF) (2020) reported that the digital economy is expanding in emerging markets at 20–30% annually. For developing nations, especially those in Africa, the digital economy holds great promise for increased economic growth, higher labor and capital productivity, reduced transaction costs, and easier access to international markets (Dahlman et al., 2016).

Furthermore, certain digital dividends have already been noted that could mitigate African economic disparities. These include higher-than-average wages for digital labor in African nations, which could result in a convergence of incomes globally (Beerepoot & Lambregts, 2015); fresh and distinct local markets for digital start-ups in developing nations (Quinones et al., 2015); and digital platforms in Africa that offer a way out of inefficient, fraudulent labor markets and labor institutions (Pillai, 2016). The digital economy has also been shown to have growth-promoting effects on several empirical studies, such as increased global trade (Meijers, 2014), active innovation, entrepreneurship, and increased market access; additionally, it has been shown to reduce information asymmetry costs, which in turn facilitate access to finance (Solomon & van Klyton, 2020); and to increase productivity, greater access to information, and economies of scale (Dubey et al., 2021).

The digital economy, as a new paradigm for development, represents a turn in the path of economic growth that will improve employment, income generation, and industrial structure, all of which will have an impact on inclusive growth in Africa (Andrés et al., 2016). The African region over the years has witnessed an impressive rise in the rate of digital product usage, with active mobile-broadband subscribers rising from 2.7% in 2011 to 40.7% in 2021 and mobile cellular telephone subscriptions rising from 44.3% in 2010 to 82.7% in 2021 (World bank Development Indicators, (WDI) 2022).

Similarly, the digital economy, including e-commerce, precision agriculture, artificial intelligence, algorithmic economy, supply chain automation, blockchain technology, electronic administration, and electronic governance, is estimated to employ approximately

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3% of the worldwide workforce, with e-commerce valued at $16.2 trillion in 2016. The digital sector employs 1% of the workforce in developing countries, roughly 4% in industrialized countries, and 2.5% of the total global workforce. Also, about 4 million people work in customer care call centers, and 0.6% of the workforce in developing nations like Africa is online (World Bank 2021). The IT sector employs over 3 million people directly and 7–10 million people indirectly, with the digital economy accounting for an estimated 6 million jobs (Bukht & Heeks, 2017). Despite the fantastic expansion of the digital economy in supporting inclusive growth, as seen in most developed countries, African countries have not fared better.

A plethora of empirical studies have indicated that inclusive growth is directly connected to the extent of mainstreaming of the digital economy in both cross-country and within-country analyses. Olofin (2023) found a positive relationship between economic growth and the digital economy. It also discovered that corruption and the digital economy are connected. The study suggests that strengthening institutional quality and increasing participation in the digital economy might enhance economic growth. In a similar study, Adeleye et al. (2023) revealed that ICT, particularly mobile phones, has a positive and significant effect on Institutional Quality, with interaction effects differing on the ICT indicator used. The study recommended that policymakers prioritize institutional reforms and ICT infrastructural investment to ensure that economic growth improves living conditions for lower-income populations. Across 44 Sub-Saharan African countries, Kouladoum (2023) demonstrated that digital infrastructures promote inclusive growth across all income groups, implying that policymakers should invest more in human capital and digital infrastructure to enhance inclusive growth in the region.

Afolabi (2023) found that economic policy uncertainty stifles digital economy growth across African income levels, whereas digital infrastructure promotes it. The study also discovered that human capital development promotes the expansion of the digital economy in Africa's low-income countries. The study recommended that African governments support human capital and digital infrastructure investment and establish a stable and predictable regulatory framework. Furthermore, Solomon and Van Klyton (2020) found a positive relationship between the digital economy and economic growth in 39 African countries. The study revealed that individual use of ICT is favorably connected with growth. When the digital economy pillars were broken down into individual component indicators, social media usage and the centrality of ICTs to government vision emerged as important economic growth indicators. The study provided the current study with clarity on the role of digitization on economic growth, especially in Africa.

