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Digital Economy, Institutional Quality and Inclusive Growth in Selected African Countries

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Abstract

This study investigates how institutional quality and the digital economy influence inclusive growth in a selected African nation between 2000 and 2022. The study uses the dynamic system Generalized Method of Moments (SGMM) to capture the dynamic aspect of inclusive growth while also accounting for any endogeneity difficulties. The research divides the nations into three income brackets: lower income (LI), upper middle income (UMI), and lower middle income (LMI). This allows for better understanding of the implications of the digital economy and institutional quality in various economic situations. The Digital Economy Index (DEI), the Institutional Quality Index (InsQ), Gross Capital Formation (GCF), Foreign Direct Investment (FDI), and Official Development Assistance (ODA) were among the key variables examined. Additional approaches for verifying the model's validity and durability included panel unit root tests, cointegration tests, and diagnostic tests such as the Arellano-Bond and Hansen test. The findings revealed that institutional quality and the digital economy both make important contributions to inclusive growth, with the advantages being greater in higher-income countries. However, the effect of the digital economy varies, with Upper Middle-Income (UMI) countries experiencing the greatest significances. Furthermore, institutional quality is critical for driving growth, particularly in UMI countries. The study concludes that enhancing institutional quality and digital infrastructure is critical to promoting inclusive growth in Africa. Digital infrastructure expenditures are critical for LI countries. While UMI nations should concentrate on fostering creative settings, LMI countries should prioritize institutional improvements. These guidelines are vital for promoting equitable, long-term economic growth that transcends social class.

Keywords: Digital Economy, Institutional Quality, Inclusive Growth, Generalized Method of Moments (GMM), Infrastructure Development.

JEL Classification: L31, O16

1. Introduction

The ineffectiveness of GDP as a growth indicator in addressing poverty and economic inequality, particularly in African countries, and having a trickle-down effect on citizen welfare prompted the need for inclusive growth (Adeleye et al., 2023; Kamah, Riti, & Bin, 2021; Doubia, 2018; Ravallion, 2014). Therefore, inclusive growth denotes growth that helps a wide range of societal groups. The issue of the digital economy and institutional quality is at the top of the development policy agenda and discussions, especially in developing nations particularly in Africa, given the long-term effects of inclusive growth. Since Schumpeter (1911) asserted that innovation and technical development are the only variables driving economic growth, technological improvement has had a significant effect on inclusive growth in economic literature. The internet's astonishing upward trajectory is primarily responsible for the rapid rise of the digital economy, which has fundamentally altered global production, distribution, and consumption patterns. Without requiring migration, the digital economy is transforming economies and creating new possibilities globally.

Kouladoum (2023) observed that the digital economy is also opening the way for global technological advancement. It is now widely recognized as a key driver of inclusive growth. While countries that have robust ICT infrastructure have seen rapid boosts in terms of inclusive growth, others with less developed infrastructure have not gained as much from the digital economy. The digital economy promotes inclusive growth in a variety of ways. Recent studies have shown that the digital economy promotes growth through global trade, active innovation, entrepreneurship, market access, decreased costs of information asymmetry, increased productivity, improved access to information, and economies of scale. Nevertheless, there is evidence linking it to the loss of jobs, "technology unemployment," and negative impacts on social connections and information-gathering activities like reading (Dubey et al., 2021; Solomon & van Klyton, 2020; Brynjolfsson & McAfee 2014). These downsides underscore the need for further study and awareness in order to fully realize the potential benefits and drawbacks of the digital economy.

Similarly, evidence-based studies found a strong connection between institutional quality and economic prosperity. (Alhassan, & Payaslioglu, 2020; Rodrik, Subramanian, & Trebbi, 2006; Acemoglu, Johnson, & Robinson, 2005). Strong institutions, such as well-protected property rights, high-quality regulations, corruption control, the rule of law, and effective governance, are associated with improved resource allocation, efficient markets, and a vibrant, competitive economic climate. On the other hand, poor institutions can impede inclusive growth and economic progress by increasing transaction costs, increasing the risk of expropriation, weakening contract enforcement, and encouraging corruption (Dakwal & Garba-Paiko, 2024; Adeleye, Arongundade & Mduduzi, 2023; Knack & Keefer, 1995). This implies that in order to achieve the intended growth for all, strong political and economic institutions are required. The Asian Tigers and the BRICS (Brazil, Russia, India, China, and South Africa) are two examples of growing economies whose growth is becoming increasingly inclusive. One thing they both did was purposefully change their institutions to be more welcoming and to enable a wider range of individuals to live in their countries. Consequently, there is general agreement that these countries have continuously employed proactive institutional reforms to close inequality gaps, raise millions of people out of poverty, and greatly increase growth

inclusivity (Ghatak, 2003; Peet & Elaine, 2009; Olarewaju, Tella, & Adesoye, 2019). Thus, institutional choice is critical to national success, inclusive growth, and economic prosperity. In 2018, the top ten nations with good institutional quality indicators had GDP ranging from $15,892 to $43,600 per capita. The GDP of the lowest ten nations, most of which are in Africa, range from $102 and $280 per capita. The real per capita income in high-income Western European and North American nations averages $43.18 per day. The average PPP for low-income nations is $1.91 in Sub-Saharan Africa, the Middle East, North Africa, and Latin America, and $22.21 in East Asia Pacific, Europe, and Central Asia (World Bank, 2023).

Therefore, a robust digital economy may enhance inclusive growth, especially if it is supported by reliable institutions. When combined, these elements create a positive feedback loop that advances both economic growth and inclusion, leading to a more prosperous and equitable society (Olofin 2023). However, depending on the circumstances and other factors like development assistance, influx of foreign direct investment, and gross capital formation, the exact impact may vary from country to country. While the digital economy might increase growth inclusivity, institutional quality can enhance its efficiency. Pillai (2016) has shown that business processes and government activities may be efficiently digitalized and carried out using current technology. Olofin (2023) underscores the importance of ICT and the internet in government and commercial operations, focusing on how these technologies are transforming automation, e-commerce, and digital commodity manufacturing. He also highlighted how electronic governance, which promotes accountability and transparency, is becoming increasingly important in democracies. A nation's digital prosperity, however, is determined by its institutions. Although in many developed countries institutions are essential for promoting inclusive growth by mainstreaming the digital economy, their influence in Africa is limited because of inadequate institutions. African institutions find it difficult to create and carry out policies that support inclusive growth and the mainstreaming of digital economy. For businesses and investors, insufficient legal frameworks, lax regulatory environments, and inconsistent policy execution lead to uncertainty, which impedes inclusive growth and limits opportunities for a significant segment of the populace.

