DIGITALIZATION OF THE ECONOMY AND ECONOMIC GROWTH

Abstract

This study analyses the association between digitalization and economic growth in developing Africa, with particular emphasis on Nigeria from 2007 to 2020. This analysis applies a covariance analysis to understand the correlation between economic growth and key facets of digitization, namely, ICT goods exports, ICT service exports, fixed broadband subscriptions, and mobile cellular subscriptions. The main findings of this study indicate that ICT goods exports, ICT service exports, and mobile cellular subscriptions have a statistically significant correlation with GDP per capita growth. The results further revealed that ICT services exports are actually 281 times higher than ICT goods exports in Nigeria, which suggests a possible comparative advantage for the former over the latter. This is an indication of the investment gap in digital technology infrastructure in Nigeria, albeit the abundance of bourgeoning digital skills among the vast active population. The policy implications of this research are also discussed.

1. INTRODUCTION

It's a well-known fact that we are currently living in a time of exciting technological innovations. Digital technologies are driving transformative change. Economic paradigms are shifting. The new technologies are reshaping product and factor markets and profoundly altering business and work. The latest advances in artificial intelligence and related innovations are expanding the frontiers of the digital revolution. It is clear that economic activities are getting smarter and faster and the world now trades in digital goods and services. We could see how critical and large transactions are conducted on the Internet through different platforms, which is seen as virtualization and globalization of economic activities.

It is quite evident that as the digital technology evolves, the modern economy is being transformed by innovative technologies such as Artificial Intelligence (AI), Internet of Things, Blockchain, Augmented Reality, Virtual Reality, Mobile, Big Data, Machine Learning, Robots, Unmanned Aerial Vehicles aka Drones, Cloud Computing, Fintech and others. All these technologies are, separately or in junction with others, paving way for improved productivity and business innovation, which in turn are leading to increased employment opportunities, creation of wealth, and formation of greater value and growth in the economy. This can also be seen in governance where nations are enabled with technologies that help them analyze public policies and improve transparency in governance by delivering better public services to citizens more efficiently.

Digital transformation is accelerating in the wake of the COVID-19 pandemic, which means that the future is arriving faster than expected. The digital economy offers a plethora of growth opportunities, utilizing the Internet as the engine room for industry and in the very near future for society. Driven by hyper-connectivity, the digital economy is reshaping businesses, interpersonal interactions, health, transportation and education to mention but a few. The digital economy is made up of various components, including a platform economy, a gig economy, an

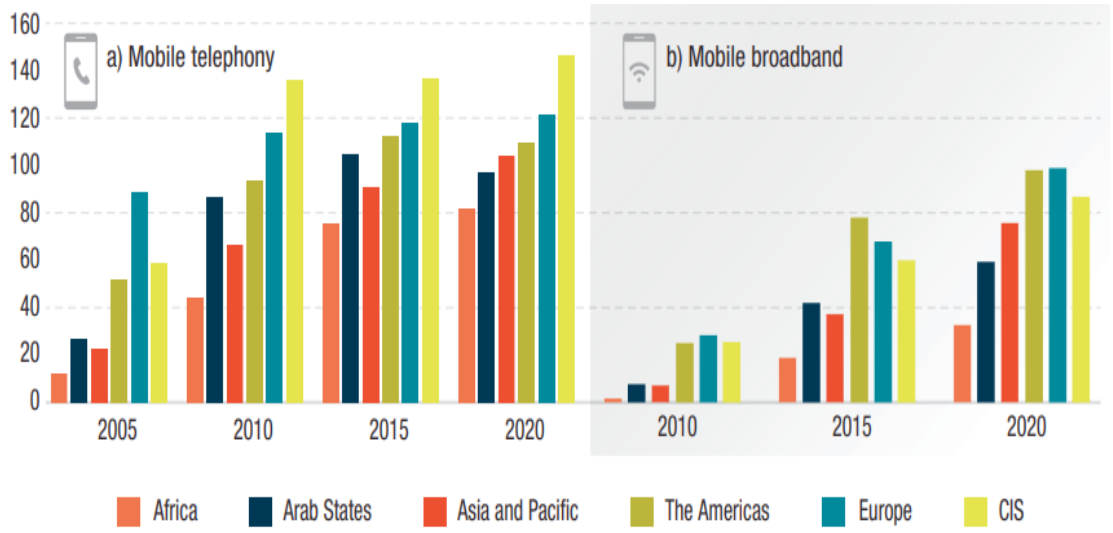
industry 4.0, a digital economy, data analytics, robotics and Artificial Intelligence (AI), machine learning, 3-D printing, and e-commerce among others. (Ernst & Young: Nigeria, 2018).