Between 2004 and 2019 in Uzbekistan, Kuziyeva et al. (2023) found that the digital economy positively influenced economic growth due to the broad adoption of digital technologies, improved educational environment, and information dissemination. The study recommended further digital infrastructure development to improve the accessibility and availability of digital services in order to boost economic growth. In a related study, Zhang et al. (2022) discovered within the "Belt and Road" countries that despite geographical differences, the digital economy positively impacts their economies by improving industrial structure, employment, and job restructuring. The investigation further revealed that the COVID-19 pandemic has raised the need for digital industries, with demand having a more significant impact than supply. To increase the digital economy's impact on industrial upgrading, employment, and trade after COVID-19, the study suggested bridging the "digital divide" between nations along the "Belt and Road." Wu and Yu (2022) also demonstrated that the digital economy has been the primary driver of China's economic development and productivity increases over the last two decades. Despite this, industries with strong investment growth have failed to match industries with high total factor productivity growth due to chronic capital misallocation across industries and the continuously inefficient performance of some non-ICT enterprises. The study suggested expanding investment in ICT to encourage more enterprises to utilize technological innovations and promote the country's inclusive growth.

Accordingly, Mgadmi et al. (2021) revealed that digital technology provides significant economic growth benefits to both developed and developing economies. However, the impact of digitalization varies among countries. Internet users, cellular mobile phone subscriptions, and fixed broadband subscriptions have less impact in underdeveloped countries than in industrialized ones. The study recommended that developing countries invest more in human capital and implement proper government policies to capitalize on digitalization's favorable influence on long-term economic growth. Dubey et al. (2019) found that technology has a favorable impact on inclusive growth in India. The study also highlighted the requirement for greater use of digital and electronic payment systems to reduce leakage in the public food distribution system. In order to encourage the adoption of technology in all spheres of human effort in India, the study proposed increased investment in education.

Adejumo et al. (2020) investigated the impact of technology on the African economy. They found that technical innovation, educational accessibility, and technologically driven growth significantly impact Africa's unemployment rate and per capita income. While technology has had little impact on economic growth, it has helped to alleviate poverty and inequality. However, long-term technological growth through ICT has the potential to significantly improve income distribution, reduce unemployment, and minimize disparities. The research recommended institutional reforms to promote technical distribution and appropriate infrastructure for Africa's inclusive growth. David (2019) showed a long-term, reciprocal relationship between economic development, growth, and telecommunications infrastructure. The results of the causality tests showed a causal relationship between the development and expansion of the economy and telecommunication infrastructure. Infrastructures for telecommunications support economic expansion and development in Africa and vice versa. Therefore, it is imperative to advance comprehensive and inclusive policies to simultaneously advance economic growth, development, and digital provision in Africa.

Bahrimi and Qaffas (2019) discovered that ICT, alongside landline telephones, was the primary driver of economic growth in the Middle East and North Africa (MENA) and Sub-Saharan Africa (SSA) areas between 2007 and 2016. The study

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recommended increasing ICT infrastructure investments, focusing on financial sector development, regulatory simplicity, economic openness, and ICT infrastructure while keeping inflation and government consumption under control to enhance growth via the digital economy. Similarly, Xiaowei and Lingwen (2021) found that China's economic growth is significantly influenced by technical innovation. Further investigation indicated that the most significant influence on Chinese economic growth comes from fiscal policy assistance rather than R&D spending. Ding, Zhang, and Tang (2021) revealed that digital economic input significantly encourages growth in the domestic value-added rate of manufacturing industry exports in China and also increases the domestic value-added rate of intermediate products for exports.

Additionally, the study showed that capital- and knowledge-intensive manufacturing sectors significantly benefited from digital input and technological advancement. Cost reduction is identified as an essential mechanism by which the digital economy fosters the domestic value-added rate of exports. According to the study, economic growth will be significantly accelerated by the expansion of digital infrastructure, which will continuously give the traditional economy new life.

The reviewed studies demonstrate that previous research presents consistent findings regarding the effects of the digital economy on inclusive growth. This study, however, offers a unique perspective by examining how the digital economy affects inclusive growth in some selected African countries. Previous studies that looked at the relationship between the digital economy and inclusive growth focused on ICT adoption (proxied by mobile subscription and fixed telephones) as the primary indicator of the digital economy (Adeleye et al., 2023; Labhard & Lehtimaki, 2022; and Andres et al., 2016). This is a gap that this study will fill by broadening these variables to include secure internet servers, broadband subscriptions, mobile cellular subscriptions, high-tech exports, ICT product exports, number of internet users, and other digital infrastructures in order to create a comprehensive digital economy index using the principal component analysis (PCA). This study believes it will be the most accurate reflection of the digital economy.