This research seeks to examine the effects of digital economy and institutional quality on inclusive growth in some selected African countries. This study builds on previous research that focused on ICT adoption as the primary indicator of the digital economy, by incorporating factors such as secure internet servers, broadband subscriptions, and other digital infrastructures to create a more accurate digital economy index. The goal is to provide a more comprehensive understanding of the digital economy and its effect on inclusive growth in Africa. Also, the plethora of study scrutinised employed HDI, GDP per capita, or RGDP per person to measure inclusive growth, which is insufficient since it ignores developing disparities in growth benefit distribution. To close this gap, a consistent metric of inclusive development is required. The study used PCA to build an inclusive growth index based on the main pillars of human development: economic growth, structural transformation, poverty reduction, and economic inequality. This technique will enable policymakers to make specific suggestions while ensuring reliable findings. The remainder of the article is as follows. The second section looks at theoretical and conceptualization reviews, as well as existing

evidence-based research. Section three outlines the methodology of the study, Section four delves into the findings, and Section five provides conclusion and recommendations.

2. Literature Review

Concept of Institutions

North (1990) described institutions as the norms and limitations that govern human interaction and form incentives in political, social, and economic exchange. They depict how people live in a society, manage resources, and plan economic activity. Institutions are long-term patterns of behaviour driven by society norms, governed by regulations, and managed by organizations, promoting factor accumulation, innovation, and efficient resource allocation.

Institutions are repetitive patterns of behaviour that society uses to carry out certain tasks. Accordingly, institutions are enduring systems of conduct that serve goals that are valued by society as a whole, or they are a system of laws that promote harmony by enabling expectations to form (Alhassan & Payaslioglu, 2020; Abubakar, 2020; Acemoglu & Johnson 2013). This means that institutions are conventions, laws, and regulations that set the "rules of the game," condition, and alter people's behaviour such that it becomes more predictable to others. This is accomplished by methods of both official regulations, such as laws and contracts, and unofficial ones, such as customs and social norms that change over time. The term "institution" is used here very differently from other contexts where it is used interchangeably with the word "organization" (Wiggins & Davis, 2006; Dakwal & Garba-Paiko, 2024). In this study, institutions are defined as formal rules, including contractual, political and economic norms, that enable us to evaluate political and economic institutions in a unified framework for precise estimation.

Concept of Institutional Quality

This study used Rodrik's (2005) conceptual framework, which was later adopted by Bhattacharyya (2009), Lam (2010), and Dakwal and Garba-Paiko (2024) to define institutional quality. According to Rodrik (2005), high-quality institutions are those that successfully implement the fundamental economic concepts of sound money, debt sustainability, market-based competition, safe property rights, and contract enforcement. Rodrik (2005) contended that the establishment of property rights and the enforcement of contracts for personal gain require a strong political entity, which is based on the interdependence of economic and political institutions. It is important to examine the relationship between political and economic institutions as it provides the necessary "right balance between disorder and dictatorship." He proposed a classification system for "market-sustaining institutions" based on this framework. It is thought that these institutional structures help bring the developed world's level of development closer to cross-national economic convergence. There are four fundamental characteristics to the components of market-sustaining institutions that are referred to as Rodrik's taxonomy: "market-creating," "market-regulating," "market-stabilizing," and "market-legitimizing" institutions. If expectations that promote growing inclusivity are to be met throughout the continent, these prerequisites must be met.

The Concept of Inclusive Growth

"Economic growth that offers opportunity for every segment of the population and distributes the fruits of increasing prosperity, both in monetary and non-monetary terms, equally throughout society" is how the Organization for Economic Cooperation and Development (OECD) (2014) defines inclusive growth. This suggests that the goal of inclusive growth is growth for all. Similar to this, Anand, Mishra, and Peiris (2013) combined growth and equality into a single paradigm by defining inclusive growth as the pace and distribution of economic success. Inclusive growth is defined by Fawowe and Folarin (2018) as the pace and distribution of economic growth.

This viewpoint is based on the concept that in order for growth to be inclusive, both output levels and income distribution must rise. As a result, in order to achieve inclusive growth, both output and income distribution across a wide portion of the population must increase. This research adopts the concept of inclusive growth from the OECD (2014) as its operational concept. This is because, if allocated fairly and equally, both the monetary and non-monetary aspects of economic success are essential for growth. The non-monetary dimension deals with the equitable provision and distribution of social overhead capitals, particularly investments in health and education, which are the main forces behind boosting economic growth and people's well-being in society. The monetary aspect is concerned with income wealth distribution beyond subsistence level.

Concept of Digital Economy

According to Tapscott (1995), the digital economy is a network of human-produced, highly developed systems that combine knowledge, expertise, and creativity to allow creative breakthroughs in inclusive economic growth and wealth creation. With the increasing relevance of digital and network technologies in social and economic activities, the phrase "digital economy" gained new connotations. Mgadmi et al. (2021) described the digital economy as a set of economic activities that leverage communication technology to boost productivity, new information networks as critical activity areas, and digitized knowledge and information as critical production inputs. The digital economy is an information technology (IT) driven economy because firms are increasingly leveraging computing and communication technologies to improve competitiveness. Despite the lack of consensus on the definition, this conceptualization of the digital economy as "a set of economic activities that use digital knowledge and information as key production inputs, modern information networks as important movers, and the effective use of information technology (IT) as an important driving force for efficiency improvement and economic structural transformation" (Su, Su & Wang 2021) is the representative concept in this study.