Information and communication technology, which is defined as "any communication device or application, including radio, television, mobile phones, computers, network hardware and software, satellite systems, and any associated applications," enables digitalisation. Digital technology has transformed how businesses operate globally, from e-commerce to business process outsourcing (Lacity et al., 2016; Liu & Aron, 2014). Furthermore, it has transformed how people communicate (via social media) as well as how governments interact with citizens via e-government platforms (Zhao et al., 2015). The consequences of successful digital technology implementation are significant (ACLEC, 2022; Tong & Wohlmuth, 2021). Technological advances have fundamentally altered the structure of our markets and economies over the past decade, promising significant increases in productivity and economic growth. Established technologies like the internet and smartphones, as well as emerging technologies like cloud computing and social media, are constantly pushing the boundaries of our "old economy," redefining businesses, jobs, and how we interact with them (Qu, Simes, and O'Mahony, 2016). Digital technologies are being used more and more around the world as general-purpose tools. This has led to claims that it will increase the spread of knowledge by making communication more efficient, make it easier for consumers to get involved, and let countries skip the traditional ways of increasing productivity (Jurayevich & Bulturbayevich, 2020; Jiao & Sun, 2021).

Customers are increasingly being offered more products and services via digital channels for their convenience, while traditional modes of sales are declining. Manufacturing, inventory, and sales management can all be managed more efficiently with automation (Mentsiev et al. 2020; Raeskyesa & Lukas, 2019). Data collection, storage, and processing assist businesses in generating analytical insights for decision-making and steering the company in the right direction for success (Solomon & Klyton; Tiutiunyk et al., 2021; Ahmedov, 2020). There are numerous reasons for any business to strongly consider digitalization at all levels (UNCTAD, 2021). Furthermore, a number of digital technology players have emerged in the digital economy to meet the digitalization needs of end-users as well as industries (Mentsiev, 2020; Arsakaev & Khatsieva, 2021). According to El-Darwiche et al. (2013), global business digital activity is growing by the day, having a significant impact on the economy, including GDP per capita, employment, labour productivity, and so on. As a result, determining the economic impact of digital technologies and industries is essential for the government to track investments, quantify success, and draught policies and regulations.

1.1 Contextual Analyses of Digitalization Channels

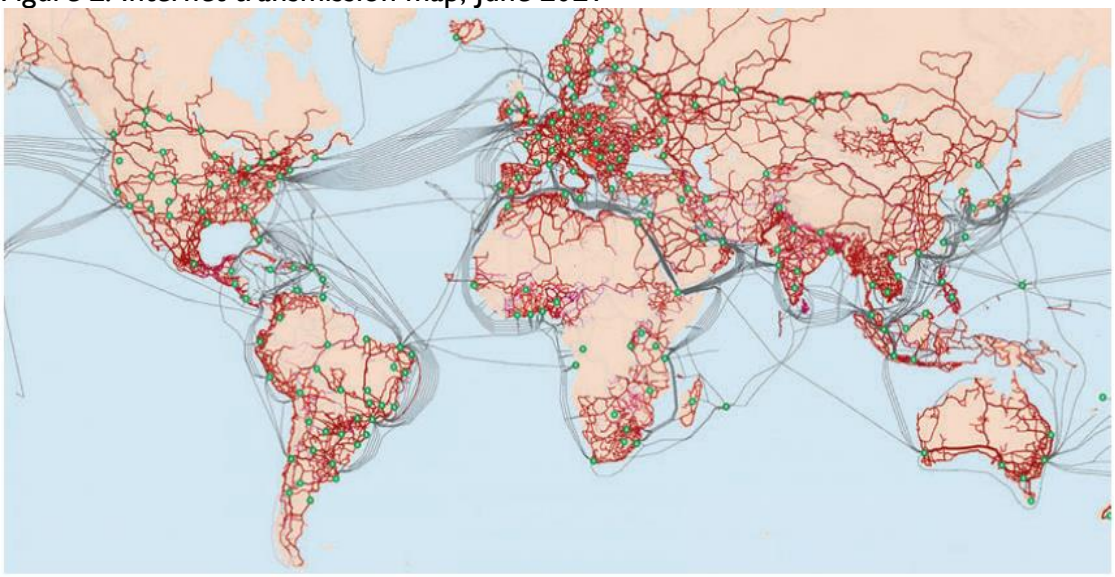
Figure 1. Mobile telephony and broadband subscriptions, by region, selected years (Per 100 people)