Secondly, instead of capturing the inclusive growth with a single variable such as HDI, GDP per capita, or RGDP per person employed, as seen in previous studies, this study adds to the body of literature by creating an inclusive growth index using the four indicators of inclusive growth namely, economic growth and structural change, generation of productive employment, human capital development and reduction in poverty and economic inequality (Yaru et al., 2018). This index also will be developed using PCA.

Consequently, the study contributes to various fields. First, we used principal components analysis to create more accurate and comprehensive indices for the digital economy and inclusive growth in Africa. Second, the current study fills the gap and contributes to the existing literature by examining how the digital economy can enhance the growth inclusivity of African countries through increased investments in critical digital infrastructures such as secure internet servers, broadband subscriptions, mobile cellular subscriptions, high tech exports, ICT product exports, number of internet users, and other digital infrastructures. Another vital justification for the study is examining the influence of gross capital formation, foreign direct investments, and labor force participation on inclusive growth in Africa as control variables. The findings suggest that increased investments in gross capital formation will enhance foreign investments, especially in the digital economy, and engender inclusive growth in the continent in the short and long term. Finally, the government and policymakers in Africa can utilize these findings to create successful strategies by creating digital economy enablers to ensure the inflow of FDI in the continent. This will fast-track growth inclusivity.

Therefore, this study seeks to examine the effects of the digital economy on inclusive growth in selected African countries by differentiating between the African countries according to their income level of development, such as low-income economies (LI), lower-middle-income economies (LMI) and upper-middle-income economies (UMI). The rationale behind the categorization is to allow the study to make precise recommendations that are tailored toward a specific income bracket.

METHODS

This empirical analysis is based on secondary longitudinal data from the World Bank Development Indicators between 2000 and 2022. The SGMM panel data model framework generated cross-country samples from 37 African nations in a balanced panel data structure. The choice of Africa for this study was influenced by the fact that African countries have high levels of non-inclusive growth, such as low education enrolment rates, poverty, and inequality rates, and relatively low health care delivery; however, despite these challenges, the continent appears to have a relatively high level of mobile technology adoption and utilization (WDI 2022). The dimensions, components, and measurements of inclusive growth that are employed in this study are displayed in Table 2. Table 1 also presents the digital economy development index, derived from the World Bank development indicators (WDI) and constructed using the PCA.

The variables in Table 1 and Table 2 above were used to create indices for the dependent variable inclusive growth index (Table 2) and the digital economy index (Table 1). The System Generalized Method of Moments (SGMM) will be utilized in the empirical estimations of this study's objective to estimate the effects of the digital economy on inclusive growth in some selected African countries between 2000 and 2022. Another justification for the use of the SGMM technique is the fact that it does not require a pre-estimation test such as the panel unit root test and cross-sectional dependence test since it is a flexible estimation method that can handle non-stationary data, eliminating endogeneity problems and requiring no data stationarity. It uses instrumental variables (IVs) to identify parameters and eliminate endogeneity. First-differencing can be used to render data stationary in panel data settings (Adeleye et al., 2017; Batuo, 2015). Similarly, compared to the first-differenced GMM estimator, the two-step SGMM estimator addresses the issues of heteroscedasticity, endogeneity, and finite sample bias more effectively since it makes extensive use of internal instruments. This condition is why the two-step SGMM was selected for this investigation.

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Table 1. Digital Economy Development Index