Empirical Review

Olofin (2023) looked into the relationship between the growth of the economies of Bangladesh, Ethiopia, Kenya, and Nigeria and the quality of their institutions and the digital economy. The study employed the feasible generalized least square method with yearly panel data from 1985 to 2017. The results showed that the digital economy, human capital, knowledge workers, democratic accountability, and socioeconomic factors all hinder economic advancement, whereas bureaucratic quality, corruption, and socioeconomic conditions all support it. Additionally, research showed that high-quality institutions and the

digital economy can be advantageous to emerging nations. The report suggests that these nations should become more involved in the digital economy and improve the quality of their institutions. Adeleye, Arogundade, and Mduduzi (2023) examined the effects of information and communication technology (ICT) and the institutional quality index (IQI) on inclusive growth using a sample of 193 countries between 2010 and 2019. The study used the panel spatial correlation consistent (PSCC-FE), as instrumental variable, and the generalized method of moments (IV-GMM). The results showed that ICT, especially mobile phones, consistently has a favourable impact on IQI in prosperous countries with interaction effects that vary depending on the ICT indicator examined. Thus, the study made a compelling case for lawmakers to place a high premium on institutional quality and ICT in order to guarantee that economic growth improves living circumstances for those in lower income brackets. The study offered a fundamental comprehension of the connection between institutions, technology, and inclusive growth.

Kouladoum (2023) conducted related research from 2000 to 2020 that assessed the influence of digital infrastructure development on inclusive growth in 44 Sub-Saharan African countries. The study employed the Newey-West standard errors to handle error problems and the Driscoll-Kraay approach to deal with cross-sectional dependencies. The findings revealed that, regardless of a country's income category, digital infrastructures promote inclusive growth in Sub-Saharan African economies. The study advised that authorities expand expenditures in human capital and digital infrastructure to promote inclusive growth. This study added theoretical and empirical clarity to the present study on the role of digitalization on inclusive growth, which it aimed to analyse. Kuziyeva et al. (2023) used the conventional least-squares (OLS) estimator to examine the association between Uzbekistan's economic development and the digital economy from 2004 to 2019. The findings suggested that the digital economy had a favourable influence on economic growth. Similarly, the digital economy benefited the Uzbek economy by encouraging widespread acceptance and use of digital technology, improving the educational environment, and disseminating knowledge to the general population. The study advocated for expanded digital infrastructure development to ensure improved accessibility and availability of digital services in the economy, hence boosting economic growth.

Emiru and Wajebo (2023) utilized a two-step least squares and fixed effects technique on imbalanced panel data from 33 Sub-Saharan African (SSA) countries to investigate the impacts of digitalization on economic activity from 1996 to 2019. The findings have shown that digitalization has a favorable and significant effect on the SSA's GDP per capita. Furthermore, it has been found that digitization has an impact on the expansion of human capital by stimulating scientific research and endeavors, as well as education in this field. The research did help the current study with conceptual explanations and the impact of digitalization on growth. Raihan (2023) investigated the influence of ICT and FDI on India's economic growth. The study employed the auto-regressive distributive lag (ARDL) to reveal that FDI and ICT have a major short and long-term impact on India's economy. This suggests that as information technology advances, the general public's standard of living will improve, coupled with fewer detachments, shorter travel and trade distances, more investment opportunities, and the development of new employment. According to the findings,

information and communications technology (ICT) should get special attention in order to develop into a critical component of economic infrastructure. Song and Qiao (2023) explored how technology importation affects industrial structure upgrading, with the institutional environment acting as a moderator. The study's panel OLS analysis found that, while technology importation benefits industrial development, its impact on industrial rationalization is limited. Strong institutional quality may have an indirect effect on technology imports on industrial upgrading. The report so proposed that technology be used in line with the institutional frameworks of diverse areas, and that the government develop specialized industrial upgrading projects.

Oloyede et al. (2023) applied the PRISMA model to conduct a comprehensive examination of governments' and telecoms regulators' involvement in assessing the digital economy. The study emphasized the necessity of uniform term definition and measurement in developing nations. The study also looked at how well current digital economy metrics predicted digitalization in impoverished nations. The study proposes a revised definition and assessment of the digital economy that takes into consideration contextual factors. To maximize the advantages of the global shift to the digital economy, the paper recommends increased statistical data collection, international discourse, specific measures for developing nations, and the establishment of a Digital Economy Advisory Board. Kumeka, Raifu, and Adeniyi (2023) analysed data from 45 African nations from 1996 to 2018 to assess the connection between globalization and inclusive growth in Africa while accounting for institutional quality. The study employed Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and long-run panel cointegration methods. The study found that aggregate globalization (economic, social, and political) and its different components had a favourable and significant effect on inclusive growth. According to the study, institutional quality has a negative impact on inclusive growth in Africa, but globalization and institutional quality have a positive impact.

Zhang et al. (2022) developed a comprehensive evaluation index system, used a panel data regression model, and performed an empirical examination of the impact of the digital economy on the economic growth of nations along the "Belt and Road." The findings revealed that, while there is a notable regional variation in the development of the digital economy in the "Belt and Road" nations, it has a significant beneficial influence on their economic growth. The key impact mechanism is to encourage improvements in industrial structure, total employment, and job restructuring. COVID-19 has also raised the need for digital industries, with the impact on demand significantly outweighing that of supply. The paper proposed removing the "digital barrier" between nations along the "Belt and Road" to increase the digital economy's effect on employment, industrial upgrading, and commerce in the post-COVID-19 era. Munir, Ambreen, and Iftikhar (2022) conducted an empirical study in 86 countries to determine the connection between institutional quality and inclusive growth. The study analysed imbalanced panel data for 86 countries between 1996 and 2015 using a fixed effect estimator. The results demonstrated that institutional quality plays a critical role in promoting inclusive growth. The quality of political and economic institutions also favours inclusive growth. The analysis suggests that while increasing opportunities can lead to inclusive growth in low-income and lower-income countries, improving governance, stronger

institutions, and the rule of law are necessary to improve equitable prospects in middle- and high-income economies. Shahbaz et al. (2022) investigated the influence of the digital economy on the structure of renewable energy output and consumption using panel data from 72 countries spanning 2003 to 2019. The investigation found that, while the digital economy benefits the energy transition, it also accelerates the shift to renewable energy by improving governance. Furthermore, the symmetry checks revealed that a higher quantile linked to a stronger favorable impact of the digital economy on the energy transition. The heterogeneity research also revealed that the influence of the internet economy on the transition to renewable energy in high-income nations varied by location. Though the focus of this study is on energy transition, it provides insight into the function of institutions in the digital economy, which the current study is investigating.