Source: UNCTAD, based on ITU Statistics database.

In the last 15 years, fixed telephony has declined in both developed and developing economies, but it has never really increased in the least developed countries (LDCs) (UNCTAD, 2019). The penetration rate of fixed broadband subscriptions has increased in both developed and developing economies. During the period 2005–2020, the average number of these subscriptions per 100 people in LDCs was virtually zero, as these nations leapfrogged to more efficient and accessible mobile connectivity (UNCTAD, 2019). Even though mobile telephony penetration rates in developed countries were still higher in 2020 than in developing countries, especially LDCs, the latter group experienced greater growth during this period, which helped to close the gap. As shown in Figure 1, transition economies had the highest rate of mobile telephone subscriptions in 2020, followed by Europe and the Americas. Asia and the Pacific, the Arab States, and Africa exhibited the lowest penetration rates. However, the latter regions, which contain the greatest number of developing countries and LDCs, experienced the most dramatic growth from 2005 to 2020. Africa, Asia and the Pacific, and the Arab States saw the greatest increase in mobile broadband subscriptions, as they all began at very low levels in 2010. In Africa, mobile broadband penetration in 2020 was almost twenty times higher than in 2010. Even though this has helped developing countries catch up to more developed countries, there is still a big gap when it comes to mobile broadband.