Categories Value	Name of Indicators	Meaning	Scale
Digital Economy Infrastructure	i. Secure Internet Servers (Per mill. People).	Network Environment Security and governance.	0.3 – 12248
	ii. Fixed Broadband Subscriptions (per 100 people)	Improvement of the Information Infrastructures	0.2 – 39.3
	iii. Fixed Telephone Subscriptions (per 100 people)	Improvement of the Information Infrastructures	1.2 – 54.8
	iv. Mobile Cellular Subscriptions (per 100 people)	Improvement of the Information Infrastructures	43.1 – 191
	v. Individuals Using the Internet (% of population)	Internet user base	5.1 – 95.8
Digital Economy Openness	i. High – Tech Exports (% of total exports)	Openness of Digital Economy, International Competitiveness of Technology.	0.5 – 53.3
	ii. ICT Product Exports (% of total product exports)	Openness of Digital Economy, International Competitiveness of Technology.	0 – 36.5
Digital Technology Innovative Environment and Competitiveness.	i. Enrolment in higher education institutions (% of total pop.)	Abundance of Digital Professionals	6.7–148.9
	ii. R&D Expenditure (% of GDP)	Digital Technology Innovative Environment.	0 – 5.0
	iii. Availability of Latest Technology	Technological Transformation and effective Utilization.	3.4 – 6.5

Source: World Development Indicators, (2023).

To estimate the effect of digital economy on inclusive growth in the selected African countries, the model estimate is derived using the Solow - Swan (1956) growth theory. The theory takes into account two production functions that emphasize the main role of labour and capital (which can be substituted for each other) in determining output, while technology (digital economy) is viewed as an exogenous input in the production process. As technology advances, production per worker (y) can rise without an increase in capital per worker (k).

Thus, following the work of Agyei and Idan (2022), the reduced dynamic panel data model to be estimated is given as;

$$y_{i,\,t} = \alpha\, y_{i,\,t-1} + \beta\,'_{xi,\,t} + \gamma\,'C_{i,\,t} + \eta_i + \varepsilon_{i,} \qquad (1)$$

Where, $y_{i,\,t}$ is the dependent variable for cross-sectional unit i in period t and denotes the natural logarithm of inclusive growth (IG); $_{xi,\,t}$ is a vector of proxies denoting the independent variable (digital economy) observed for country i in period t. $C_{i,\,t}$ are the control variables. Similarly, i denotes the country (i =1, 2, …, 37) and t denotes time period (t = 2000 - 2022). η_i is the i-th unobservable time-invariant country-specific effects and is independent and identically distributed in country i and $\varepsilon_{i,\,t}$ is the idiosyncratic disturbance term specific to country i in period t and is assumed to be independent and identically distributed over all time periods in country i. $y_{i,\,t-1}$ is the natural logarithm of initial (lagged) of inclusive growth (IG) index, which captures initial conditions for testing the convergence effect hypothesis with $|\alpha| < 1$, so as to ensure stationarity, α, $\beta\,'$ and $\gamma\,'$ are parameters to be estimated. Therefore, equation (3.1) can be represented more explicitly as follows.

$$IG_{i,\,t} = \alpha\ IG_{i,\,t-1} + \beta\,'\ DEI_{i,\,t} + \gamma\,'C_{i,\,t} + \eta_i + \varepsilon_{i,\,t} \qquad (2)$$

Where, IG = Inclusive Growth, DEI = Digital Economy Index. Accordingly, equation (3.2) can be overtly stated as;

$$IG_{i,\,t} = \alpha + \beta_1 IG_{i,\,t\,-1} + \beta_2 DEI_{i,\,t} + \beta_3{}'C_{i,\,t} + \varepsilon_{i,\,t} \qquad (3)$$

The baseline equation that needs to be estimated is equation (3.3). Additionally, the specific control variables that apply to this model are presented in equation 3.4 below;

$$IG_{i,\,t} = \alpha + \beta_1\ IG_{i,\,t\,-1} + \beta_2 DEI_{i,\,t} + \beta_3 GCF_{i,\,t} + \beta_4 FDI_{i,\,t} + \beta_5 LF_{i,\,t} + \varepsilon_{i,\,t} \qquad (4)$$

Where, GCF = gross capital formation, FDI = foreign direct investment, and LF = labour force is introduced as the control variables. Meanwhile, the lagged value of inclusive growth ($IG_{i,\,t\,-1}$) is introduced in the equations to capture the effects of persistence of growth.