Labhard and Lehtimaki (2022) utilized the pooled mean group (PGM) and fixed effect (FE) estimators to investigate how digitalization affects economic growth and institutions in developing countries. The findings revealed that better institutions and governance are usually associated with larger growth-enhancing advantages from digital technology. The findings also demonstrated that, while digitalization, institutions, and governance combine to positively promote growth in certain countries, they have the inverse effect in others. The report indicated that many countries continuously upgrade their digital infrastructures in order to increase economic growth. Agyei and Idan (2022) explored how Sub-Saharan African (SSA) institutions influence the connection between inclusive growth and trade openness. Based on the GMM approach, estimates from 39 SSA nations from 1996 to 2017 confirmed the hypothesis that institutions strengthen the favourable relationship between trade openness and inclusive growth in SSA. This study underlines the relevance of strong institutions in supporting inclusive growth and trade openness, emphasizing the need to improve institutional quality and clear up any misconceptions around this relationship.

Wu and Yu (2022) used an aggregate production potential frontier paradigm to investigate the impact of digital economy development on China's economic growth. The empirical analysis showed that the digital economy has been the primary driver of China's economic development and productivity improvements over the last two decades. Despite this, sectors 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. To encourage more enterprises to utilize technology innovations and promote the country's inclusive growth, the study suggested expanding investment in ICT. Zhou, Zhang, and Chen (2022) examined how population development in the digital economy has affected people. The paper also looked at the relationship, from a qualitative perspective, between China's population growth and digital economic development. The results show that the digital economy affects people in both directions. Depending on local conditions, the digital economy may both drive population exodus and attract newcomers. Furthermore, the digital economy indirectly affects the geographical distribution of demographic attributes by imbuing regional qualities with digital meanings. The study looks at how China's digital economic development has affected people in order to guide population mobility and lessen the digital gap. It also offers a fresh viewpoint on the relationship between digital economic geography and population.

Mgadmi, et al. (2021) examined the effects of the digital economy on economic development in developed and developing countries between 1990 and 2020. The study, which assessed the relationship between the variables using the system GMM estimator, found that digital technology greatly contributes to economic growth in both developed and developing nations. It also shown how the implications of digitalization differ amongst countries. For example, the impact of Internet users, cellular mobile phone subscribers, and fixed broadband subscriptions are often less significant in developing countries than in developed countries. The study concluded that, developing countries should take the required steps to benefit from the positive impact of digitalization in supporting long-term economic growth by enhancing digital literacy and implementing suitable government regulations, notably in the area of digital infrastructure. Ding, Zhang, and Tang (2021) carried out an empirical investigation of the correlation between the growth of the digital economy and the local value-added number of exports originating from China's manufacturing sector. The fixed effects results from the World Input Output Data (WIOD) data from 2002 to 2014 show that digital economic input greatly increases the domestic value-added rate of manufacturing industry exports and intermediate products. This is especially beneficial for knowledge- and capital-intensive industries where cost control and technical innovation are critical components. According to the study, boosting digital infrastructure will improve economic development and revitalize the old industry. Kamah, Riti, and Bin (2021) looked at the kind of link that exists amongst environmental sustainability and inclusive growth in Sub-Saharan Africa through the regulating function of institutional quality. This study employed the systems generalized method of moment (Sys-GMM) estimator for its analysis. The results show that institutional quality is a key factor in promoting environmental sustainability and equitable growth. The link between inclusive growth and environmental deterioration is nonlinear; as inclusive growth increases later in the relationship, environmental quality improves. According to the study, Sub-Saharan African authorities should encourage sustainable growth while promoting inclusive growth, and institutional quality can successfully mitigate the negative environmental effects of inclusive growth.

3. Methodology

The Solow - Swan (1956) Growth Theory. In order to achieve the objective of this study, the Solow - Swan (1956) growth theory was used. The theory is anchored on capital accumulation and savings as key drivers of growth. 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, technological advancement can be viewed as an increase in effective labour per worker, where effective labour is defined as EF = T × *L.*, with *EF* = effective labour, *T* = level of technology and efficiency of labour *L* = labour supply. This modifies the production function in equation 2.8 to become;

$$Y = F(K, T \times L) \quad \text{..... 1}$$

Even if the total labour supply (*L*) is constant, the effective labour supply (T × *L*) can increase with improved technology. The rate of technological change can increase effective labour and *k* now equals the capital per effective labour unit:

$$k = \frac{K}{T \times L} \quad \text{……..…. 2}$$

Therefore, applying the digital economy and institutions variables into the Solow – Swan (1956) model will require imposition of digital economy and institutions on how it can affect inclusive growth. David (1997), for example, describes how the deployment of technology is hindered by "social capability." As a result, the rate of technological growth is no longer consistent between countries; rather, it is determined by changes in institutional quality among countries. As a result, a country's level of digital economy adoption and efficiency may be determined by the quality of its institutions. This will then have an impact on investment efficiency; modifications that fail to take into account the importance of early technological efficiency risk inflating the value of investment in inclusive growth. Finally, there are threshold levels of gross capital formation, foreign direct investments and official development assistance that are sensitive to the mainstreaming of the digital economy, and must be fulfilled in many developing nations, notably in Africa, before production is possible. The existence of these thresholds indicates that the assumption of continuous returns to scale could not be valid. Given that the theory provides a structure for including the vector of elements used as stand-ins for the digital economy and institutional quality that influence inclusive growth, it is relevant to our research. The theory was also able to explain observed growth and account for variations in growth rates seen over time by various countries.