Figure 2. Internet transmission map, June 2021

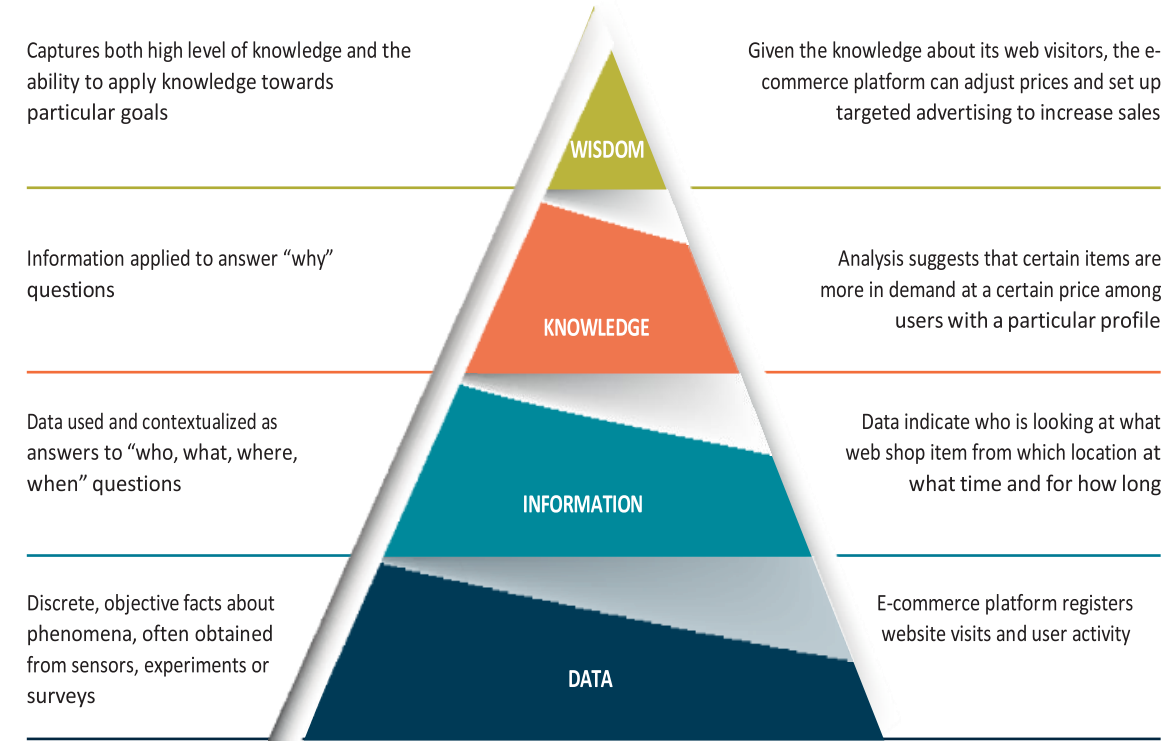


Source: UNCTAD, based on ITU Interactive Terrestrial Transmission Map

Regarding cross border routes, the map in Figure 2 reveals that the northern transatlantic route and the transpacific routes, between the United States and Europe and Asia, respectively, have the highest submarine cable network density. The map also shows that Europe, East Asia, and South Asia have the highest concentration of interregional connections. Africa and Latin America have fewer connections between continents and between regions, so large parts of these areas are still not served.

1.2 Recent Trends in the Digital Economy Driven by Data

Figure 3. The data pyramid



Source: UNCTAD, based on United States Chamber of Commerce Foundation (2014)

"Data products" are what you get when you turn raw data into digital intelligence in the form of statistics, databases, insights, information, etc. Figure 3 shows a pyramid with three levels: information, knowledge, and wisdom. They could be thought of as services, so their cross-border flows (when they are paid for) are tracked by trade statistics and laws. But the main thing that drives the development of data-related technologies and the growth of trade in new data products and services is the processing of raw data. So, it is likely that the growth of cross-border data flows will require changes to the rules for trade in services (UNCTAD, 2021).

Table 1. Internet activities undertaken by individuals, by level of development and region (Per cent)

Internet activity	Developed economies	Transition economies	Developing economies - Africa	Developing economies - Asia	Developing economies - Latin America and the Caribbean
Internet banking	62.3	14.9	9.8	34.8	11.6
Sending or receiving email	84.9	44.8	46.6	59.7	52.4
Making calls (telephoning over the Internet/Voice over Internet Protocol. using Skype. iTalk. etc.)	56.9	71.0	47.6	63.2	73.4
Reading or downloading online newspapers or magazines. electronic books	76.4	41.5	38.6	46.0	30.3
Getting information about goods or services	83.9	50.9	30.6	68.0	51.8
Getting information from general government organizations	55.1	11.1	17.6	20.9	23.2
Interacting with general government organizations	54.5	5.7	12.1	25.6	10.7
Purchasing or ordering goods or services	53.9	18.2	14.6	29.1	13.1
Seeking health information (on injury. disease. nutrition. etc.)	62.4	37.5	24.3	47.1	41.1
Making an appointment with a health practitioner via a website	16.4	3.9	4.0	7.6	3.1
Participating in social networks	70.4	70.7	86.3	87.2	79.0
Accessing or posting opinions on chat sites. blogs. newsgroups or online discussions	13.9	11.6	45.1	26.5	26.0
Selling goods or services	16.8	7.0	3.5	6.4	9.3
Using services related to travel or travel-related accommodation	55.0	5.7	7.5	25.2	28.4
Doing a formal online course	8.1	4.5	17.5	15.9	28.5
Consulting wikis. online encyclopedias or other websites for formal learning purposes	23.8	14.6	17.2	13.2	31.4
Listening to web radio	61.2	17.0	13.3	20.9	11.2
Watching web television	41.1	8.8	30.2	33.1	18.1
Streaming or downloading images. movies. videos or music. playing or downloading games	57.4	52.9	64.2	66.4	50.8
Downloading software or applications	19.0	5.5	62.8	41.0	20.7
Looking for a job or sending/submitting a job application	17.4	9.8	14.3	19.9	16.6
Participating in professional networks	21.0	3.6	5.9	6.4	0.7
Uploading self/user-created content to a website to be shared	38.8	33.4	12.7	21.3	35.6
Taking part in online consultations or voting to define civic or political issues	9.8	3.5	5.5	8.1	N/A
Using storage space on the Internet to save documents. pictures. music. video or other files	38.7	15.0	17.5	20.8	21.7
Using software run over the Internet for editing text documents. spreadsheets or presentations	28.0	4.3	6.1	11.7	4.8