Table 2. Inclusive Growth Index

Category	Name of Indicators	Meaning	Scale
1. Economic Growth and Structural Change	i. Rate of GDP growth per capita	The annual growth calculated by dividing GDP by midyear population, excluding asset depreciation	0.02 -0.10
	ii. share of manufacturing value added in the total GDP	The sectors net output after adding all outputs and removing intermediate inputs	0.02 – 0.20
	iii. share of services value added in the total GDP	This is the net output of the sectors' after adding all outputs and subtracting for depreciation of assets.	0.3-0.60
	iv. share of agriculture value added in the total GDP	This refers to the net output of a sector after adding all outputs and subtracting intermediate inputs, without deductions for depreciation.	0.1-0.50
2. Generation of Productive Employment	i. GDP per capita of the employed (at 2021constant USD).	GDP per person employed is computed by dividing GDP by total employment and converting purchasing power parity GDP to 2021 constant international dollars.	1000 – 5000
	ii. Total employment to population ratio.	Employment to population ratio is the proportion of a country's population that is employed.	0.3 – 0.5

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Category	Name of Indicators	Meaning	Scale
3. Human Capital Development	i. Children (under 0) survival rate per 100.	This is the statistical measure that estimates the number of children who die before reaching the age of 5.	0.7 – 0.9
	ii. Life expectancy	It refers to how long a newborn infant would live if current death rates at birth stayed constant throughout their lives.	45 – 80
	iii. Proportion of population with safe drinking water.	It is defined as drinking water from improved sources with a collection time of 30 minutes or less.	0.2 – 0.8
	iv. proportion of population with improved sanitation facilities.	The percentage of individuals using improved facilities not shared with others, including flush systems, septic tanks, etc	0.1 – 0.6
	v. Secondary school enrolment	The proportion of total enrolment in a population based on their level of education, focusing on secondary education for lifelong learning and growth.	0.1 – 0.8
4. Reduction in Poverty Rate& inequalities.	i. Proportion of population living above $2.15 per day	The percentage of a country's population living in households with non-health expenditures below the$2.15 poverty line.	0.05–0.7
	ii. Proportion of population living above $3.65 per day.	The percentage of a country's population living in households with non-health expenditures below the$3.65 poverty line.	
	iii. GINI index	Measures the deviation from a perfectly equal distribution of income or consumption expenditure within an economy.	0 – 100

Source: World Development Indicators, (2023).

RESULTS AND DISCUSSION

Table 3 reports the descriptive statistics of the investigated variables. The descriptive statistics of the data utilized are presented according to income groups. These statistics include the mean, median, standard deviation, minimum, and maximum and the Jarque-Bera normality test with their respective p-values. Table 3 above presented descriptive statistics by income group and showed that low-income (LI), lower-middle-income (LMI), and upper-middle-income (UMI) countries differed significantly in terms of inclusive growth measures and related economic indicators. Compared to LI countries (0.78) and LMI countries (1.05), UMI countries have a higher mean value of 1.30 for inclusive growth (IG). This result suggests that the growth of UMI countries is more inclusive in that a more significant proportion of the population is involved in productive activities and that the distribution of economic gains is equitable and fair. The 0.25 standard deviation suggests that inclusive growth results are more widely distributed in UMI nations.

The distribution of inclusive growth data across all income groups is essentially normal, according to the Jarque-Bera statistics and p-values, with p-values surpassing the standard threshold of 0.05. The findings also reveal that UMI countries had the highest mean of 5.00 on the Digital Economy Index (DEI), a sign of more advanced infrastructure for the digital economy. This result suggests that higher-income countries allocate more funds to developing digital infrastructure. The UMI nations have a standard deviation of 1.20, indicating more significant variability in the expansion of the digital economy within this group.

Table 3. Descriptive Statistics by Income Category

Variable	Income Category	Mean	Standard Deviation	Minimum	Maximum	Jarque-Bera Statistic	p-value
IG	LI	0.78	0.15	0.50	1.10	3.50	0.17
	LMI	1.05	0.20	0.70	1.40	4.20	0.12
	UMI	1.30	0.25	0.90	1.80	5.00	0.08
DEI	LI	2.50	0.80	1.00	4.00	6.00	0.05
	LMI	3.70	1.00	2.00	5.00	4.50	0.10
	UMI	5.00	1.20	3.00	7.00	3.80	0.15
GCF	LI	12.0	3.0	8.0	18.0	2.50	0.29
	LMI	20.0	4.5	14.0	28.0	4.00	0.13
	UMI	30.0	6.0	22.0	40.0	3.60	0.16
FDI	LI	1.5	0.6	0.5	3.0	4.10	0.11
	LMI	3.0	1.0	1.0	5.0	3.90	0.14
	UMI	5.0	1.5	3.0	8.0	3.70	0.16
LF	LI	45.0	10.0	30.0	60.0	2.90	0.23
	LMI	55.0	12.0	40.0	70.0	4.00	0.12
	UMI	65.0	15.0	50.0	85.0	3.80	0.15

Source: Author's computation using Stata Version 17, (2024).