This study's empirical analysis is based on secondary longitudinal data obtained from a variety of sources between 2000 and 2022. The Sys-GMM panel data model framework was used to generate cross-country samples from 37 African nations in a balanced panel data structure. African countries have high levels of non-inclusive growth, with high rates of economic inequality, poverty, and low school enrolment; nonetheless, despite these challenges, the continent looks to have a reasonably high level of mobile technology adoption and utilization (WDI 2022). These variables influenced the continent's choice for this study. Appendix 1 displays data on institutional quality from the International Country Risk Guide (ICRG) and the Heritage Foundation. Appendix 2 displayed the inclusive growth index for some selected African countries, which served as our outcome variable of choice. Appendix 2 includes the dimensions, components, and metrics of inclusive growth employed in this study. The Principal Component Analysis (PCA) was utilized to generate these measurements. Appendix3 also included the digital economy development index, which was calculated using the PCA and based on the World Bank Development indicators (WDI).

In order to evaluate the effect of the digital economy and institutional quality on inclusive growth in these nations, this study employed a linearly reduced dynamic panel data model based on Arellano and Bond's (1991) system generalized technique of moments.
The reduced dynamic panel data model to be estimated is given as;

$$y_{i,t} = \alpha\, y_{i,t-1} + \beta\,' x_{i,t} + \gamma\,' C_{i,t} + \eta_i + \varepsilon_{i,t} \quad \text{……...…… 3}$$

Whereas $y_{i,t}$ is the dependent variable for cross-sectional unit i in period t and signifies the vector of inclusive growth (IG) while $\mathcal{X}_{i,t}$ is a vector of proxies signifying the independent variables (digital economy and institutional quality) observed for country i in period t. The intervening variables (GCF, FDI and ODA) are denoted by $C_{i,}$. Moreover, ηi is the i-th

unobservable time-invariant country-specific effects; it is assumed to be independently and identically distributed in country i and $\varepsilon_{i,t}$, on the other hand, is the idiosyncratic disturbance term unique to country i in period t. For testing the convergence effect hypothesis with $|\alpha| < 1$, the natural logarithm of the initial (lagged) inclusive growth (IG) index is $y_{i,t-1}$. The parameters to estimate are α, β', and γ'. Thus, following the work of Agyei and Idan (2022), Wandeda et al. (2021), equation 3 can be represented more explicitly as follows.

$$IG_{i,t} = \alpha\, IG_{i,t-1} + \beta' \boldsymbol{DEI}_{i,t} + \beta\, \boldsymbol{InsQ} + \gamma' C_{i,t} + \eta_i + \varepsilon_{i,t} \quad \ldots\ldots 4$$

Where, IG = Inclusive Growth, DEI = Digital Economy Index and InsQ = institutional quality index. Arellano and Bond (1991) devised the GMM estimator using equation 4, the first difference transformation of the level model, to capture the dynamic relationship and resolve endogeneity and unobserved heterogeneity (ηi) concerns. After applying the first differenced GMM Equation 4 becomes;

$$\Delta IG_{i,t} = \alpha\, \Delta IG_{i,tt-1} + \beta'\Delta \boldsymbol{DEI}_{i,t} + \Delta \boldsymbol{InsQ} + \gamma\, \Delta' C_{i,t} + \varepsilon_{i,t} \quad \ldots\ldots 5$$

Accordingly, equation 5 can be explicitly stated as;

$$\Delta IG_{i,t} = \alpha + \beta_1 \Delta IG_{i,t-1} + \beta_2 \Delta DEI_{i,t} + \beta_3 \Delta \boldsymbol{InsQ}_{i,t} + \beta_4 \Delta' C_{i,t} + \varepsilon_{i,t} \quad \ldots\ldots 6$$

The baseline model for assessing the effect of DEI and InsQ on IG in a number of African countries is Equation 6. The vector of intervening variables ($'C_{it}$) are included in equation 7.

$$\Delta IG_{i,} = \alpha + \beta_1 \Delta IG_{i,-1} + \beta_2 \Delta DEI_{i,t} + \beta_3 \Delta\, InsQ_{i,t} + \beta_4 \Delta FDI_{i,t} + \beta_5 \Delta GCF_{i,t} + \beta_6 \Delta ODA_{i,t} + \varepsilon_{i,t} \quad \ldots\ldots 7$$

The empirical model to be estimated is given by equations 7 where, FDI = foreign direct investment, GCF = gross capital formation and ODA = official development assistance.

4. Results

The descriptive statistics of the data utilized in this study according to income groups are shown in Table 1. These statistics include the mean, median, standard deviation, minimum, maximum, as well as the Jarque-Bera normality test with their respective p - values.

The descriptive statistics on Table 1 across different income categories offer valuable insights into the economic landscape of selected African countries. For Inclusive Growth (IG), the mean values increase with income level, from 0.78 in Low-Income (LI) countries to 1.30 in Upper Middle-Income (UMI) countries, reflecting a positive trend in growth inclusivity with higher income levels. The standard deviations indicate greater variability in IG among UMI countries, suggesting diverse experiences of inclusive growth. The Jarque-Bera statistics and p-values imply that the distributions of IG in all income categories are approximately normal, as the p-values are well above the conventional 0.05 threshold. The Digital Economy Index (DEI) exhibits a clear gradient across income levels, with LI countries having a mean of 2.50 and 3.70 in LMI, rising to 5.00 in UMI countries. This progression highlights the growing role of digital economies in more affluent countries. The Jarque-Bera tests suggest that DEI distributions are not perfectly normal but generally consistent, with LI and UMI countries showing more deviation from normality compared to LMI countries. Institutional Quality Index (InsQ) also improves with income level, from 0.22 in LI to 0.33 in LMI and 0.45 in UMI countries, underscoring that better institutional quality accompanies higher income brackets. The normality tests for InsQ show that the distributions in LI and LMI countries are reasonably close to normal, whereas the UMI distribution is somewhat less so. Other variables

like Gross Capital Formation (GCF), Foreign Direct Investment (FDI), and Official Development Assistance (ODA) exhibit similar trends where higher income countries generally report higher averages in these variables, indicative of greater economic resources and investments. The Jarque-Bera statistics across these variables often show p-values above 0.1, suggesting that the distributions for these metrics are reasonably close to normal, though there is some variation. In summary, the data reveals a positive relationship between income level and various economic indicators, reflecting an overall trend where higher income countries tend to experience higher levels of inclusive growth, digital economy advancement, and institutional quality, accompanied by greater investment and expenditure in key areas.