Source: UNCTAD calculations, based on ITU World Telecommunication/ICT Indicators database.

Table 1 depicts some of the activities that people engage in while using the Internet. For example, use of Internet banking is much higher in developed economies than in transition and developing economies, though Asia leads by far among these. This is also true when buying or ordering goods or services. Social media participation is high across all regions studied, and it is higher in developing economies than in developed and transition economies.

Table 2. B2C E-commerce Index, by region, 2020

Groups, by region and level of development	Share of individuals using the Internet (2019 or latest)	Share of individuals with a bank account (15+, 2017)	Secure Internet servers (normalized, 2019)	UPU postal reliability score (2019 or latest)	2020 Index value	2019 Index value (2018 data)
Africa	30	40	28	21	30	31
East, South and Southeast Asia	57	60	54	58	57	58
Latin America and the Caribbean	64	53	50	29	49	48
Western Asia	77	58	45	50	58	59
Transition economies	71	58	60	59	62	63
Developed economies	88	93	84	80	86	87
World	60	60	53	47	55	55

Source: UNCTAD (2021c).

The UNCTAD recently developed business-to-consumer (B2C) E-commerce Index, which is an average of four indicators, highlights the differences between countries (UNCTAD, 2021). The regional values of the 2020 index are shown in Table 2. The relative strengths and weaknesses vary in general. Internet use is the only metric in East, South, and South-East Asia that is below the global average. Postal dependability provides the most room for growth in Latin America and the Caribbean. African nations would benefit from catching up in all index categories to facilitate more inclusive e-commerce (UNCTAD, 2021).

2. REVIEW OF LITERATURE

2.1 Empirical Literature on Digitization and Economic growth

The rise of digitization as a key socioeconomic driver and enabler is a relatively recent phenomenon. In recent years, one of the most important economic drivers that has emerged as a key accelerator of growth and a facilitator of job creation is the widespread adoption of connected digital services by consumers, businesses, and governments (Zhang et al. 2022). However, digitally constrained economies receive the least benefit, primarily because they have not yet established an ICT ecosystem that can capitalize on the benefits of digitization. This is

one of the main reasons why digitally constrained economies receive the least benefit. In the context of the current stagnant state of the global economy, the role that digitization can play in assisting policymakers to stimulate economic growth and employment is of critical importance (Sabbagh et al. 2013).

World Bank studies can be a good starting point for an investigation into the uncertain or inconclusive impact that digital technology may have on an economy's expansion (Chiemeke & Imafidor, 2020). In an earlier report titled "Economic Impacts of Broadband," published in 2009, the World Bank proposed that broadband connectivity had a positive impact on economic growth. This report is regarded as a seminal study and has been widely cited in the academic literature. On the other hand, the World Bank recently admitted that the Internet does not have the same positive impact on development wherever it is used and for whomever it is used. In its flagship publication by Deichmann and Mishra (2016), the World Bank acknowledged that the impact of information and communications technology (ICT) varies geographically, resulting in divides between "digital haves and have-nots." Even more subtly, the World Bank's (2009) methodology is shown to be flawed by this report, which maintains that cross-country regressions are not appropriate tools for drawing conclusions about the impact of ICT on economic growth (Deichmann and Mishra, 2016).