Foreign Direct Investment (FDI) and Gross Capital Formation (GCF) likewise exhibit rising trends from LI to UMI countries, with the UMI group exhibiting more excellent means and standard deviations. This result indicates that UMI nations have made more significant capital investments and drawn more foreign investments. The distributions of GCF and FDI, according to the Jarque-Bera statistics, do not significantly differ from regular. In addition, compared to LI and LMI countries, UMI countries have the most prominent mean and standard deviation in labor force data. This result indicates that these countries have a larger workforce and more fluctuation in job conditions. Gross Capital Formation (GCF) and Foreign Direct Investment (FDI) are trending upward from LI to UMI countries, with UMI countries exhibiting more considerable means and standard deviations. This result implies increased foreign investment as well as more considerable capital expenditures. With p-values more significant than 0.1, the distributions of FDI and GCF do not deviate substantially from the mean. Compared to LI and LMI nations, UMI countries have the most significant labor force statistics mean and standard deviation.

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Table 4 presents the Sargan – Hansen test of over-identifying restrictions, which determines the most suitable and efficient technique for estimating the model between the difference GMM and the system GMM. Table 4 summarizes the pooled regression, fixed effect, and difference-GMM results. The estimated results are robust because they corrected for heteroscedasticity and auto-correlation problems. According to Bond (2001), to choose between System-GMM and Difference-GMM, there is a need to estimate the models with the dependent variable lag to obtain the coefficient by Pooled regression, Fixed effects, and Diff-GMM methods. From the result, the coefficient of Diff-GMM of 0.7934 is closer to the coefficient of Fixed effects of 0.8461 than that of Pooled regression of 0.9592. Thus, the SGMM was found to be a better estimator than the difference-GMM.

Table 4. Choice of System-GMM and Difference-GMM

Variable	Pooled	Fixed Effects	Diff – GMM
$EG_{i,t-1}$	.959184**	.8461365**	.79337
$DEI_{i,t}$	-.0035205	-.0027469	-.026986
$GCF_{i,t}$	-.0003066	-.0022976	-.002797
$FDI_{i,t}$	-.0008235	-.000294	-.0013427
Constant	.0117219	.0666874***	.0894438
N	560	560	501
R^2	0.9498	0.9493	-
F-stat	676.77**	368.70**	1003.76**

Source: Author's computation; Dependent Variable: $IG_{i,t}$
Note: *, ** and *** show significance at 1%, 5% and 10% respectively.

Table 5 presents the Arellano and Bond (1991) System Generalized Method of Moments (SGMM) regression, which provides a summary of the analysis of the effects of the digital economy on inclusive growth in the selected African countries. Table 5 shows the summary of results for the SGMM. The result reveals that the model is correctly specified and linearly a good fit. Again, the AR-1 and AR-2 show that the model is free from the auto-correlation problem. Similarly, the Hansen value and the Wald chi-squared tests show that the models are statistically significant and free from the proliferation of instruments. The lag effect of economic growth on the current economic growth was found to be positive and significant. This result means that the past strongly affects the current year. Thus, previous inclusive growth activities in Africa for LMI, LI, and UMI countries are strong determinants of the current inclusive growth.

The digital economy index (DEI) has a positive effect on inclusive growth in all countries in Africa. This result means that the digital economy has a positive and significant effect on inclusive growth in the continent. The coefficients for LI and LMI nations are 0.0020 and 0.0012, respectively in Algeria, Kenya, Nigeria, Angola, Ghana, Cameroon, and Zambia. It is, however, 0.0008 in UMI nations such as Namibia, South Africa, Gabon, Namibia, and Botswana. This result demonstrates that the influence of the digital economy on inclusive growth is more potent in LI and LMI countries.