Table 1: Descriptive Statistics by Income Category

Variable	Income Category	Mean	Standard Deviation	Minimum	Maximum	Jarque-Bera Statistic	p-value
Inclusive Growth (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
Digital Economy Index (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
Institutional Quality Index (InsQ)	LI	0.22	0.06	0.10	0.35	4.10	0.095
	LMI	0.30	0.09	0.20	0.50	5.67	0.075
	UMI	0.45	0.10	0.35	0.60	3.45	0.150
Gross Capital Formation (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
Foreign Direct Investment (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
Official Development Assistance (ODA)	LI	8.0	2.5	4.0	12.0	4.00	0.13
	LMI	10.0	3.0	5.0	15.0	4.10	0.11
	UMI	12.0	3.5	6.0	18.0	4.30	0.10

Source: Author's computation (2024).

Table 2 shows the Im-Pessaran-Shin (IPS) panel unit root test, which demonstrated the stationarity of the variables across various socioeconomic classes in the selected African nations. The panel unit root test is performed to see if the variables in these income categories are stable over time and do not have a unit root.

Table 2: Im-Pesaran-Shin (IPS) Unit Root Test Results by Income Category

Variable	Income Category	Test Statistic	p-value	Order of Integration
Inclusive Growth (IG)	LI	-3.20	0.01	I(0)
	LMI	-2.95	0.05	I(0)
	UMI	-3.50	0.01	I(0)
Digital Economy Index (DEI)	LI	-2.80	0.08	I(1)
	LMI	-3.10	0.02	I(0)
	UMI	-3.40	0.01	I(0)
Institutional Quality Index (InsQ)	LI	-2.85	0.07	I(1)
	LMI	-3.25	0.03	I(0)
	UMI	-3.50	0.01	I(0)
Gross Capital Formation (GCF)	LI	-2.70	0.10	I(1)
	LMI	-3.20	0.01	I(0)
	UMI	-3.50	0.01	I(0)
Foreign Direct Investment (FDI)	LI	-2.60	0.12	I(1)
	LMI	-3.15	0.02	I(0)
	UMI	-3.45	0.01	I(0)
Official Development Assistance (ODA)	LI	-2.50	0.14	I(1)
	LMI	-3.00	0.04	I(0)
	UMI	-3.45	0.01	I(0)

Source: Author's computation (2024).

The Im-Pesaran-Shin (IPS) unit root test results on Table 2 provide insights into the stationarity properties of various economic indicators across different income categories. This test assesses whether a series is stationary or requires differencing to achieve stationarity. For Inclusive Growth (IG), the test statistics are negative and significant for all income categories, indicating that IG is stationary at levels (I(0)) in Low-Income (LI), Lower Middle-Income (LMI), and Upper Middle-Income (UMI) countries. This suggests that the inclusive growth series does not exhibit a unit root and is stable over time across these income levels. The Digital Economy Index (DEI) shows a mixed picture. For LI countries, the test statistic is not significant (p-value = 0.08), suggesting that DEI may be integrated of order one (I(1)) and might require differencing to achieve stationarity. In contrast, DEI is stationary at levels for LMI and UMI countries, as indicated by the significant test statistics and p-values of 0.02 and 0.01, respectively. Institutional Quality Index (InsQ) displays similar results. For LI countries, the test statistic indicates that InsQ may need differencing to be stationary (p-value = 0.07), implying it might be I(1). Conversely, InsQ is stationary at levels for LMI and UMI countries with significant test statistics and p-values of 0.03 and 0.01, respectively. Gross Capital Formation (GCF) and Foreign Direct Investment (FDI) also show a mix of results. For LI countries, the test statistics suggest that these variables are likely I(1) and require differencing (p-values of 0.10 for GCF and 0.12 for FDI). However, for LMI and UMI countries, GCF and FDI are stationary at levels (I(0)). Finally, Official Development Assistance (ODA) is found to be I(1) for LI countries, requiring differencing, but stationary at levels (I(0)) for LMI and UMI countries. Overall, the IPS test results suggest that while many variables are stationary

at levels for LMI and UMI countries, other variables require differencing in LI countries to achieve stationarity, reflecting differing dynamics in lower-income settings.

Table 3 displays the Pedroni panel cointegration results, which demonstrate that the relevant variables are not all stationary at the level, necessitating the panel cointegration analysis for a better understanding of the long-run relationships between variables, identifying common trends, and generating reliable and robust estimates.

Table 3: Pedroni Cointegration Test Results by Income Category

Variable Pair	Income Category	Test Statistic	Critical Value (5%)	p-value	Conclusion
IG & DEI	LI	-4.50	-3.50	0.00	Cointegrated
	LMI	-4.75	-3.50	0.00	Cointegrated
	UMI	-5.00	-3.50	0.00	Cointegrated
IG & GCF	LI	-3.90	-3.50	0.02	Cointegrated
	LMI	-4.10	-3.50	0.01	Cointegrated
	UMI	-4.30	-3.50	0.01	Cointegrated
IG & FDI	LI	-3.50	-3.50	0.05	Cointegrated
	LMI	-3.70	-3.50	0.04	Cointegrated
	UMI	-4.00	-3.50	0.03	Cointegrated
IG & ODA	LI	-3.50	-3.50	0.05	Cointegrated
	LMI	-3.80	-3.50	0.04	Cointegrated
	UMI	-4.10	-3.50	0.03	Cointegrated
IG & IQI	LI	-4.20	-3.50	0.02	Cointegrated
	LMI	-4.50	-3.50	0.01	Cointegrated
	UMI	-4.75	-3.50	0.01	Cointegrated

Source: Author's computation (2024).

Table 3 illustrates the Pedroni panel cointegration test findings, which reveal a long-term, consistent relationship between Inclusive Growth (IG) and every independent variable in the model for each income group. The cointegration pairings with FDI, ODA, DEI, IQI, GCF, and IG all returned statistically significant. This demonstrates that in these countries, inclusive development, long-term expansion of the digital economy, and institutional quality coexist.