The conventional and neoclassical view of information and communications technology holds that falling ICT prices contribute to increased economic growth through capital deepening (that is, investment in ICT) (van Ark et al., 2008). The alternative viewpoint holds that information and communications technology fosters innovation (Cardona et al., 2013; Paunov and Rollo, 2016; Stiroh, 2002). The influence of information and communications technology on the expansion of the economy has been the subject of investigation in a number of studies. Chowdhury (2006) found that ICTs create a web of network externalities that makes it easier for firms, suppliers, and consumers to share information (like prices) within or between sectors. He did this by looking at survey data that was collected at the firm level in Kenya and Tanzania between November 1999 and May 2000. However, it was found that investments in information and communications technologies (ICT) had a negative effect on the amount of work that could be accomplished by employees in small and medium-sized businesses (SMEs). The reason for this was the lag effect that exists between the utilisation of ICT and increases in productivity. Another explanation for this negative relationship was that usage requires a skilled labour force in addition to a learning curve to integrate new technology. This learning curve can result in a potential mismatch between the skills and the technology.

A growing number of studies in developing countries contend that ICT adoption and investment have a positive and significant impact on the growth of these economies. Adeleye and Eboagu (2019) examined the impact of ICT on economic growth in 54 African countries from 2005 to 2015, using the internet, mobile subscribers, and fixed telephone subscribers as ICT variables. Andrianaivo and Kpodar (2011) established, using a wide range of ICT indicators, that ICT contributed significantly to the output of African economies from 1988 to 2007. Lee, Levendis, and Gutierrez (2012) investigated the impact of investments in telecommunication infrastructure such as fixed landline telephony and mobile phones in the Sub-Saharan Africa (SSA) region.

Furthermore, Bahrini and Qaffas (2019) used a panel Generalized Method of Moment (GMM) growth model to examine the impact of information and communications technology (ICT) on economic growth in developing countries in the Middle East and North Africa (MENA) and Sub-Saharan Africa (SSA) regions between 2007 and 2016. Their study spanned the years 2007 to 2016. They concluded that the availability of mobile phones benefits economic growth. However, mobile phones have a much greater and more significant impact in SSA countries, where they have completely replaced the use of fixed telephone lines. Other factors, such as the percentage of people who use the internet and the number of people who subscribe to fixed broadband services per 100 inhabitants, have a positive and significant effect on economic expansion.

2.2 Theoretical Underpinning

The assumptions of neoclassical production functions serve as the theoretical foundation for this paper. According to the model, the primary drivers of economic growth are the interactions of labour, capital, and human capital, as well as the productivity or effectiveness with which each of these inputs is deployed in the economy. The model makes simple predictions that can be verified about how the aforementioned important factors influence the constant level of income. Furthermore, the strategy allows us to investigate the factors that influence growth by increasing productivity and efficiency.

Specifically, this paper will examine how a variety of factors, including aspects of digitization such as Mobile cellular subscriptions (per 100 people), Fixed broadband subscriptions (per 100 people), and ICT goods and services exports, may drive economic growth. Hypothetically, and in accordance with Counted and Arawole (2016), we assert that ICT usage contributes to economic growth by enhancing the competitiveness, efficiency, and productivity of businesses. In addition, access to ICTs fosters innovation and provides benefits that extend beyond the telecommunications sector to other economic sectors.

3. ANALYSIS OF DIGITIZATION VARIABLES

The relevant variables were obtained from the World Bank's World Development Indicators for Nigeria between 2007 and 2020. The base year of 2007 was informed by the need to harmonise all the data sets, which are scanty, mostly from 1999 to 2006. As a result, the included observation is 11 years after adjusting for the missing variables within the established period. Given the observed short period, in-depth regression estimates cannot be conducted due to an insufficient number of observations. However, the dataset has been analysed using descriptive statistics and the covariance analysis based on Spearman rank-order.