Considering the control variables incorporated in the estimations, the study discovered that foreign direct investment (FDI) significantly affects inclusive growth in UMI countries as it enhances productivity and economic opportunities. However, its impacts are negligible in LI and LMI countries, suggesting that FDI is more helpful in economies better prepared to leverage such investments. The labor force (LF) has a negative impact on inclusive growth in LI and LMI countries, implying that labor force expansion may not be a direct driver of inclusive growth due to concerns with employment quality or labor market inefficiencies. The Gross Capital Formation (GCF) coefficients vary in significance across income categories, for lower- and upper-middle-income countries, implying that capital formation increases have a more noticeable and quantifiable effect on inclusive growth in these economies.

Table 5. Two-Step (Robust) SGMM Regression: Inclusive Growth (IG), Digital Economy Index (DEI), Gross Capital Formation (GCF), Labour Force Participation (LF), and Foreign Direct Investment (FDI)

	(ALL)	(LI)	(LMI)	(UMI)
IG	0.752***	0.680***	0.755***	0.790***
	(0.045)	(0.065)	(0.053)	(0.047)
DEI	0.0013*	0.0020**	0.0012	0.0008***
	(0.0007)	(0.0008)	(0.0006)	(0.0009)
GCF	0.0035*	0.0011	0.0032**	0.0041*
	(0.0021)	(0.0018)	(0.0015)	(0.0020)
FDI	0.0018	0.0005**	0.0016	0.0020**
	(0.0012)	(0.0009)	(0.0010)	(0.0011)
LF	-0.0023***	-0.0031*	-0.0019	-0.0020
	(0.752)	(0.0013)	(0.0011)	(0.0017)
Constant	-0.054*	-0.085	-0.048	-0.023*
	(0.058)	(0.070)	(0.062)	(0.074)
No of observations	851	332	414	105
No. of countries	37	12	18	7
No. of instruments	72	72	72	72
Hansen (p-value)	0.123	0.075	0.098	0.211
AR1 (p-value)	0.021	0.030	0.025	0.045
AR2 (p-value)	0.178	0.201	0.156	0.214
F- stat	1682.34**	-	3150	3129*
F (p-value)	0.0000	-	0.0020	0.0011
Wald chi2	23456.78	7851.25	14124.67	8231.44
Chi2 (p-value)	0.0000	0.0000	0.0000	0.0000

Source: Author's computation; Dependent Variable: $IG_{\square, \square}$
Note: *, ** and *** show significance at 1%, 5% and 10% respectively.

In general, Table 5 shows the empirical results obtained from model estimates when evaluating the effects of the digital economy on inclusive growth in Africa. The above findings are for the primary sample of selected African counties (ALL) as well as

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the subsamples: low-income (LI), lower-middle-income (LMI), and upper-middle-income (UMI) from 2000 to 2022. The effects of the digital economy on inclusive growth in selected African countries are positive and significant for all income categories. These findings are similar to those of Olofin (2023), Adeleye et al. (2023), Zhang et al. (2022), and Bahrimi and Qaffas (2019), who found that while developments in the digital economy influence inclusive growth, it is relatively moderate. Similarly, the findings reveal varying degrees of influence of the digital economy on inclusive growth across different African income categories. It positively affects inclusive growth, which is 0.08 percent in UMI nations, 0.1 percent in LMI countries, and 0.2 percent in LI countries. This result implies that the digital economy may be used as a catalyst for inclusive growth, especially in LI and LMI nations. In UMI countries, however, the benefits of improvements in the digital economy on inclusive growth may be less pronounced or obscured by other factors. In such countries, where other economic drivers may take precedence, digital advancements may not be as revolutionary, even though they are still important.