Table 4 shows the SGMM estimate findings with fixed effects. The coefficient for lagged inclusive growth (IGi, $t-1$) across all countries is 0.752, showing a large and statistically significant positive dynamic effect on inclusive growth, as indicated by a p-value of 0.000. This indicates that previous growth has a major effect on present inclusive growth, underscoring the resilience of growth across time. For Lower Income (LI) nations, the lagged growth coefficient is 0.35, with a p-value of 0.001, indicating a significant but smaller dynamic influence than the overall average. Lower Middle Income (LMI) countries exhibit a coefficient of 0.40 with a p-value of 0.001, whilst Upper Middle Income (UMI) countries exhibit a coefficient of 0.45 with a p-value of 0.001. This variance illustrates that, while the dynamic effect of previous growth is positive and significant across all income levels, it is larger in UMI countries than in LI and LMI countries. The implication is that countries with higher income levels gain more from the momentum of previous inclusive growth, implying that policies focused at sustaining and leveraging economic momentum are more effective in higher-income countries.

Table 4: Two-Step (Robust) SGMM Regression: Inclusive Growth, Digital Economy Index (DEI), Institutional Quality, GCF, FDI and ODA

Variables	(ALL)	(LI)	(LMI)	(UMI)
$IG_{i,\,t-1}$	0.752***	0.35	0.40	0.45
	(0.045)	(0.08)	(0.10)	(0.11)
	0.000	0.001	0.001	0.001
DEI	0.0013***	0.12***	0.18***	0.25**
	(0.0007)	(0.05)	(0.06)	(0.08)
	0.021	0.015	0.010	0.005
IQI	0.0020**	0.20	0.25	0.30
	(0.0008)	(0.06)	(0.07)	(0.09)
	0.075	0.005	0.003	0.002
GCF	0.0035**	0.08	0.12	0.15**
	(0.0021)	(0.04)	(0.05)	(0.06)
	0.124	0.050	0.040	0.030
FDI	0.0018	0.05	0.07	0.10***
	(0.0012)	(0.02)	(0.03)	(0.04)
	0.118	0.080	0.050	0.020
ODA	0.0010	0.01**	0.02	0.03
	(0.0020)	(0.02)	(0.02)	(0.02)
	0.200	0.200	0.140	0.090
Constant	-0.054	-0.085	-0.048	-0.023**
	(0.058)	(0.070)	(0.062)	(0.074)
	0.089	0.075	0.100	0.200
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
AR3 (p-value)	0.323	0.278	0.349	0.256
Wald chi2	23456.78	7851.25	14124.67	8231.44
Chi2 (p-value)	0.0000	0.0000	0.0000	0.0000

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Sources: Heritage Foundation (2023); International Country Risk Guide (2023); World Bank. (2023). World Development Indicators

The digital economy has a coefficient of 0.0013 across all countries, with a p-value of 0.021, showing a positive and significant effect on inclusive growth. The coefficients for LI nations are 0.12 (p-value 0.015), LMI countries are 0.18 (p-value 0.010), and UMI countries are 0.25 (p-value 0.005). These findings agree with those of Olofin (2023), Adeleye, Arogundade, and Mduduzi (2023), and Kouladoum (2023), Mgadmi, et al. (2021). These findings indicate that the digital economy plays an important role in supporting inclusive growth, with a greater influence in UMI categories. The consequence is that investments in digital infrastructure and digital economy efforts have a greater impact on inclusive growth in these economies such as Gabon, South Africa, Libya, Namibia, and Botswana, while being advantageous at all income levels. For policymakers, this emphasizes the need of prioritizing digital economy growth as

a strategy of increasing economic inclusion, particularly in higher-income countries where the rewards are greater.

Institutional quality has a coefficient of 0.0020 across all nations, with a p-value of 0.075, showing a positive but insignificant effect on inclusive growth. This suggests that a unit improvement in institutional quality will result in a 0.2% increase in inclusive growth in Africa. These results support the findings of Kumeka, Raifu, and Adeniyi (2023), Munir, Ambreen, and Iftikhar (2022), Kamah, Riti, and Bin (2021), and Abukakar (2020). Nevertheless, the impacts were shown to be significant across all income ranges when broken down by income category. A coefficient of 0.20 (p-value 0.005) is found in LI countries, such as Ethiopia, Malawi, Gambia, Madagascar, and Mozambique; a coefficient of 0.25 (p-value 0.003) is found in LMI countries, such as Algeria, Angola, Kenya, Nigeria, and Cameroon; and a coefficient of 0.30 (p-value 0.002) is found in UMI countries, such as Gabon, Botswana, South Africa, Libya, and Namibia. This suggests that inclusive growth is greatly enhanced by institutional quality, with UMI nations witnessing the greatest benefit. Robust institutions play a crucial role in advancing inclusive growth, and their impact is particularly noticeable in UMI nations. It follows that improving institutional quality is essential for promoting inclusive growth, particularly in LI and LMI nations where institutions require strengthening.

GCF has a coefficient of 0.0035 for all countries, with a p-value of 0.124, suggesting a weak and statistically insignificant effect on inclusive growth. In LI countries, the coefficient is 0.08 (p-value 0.050), in LMI countries, it is 0.12 (p-value 0.040), and in UMI countries, it is 0.15 (p-value 0.030). The findings indicate that while capital formation has a positive impact, it is relatively weak across all income categories, but more significant in higher-income countries like Botswana, Libya and South Africa. This reflects that while investment in capital is beneficial for growth, its impact on inclusivity is limited. For policymakers, this suggests that capital formation alone may not be sufficient to drive inclusive growth, and complementary measures are needed. In a similar vein, FDI exhibits a small and statistically insignificant effect across all nations, with a coefficient of 0.0018 and a p-value of 0.118. The coefficient is 0.05 (p-value 0.080) for LI nations, 0.07 (p-value 0.050) for LMI countries, and 0.10 (p-value 0.020) for UMI countries. This suggests that FDI affects growth less generally and more prominently in nations with greater incomes. It follows that although FDI boosts GDP, its impact on inclusive growth is inadequate and varies according to income level. Strategies to attract and leverage FDI should be tailored to specific income contexts to maximize their impact on inclusive growth.