3.1 Descriptive Statistics of Digitization Variables

Table. 3 Descriptive Statistics

	Mean	Max.	Min.	S.D	Obs.
GDPPC	1.30	5.20	-4.26	3.23	14
ICTGE	0.01	0.02	0.01	0.01	12

ICTSE	2.81	5.77	1.32	1.40	14
FBS	0.04	0.06	0.01	0.02	13
MCS	69.50	99.07	27.60	20.65	14

Note: GDPPC = GDP per capita growth (annual %). ICTGE = ICT goods exports (% of total goods exports). ICTSE = ICT service exports (% of service exports, BoP). FBS = Fixed broadband subscriptions (per 100 people). MCS = Mobile cellular subscriptions (per 100 people).

Table 3 presents a statistical description of selected digitization variables and shows that ICGE and ICSE averaged 0.01% and 2.81%, respectively. This is an indication that ICT services export is actually 281 times higher than ICT goods export in Nigeria, and suggests a possible comparative advantage for ICTSE over ICTGE. FBS and MCS averaged 0.04 and 69.50, respectively. Within the period, GDPPC ranged between -4.26% in 2020 and 5.20% in 2009.

3. Covariance Analysis of Measurable Digitization Facets

Table 4. Covariance Analysis: Spearman rank-order
Sample: 2007 2019
Included observations: 11
Balanced sample (listwise missing value deletion)

Correlation t-Statistic	GDPPC	ICTGE	ICTSE	FBS	MCS
GDPPC	1.				
ICTGE	0.345455 (2.535175)	1.			
ICTSE	-0.400000 (-6.194225)	-0.509091 (-1.774428)	1.		
FBS	0.218182 (0.670704)	-0.109091 (-0.329238)	-0.154545 (-0.469274)	1.	
MCS	-0.336364 (-3.265056)	-0.200000 (-0.612372)	0.827273 (4.417615)	-0.218182 (-0.670704)	1.

Note: GDPPC = GDP per capita growth (annual %). ICTGE = ICT goods exports (% of total goods exports). ICTSE = ICT service exports (% of service exports, BoP). FBS = Fixed broadband subscriptions (per 100 people). MCS = Mobile cellular subscriptions (per 100 people). Values in parenthesis () are t-statistics.

Covariance analysis in Table 4 reveals that both ICTGE and ICTSE are significantly correlated with GDPPC. However, while ICTGE is shown to be directly correlated with GDPPC, ICTSE is

negatively correlated with GDPPC. On the other hand, while MCS is observed to have a statistically significant correlation with the response variable, FBS does not have a significant correlation with GDPPC. Moreover, MSC seems to contribute more to ICTSE compared to FBS, whereas both FBS and MCS have a negative and statistically insignificant correlation with ICTGE.

5. CONCLUDING POLICY IMPLICATION

Nigeria has one of the largest population of young people in the world and is well-positioned to develop a strong digital economy, which would have a transformational impact on the country. Its therefore believed that through innovations and investments, the Nigerian economy can harness digital data and new technologies, generate new content, link individuals with markets and government services, and roll out new and sustainable business models to propel economic growth.

Digitalization presents both opportunities and challenges for developing economies. Countries' levels of development and digital readiness are significant factors that heavily influence the net effects of digital disruption. Policies that are adopted and strictly adhered to have a significant impact on the situation. The foundation of digital infrastructure must be strengthened to broaden access to new opportunities. This calls for increased public investment and frameworks to encourage more private investment to improve digital access for underserved groups and areas. The digital divide remains particularly wide in developing economies. Stronger digital infrastructure and literacy will be crucial for these economies as technological change forces a shift away from growth models reliant on low-skill, low-wage manufacturing.

As digitization becomes more widespread and comprehensive around the world, its importance as a key growth driver and source of national competitive advantage is expected to grow. In the past, policymakers have prioritized expanding the availability of ICT services at more affordable prices, and more recently, they have done so by facilitating and even investing in massive broadband rollouts. Despite its importance, this is only one aspect of the overall story. In the future, policymakers will need to become digital market makers, which means they will need to build a digital economy that gives citizens, businesses, and economic sectors the competitive advantage they need to thrive in an increasingly global market.