The Gross Capital Formation (GCF) coefficients show varying degrees of significance across income categories suggesting that increases in capital formation have a more notable and quantifiable effect on inclusive growth in these economies. This result emphasizes the significance of physical capital investment as a vital engine of economic growth, especially in developing countries where capital accumulation is essential to realizing full economic potential. Though the effect is statistically significant in LI, it is unimportant. This result suggests that although capital formation is important, its effect on growth may be less pronounced in these economies because additional capital investments are necessary to effectively take advantage of growth opportunities. In upper-middle-income nations, foreign direct investment (FDI) has a positive impact on inclusive growth. This implies that FDI, which can increase productivity and economic prospects, plays a significant role in developing economies in more developed nations. FDI may contribute to growth, but its effects are not statistically significant in lower-income and lower-middle-income nations. This result suggests that FDI is more beneficial when the economy is better suited to leverage such investments. Labour Force (LF) negatively affects inclusive growth in lower-middle-income nations. This result implies that labor force growth may not be a direct driver of inclusive growth in these economies due to issues with the quality of employment or labor market inefficiencies that could counteract the benefits of an expanding labor force. In contrast, the labor force effect is insignificant in other income categories, suggesting that a more complex relationship varies depending on the economic situation between changes in the labor force and inclusive growth.

These findings support and reinforce many African governments' attempts to increase digital technology adoption to promote inclusive growth throughout the continent. For example, governments through public-private partnerships in Cameroon, Angola, Botswana, Ghana, Kenya, Nigeria, South Africa, Algeria, and Zambia are increasing their investments in digital infrastructure. They provide continuous internet connectivity for citizens, enhance broadband accessibility, and promote mobile technology to expedite the acceptance and spread of mobile technological services. Consequently, enhanced mobile coverage makes it simpler for the African digital economy to develop and support inclusive growth.

The findings of this research also validate earlier theoretical studies that proposed that the digital economy should promote inclusive growth by accelerating the adoption and development of innovation processes and, in turn, fostering competition that leads to the creation of new goods, procedures, and business models (Schumpeter, 1911; Solo-Swan, 1956; Romer, 1990; Mgadmi et al., 2021). Furthermore, these results align with most of the prior empirical studies confirming the significant positive effect of the digital economy on inclusive growth in the selected African nations, indicating that economies that have had widespread access to digital technologies have experienced more robust growth (Kouladoum, 2023; Adeleye et al., 2023; Olofin, 2023; Solomon & Van Klyton, 2020; Dubey et al., 2019; Bahrimi & Qaffas, 2019).

CONCLUSION

This study holds significant importance as it explores the effects of the digital economy on inclusive growth in selected African countries from 2000 to 2022. The varying significance of the digital economy across different income categories suggests that the digital economy is particularly influential in LI and LMI countries. Digital infrastructure and service improvements for these countries reveal a more significant impact on inclusive growth. This result indicates that the digital economy can act as a catalyst for inclusive growth in these nations. Conversely, in UMI countries, the impact of the digital economy is less pronounced, suggesting that in more advanced economies, the benefits of further digital improvements might be overshadowed by other growth factors or may exhibit diminishing returns.

The role of Gross Capital Formation (GCF) and Foreign Direct Investment (FDI) further illuminates the nuanced effects of different economic drivers on inclusive growth. Capital formation emerges as a critical factor in transitioning economies (LI and LMI), while FDI plays a more significant role in relatively advanced economies (UMI). The negative effect of the Labour Force (LF) on inclusive growth in LI and LMI countries highlights potential challenges related to employment quality and labor market inefficiencies in Africa. Overall, the findings imply that the digital economy has a effect on inclusive growth in the continent.

These results carry significant implications for policy and strategy in Africa. Therefore, tailoring digital and economic policies to the specific needs of different income categories can enhance their effectiveness, ensuring that digital transformation fosters inclusive growth in diverse economic environments. Prioritizing investments in digital infrastructure and services in these countries is imperative since the digital economy significantly affects inclusive growth in these regions. Expanding internet access and broadband subscriptions, enhancing digital literacy, and encouraging the population›s acquisition of digital skills should be the main priorities for policymakers.

Similarly, strategic capital formation and investment policies are crucial for inclusive growth in both LMI and UMI countries. Encouraging efficient capital formation and attracting quality and vital foreign investments is essential. This policy includes fostering a conducive environment for private sector investment, enhancing infrastructure, and

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allocating capital expenditures to industries that promote inclusive and sustainable growth. Incentives and regulatory changes can also help attract and retain international capital. Finally, since the labor force has a negative effect on inclusive growth, LI and LMI economies must address labor market inefficiencies. Policymakers may raise the quality of employment by providing financing for education and training initiatives, enhancing regulations, and establishing respectable job possibilities with decent remuneration and working conditions.

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