Additionally, for all countries, ODA has a coefficient of 0.0010 with a p-value of 0.200, suggesting a modest and insignificant effect on inclusive growth. The coefficient is 0.01 (p-value 0.200) for LI nations, 0.02 (p-value 0.140) for LMI countries, and 0.03 (p-value 0.090) for UMI countries. This indicates that ODA has a moderate influence on growth, with higher-income nations seeing a somewhat more significant effect. It follows that although ODA can promote inclusive growth, its impact is minimal and other national and international initiatives should be used in addition.

The findings of this research confirmed previous theoretical works like Schumpeter, 1911; Solo-Swan, 1956; Romer 1990; etc. which argued that the digital economy and strong institutions should promote inclusive growth by accelerating the adoption and development

of innovation processes and, as a consequence, fostering competition that leads to the creation of new merchandise, processes, and business models. Additionally, these findings are consistent with the majority of previous empirical research demonstrating the positive effect of the digital economy and quality institutions on inclusive growth in the selected African countries. This suggests that inclusive growth can be supported by a strong digital economy, particularly when it is backed by reliable institutions (Adeleye, Arogundade, & Mduduzi 2023; Olofin, 2023; Kouladoum, 2023; Mgadmi, et al. (2021); Solomon & Van Klyton, 2020).

The model specifications are strong and the instruments utilized in the SGMM estimation are valid, as shown by the Hansen test p-values for all income categories being greater than 0.05. There appears to be first-order autocorrelation based on the AR1 test p-values being less than 0.05. The AR2 and AR3 tests validate the dependability of the regression findings, which do not reveal any second- or third-order autocorrelation. Strengthening the robustness of the findings, the Wald chi-squared tests show that the models are statistically significant. This adds more evidence to the dependability of the data by confirming that the techniques are suitable and that the SGMM model is appropriately stated.

5. Conclusion and Recommendations

The analysis of the digital economy, institutional quality, and inclusive growth in selected African nations sheds light on the relationships between these factors across income levels. The findings show that inclusive growth is driven by a mix of past economic performance, digital infrastructure development, institutional quality, and other economic factors like capital formation, foreign direct investment, and official development assistance. While these associations exist across all income groups, their strength and relevance vary according to the countries' income levels. The findings revealed that the digital economy drives inclusive growth across all income categories, particularly in upper middle-income (UMI) countries. Access to technology and digital services creates new opportunities, reduces inequality, and boosts productivity. Therefore, investment in the digital economy, particularly in LI and LMI countries should be emphasize. Also, the study showed that institutional quality is critical for inclusive growth, particularly in high-income nations where stability and progress are prioritized. Promoting an inclusive environment requires strong governance, the rule of law, the protection of property rights, and anti-corruption initiatives. Institutional reforms are less prominent in low-income nations, implying that capacity building and economic diversification are required for a more transformative effect. Overall, institutional quality contributes significantly to inclusive growth.

Three main recommendations, each specific to the income categories can be made in light of the analysis's findings; first, the analysis shows that, while digital economy development and institutional quality have a favourable effect on inclusive growth in lower-income (LI) nations, their benefits are less significant than in higher-income countries. To achieve inclusive growth, LI countries should prioritize basic investments in digital infrastructure, such as internet penetration, broadband technology, and mobile connection, as well as work on institutional reforms that create an institutional environment that promotes digital innovation and adoption across industries. Similarly, for lower middle-income (LMI) countries to leverage on the digital economy to drive inclusive growth, they need to strengthen their institutional structures and governance systems. This can support effective governance,

the rule of law, and minimize corruption, increasing the effectiveness of digital initiatives and attracting more foreign direct investment (FDI). Therefore, institutional reforms should prioritize contract enforcement, accountability, and public service delivery in order to disperse benefits more evenly. Finally, the Upper Middle Income (UMI) countries is to use advanced digital technologies and develop innovation ecosystems. This includes building an atmosphere conducive to high-tech industries, research, development, and entrepreneurship, as well as fostering an innovative culture. Furthermore, UMI countries should enhance institutional quality by decreasing bureaucratic inefficiencies and ensuring that legal frameworks promote innovation and investment.

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Appendix

Appendix 1: Description of Institutional Quality Variables

Indicator	Meaning	Scale	Source/Date
Property Rights	Legal ownership of resources secured by law and enforced by the state.	0 – 100	Heritage Foundations (2023)
Risk of Expropriation	The possibility of the government forcibly acquiring privately owned property without adequate compensation.	0 -10	ICRG (2023)
Corruption	Dishonest or fraudulent conduct by those in power typically involving bribery	0 – 6	ICRG (2023)
Rule of Law	The restriction of the arbitrary exercise of	0 - 6	ICRG (2023)
Bureaucratic	Power by subordinating it to well defined and established laws.		
Quality	The neutrality with which public servants implement laws, policies, and programs.	0 – 6	ICRG (2023)

Note: *Higher values indicate better quality and vice-versa.*

Appendix 2: Inclusive Growth Indicators and Dimensions

Dimensions	Indicators use for this study
1. Economic Growth.	i. Rate of growth of GDP per capita
2. Reduction in Poverty Rate (vertical and horizontal)	i. Proportion of population living above $1.25 per day ii. Proportion of population living above $2.00 per day
3. Economic Inequalities	i. GINI index ii. Income share of the poorest 20% of the population. iii. Income share of the poorest 60% of the population.

Source: World Bank Development Indicators, (2022).

Appendix 3: Digital Economy Development Index

Categories	Name of Indicator	Meaning	Scale Value
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

Categories	Name of Indicator	Meaning	Scale Value
	ii. ICT Product Exports (% of total product exp)	Openness of Digital Economy, International Competitiveness of Technology.	0 – 36.5
Digital Technology	i. Enrollment in higher education institutions (% of total pop.)	Abundance of Digital Professionals	6.7–148.9
Innovative Environment and Competitiveness.	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 Bank Data Base, (2023).