References

Adeleye, N., & Eboagu, C. (2019). Evaluation of ICT development and economic growth in Africa. *Netnomics,* 20, 31–53. https://doi.org/10.1007/s11066-019-09131-6.

Ahmedov, I. (2020). The impact of digital economy on international trade. *EJBMR, European Journal of Business and Management Research*, *5*(4), 1–7.

Andrianaivo, M., & Kpodar, K. (2011). ICT, financial inclusion, and growth: Evidence from African countries. Working paper no. 11/73, *International Monetary Fund, IMF Working Paper.*

Arsakaev, I., & Khatsieva, L. (2021). The role of digitalization in the development of socio-economic systems. *SHS Web of Conferences*, *106*(01008), 1–7.

Bahrini, R., & Qaffas, A. A. (2019). Impact of information and communication technology on economic growth: Evidence from developing countries. *Economies*, 7(1), 21. doi: https://doi.org/10.3390/economies7010021.

Chiemeke, S. C., & Imafidor, O. M. (2021). An assessment of the impact of digital technology adoption on economic growth and labour productivity in Nigeria. *NETNOMICS: Economic Research and Electronic Networking*, *21*, 103–128.

Deichmann, U., & Mishra, D. (2016). World development report 2016: Digital dividends. Washington, D.C.: World Bank.

eLAC. (2022). *Digital technologies for a new future*.

El-Darwiche, B., Friedrich, R., Koster, A., & Singh, M. (2013). Digitization for economic growth and job creation. *The Global Information Technology Report 2013*, 1–24.

Jiao, S., & Sun, Q. (2021). Digital economic development and its impact on economic growth in China: Research Based on the Prespective of Sustainability. *Sustainability*, *13*, 1–18.

Jurayevich, M. B., & Bulturbayevich, M. B. (2020). The impact of the digital economy on economic growth. *International Journal of Business, Law, and Education*, *01*(01), 4–7.

Lee, H., Levendis, J., & Gutierrez, L. (2012). Telecommunications and economic growth: an empirical analysis of sub-Saharan Africa. *Applied Economics*, 44, 461–469. https://doi.org/10.1080/00036846. 2010.508730.

Maeyen, E., & Klyton, A. Van. (2020). The impact of digital technology usage on economic growth in Africa. *Utilities Policy*, *67*(July), 101104. https://doi.org/10.1016/j.jup.2020.101104

Mentsiev, A. U., Engel, M. V, Tsamaev, A. M., Abubakarov, M. V, & Yushaeva, R. S.-E. (2020). The Concept of Digitalization and Its Impact on the Modern Economy. *Advances in Economics, Business and Management Research*, *128*, 2960–2964.

Qu, J., Simes, R., & Mahony, J. O. (2016). How Do Digital Technologies Drive Economic Growth? *Research Outline*, (March), 1–9.

Raeskyesa, D. G. S., & Lukas, E. N. (2019). Does digitalization increase economic growth? Evidence from ASEAN8 Countries. *Jurnal Ekonomi Indonesia*, *8*(2), 267–278.

Solomon, E. M., & Klyton, A. van. (2020). The impact of digital technology usage on economic growth in Africa. *Utilities Policy*, *67*, 1–13.

Tiutiunyk, I., Drabek, J., Antoniuk, N., Navickas, V., & Rubanov, P. (2021). The impact of digital transformation on macroeconomic stability: Evidence from EU countries. *Journal of International Studies*, *14*(4), 220–234. https://doi.org/10.14254/2071-220

UNCTAD. (2019). *Digital Economy Report Economy Report 2019*.

UNCTAD. (2021). *Digital Economy Report 2021: Cross-border data flows and development: For whom the data flow*.

Zhang, J., Zhao, W., Cheng, B., Li, A., Wang, Y., Yang, N., & Tian, Y. (2022). The Impact of Digital Economy on the Economic Growth and the Development Strategies in the post-COVID-19 Era: Evidence from Countries Along the "Belt and Road" Jinzhu. *Front. Public Health*, *10*, 1–17. https://doi.org/10.3389/fpubh.2022.856142