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Nexus between Digital Economy, Productivity and Growth: Evidence from Nigeria

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A B S T R A C T

This study investigated the role of the digital economy on the growth of the Nigerian economy. Quarterly data on the two indicators of the digital economy which include internet penetration and ICT and some other control variables were analyzed using the Autoregressive Distributed Lag Model (ARDL). In addition to that, the Bound test is employed to determine the long-run relationship among the variables. The findings showed that the digital economy indicators are negatively impacting the growth of GDP and productivity in Nigeria. The unfavorable result can be attributed to the dominance of the government in the ICT sector. Before the 2001 liberalization agenda, the sector was entirely owned and managed by the Nigerian Government through the Nigerian Telecommunications Limited (NITEL).

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INTRODUCTION

Advances in information and communication technology (ICT), coupled with sophistication in digital technology, have significantly improved macroeconomic performance and accelerated economic growth. ICT is the backbone of the digital economy revolution. Countries that lag in ICT are no longer competitive in the global economic landscape. That is why many developing nations map out policies and strategies to kick-start start digital economic sector. Nigeria is not left behind in the race for investment in the ICT industry.

Nigeria's Federal Ministry of Communications and Digital Economy (FMCDE) oversees the digital economy. In 2019, the Federal Government introduced a new policy "National Digital Economy Policy and Strategy (2020-2030)" to create employment opportunities and diversify the economic base by downsizing the oil economy. The policy document is built on 8 pillars which include, 1) directing digital development; 2) upscaling a digitally literate and skillful society; 3) providing solid infrastructure; 4) promoting service infrastructure; 5) fast-tracking digital services; 6) fostering soft skills; 7) facilitating digital society and emerging technologies; and 8) increasing local content in the value chain (FMCDE, 2019).

The study has significant contributions in looking at the complexity of the Nigerian economy. First, Nigeria has low technological advancement compared to its peer African economies such as South Africa, Kenya, and Egypt whose level of ICT adoption and investment surpassed Nigeria's experience. Second, Nigeria has weak institutions despite huge public investment in ICT to empower private firms, increase ICT adoption, and make public service more efficient. Hence, improving institutional quality through the digital economy can enhance the capability of the existing public institutions by making them more transparent. Third, Nigeria is a resource-dependent economy, a net export of primary commodities, and import import-dependent economy. Volatility in the oil market can distort the revenue base of the country; however, strategic investment policy in the digital economy will diversify the economy and make the government more fiscally resilient.

In light of the above, the research establishes the digital economy–productivity nexus in Nigeria. The paper is structured into four sections. Section two reviews empirical works, section three provides the methodological framework, section four entails results and discussion, and section five concludes and proffers recommendations.

LITERATURE REVIEW

Stylized Facts on the ICT Sector

At the dawn of the millennium, Jorgenson and Stiroh (2000) argued that productivity, accumulation of capital, and the effects of technology were confined to academic discourse; but the scope expanded to the public sphere as a result of the economic success of the United States. They observed that a continuous rise in workers' productive capacity has been a primary concern for forecasting future growth. However, differences in accumulated capital, increased labor quality, and total factor productivity may not be important,

when growth in average labor productivity was anticipated to sustain. In essence, sustained increases in worker productivity were what eventually spurred long-term economic performance and boosted economic prosperity.

In the Nigerian context, the agenda for the ICT revolution began in August 2001 when MTN Nigeria, a private telecom company, started operating and competing with a state-owned telecom company Nigerian Telecommunications (NITEL). The data extracted from the Statistical Bulletin (Central Bank of Nigeria, 2022) show the contribution of ICT to both the service sector and the overall real GDP. Figure 1 shows the trends in ICT, services, and GDP between 2001 and 2021.

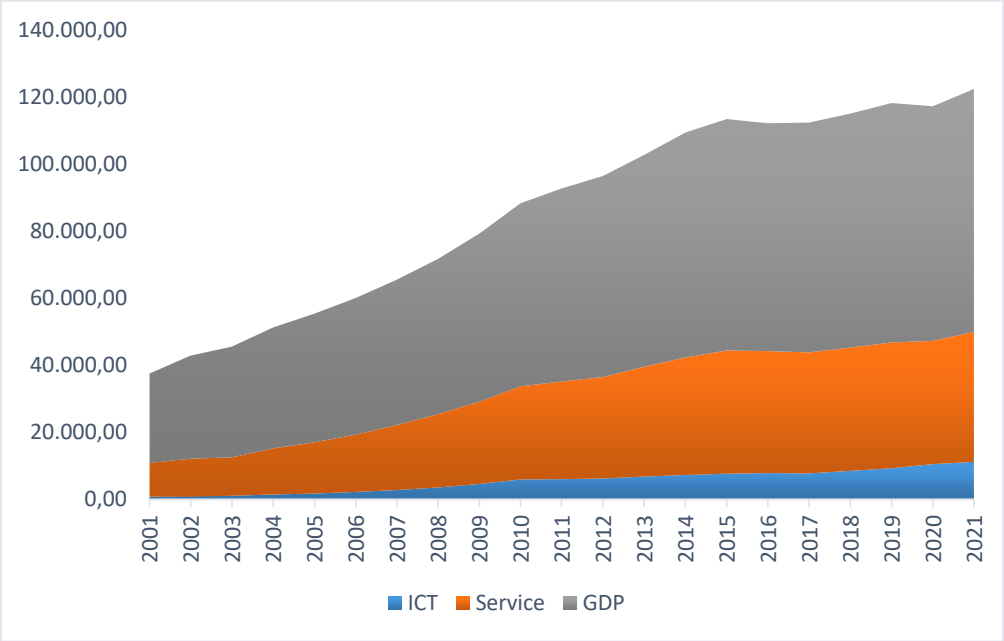

Figure 1: Value of ICT, Services and GDP

In Figure 1, ICT contributes very negligible to both services and GDP between 2001 and 2006. However, with the implementation of government policies to boost the ICT industry, the contribution of ICT was monumental beginning from 2010 were it contributed nearly 6 trillion naira compared to 1 trillion naira in 2003. In 2020 and 2021, the size of ICT in the total economic output (GDP) exceeded 10 trillion naira implying a dramatic change in the role of ICT in the Nigerian economy.

As already explained, ICT is under the service sector in Nigeria's GDP classification, while services are one of the major components of the GDP. The ratio of ICT to service and ICT to GDP ratio have been increasing particularly after deregulating the telecommunication industry. The trends are presented in Figure 2.

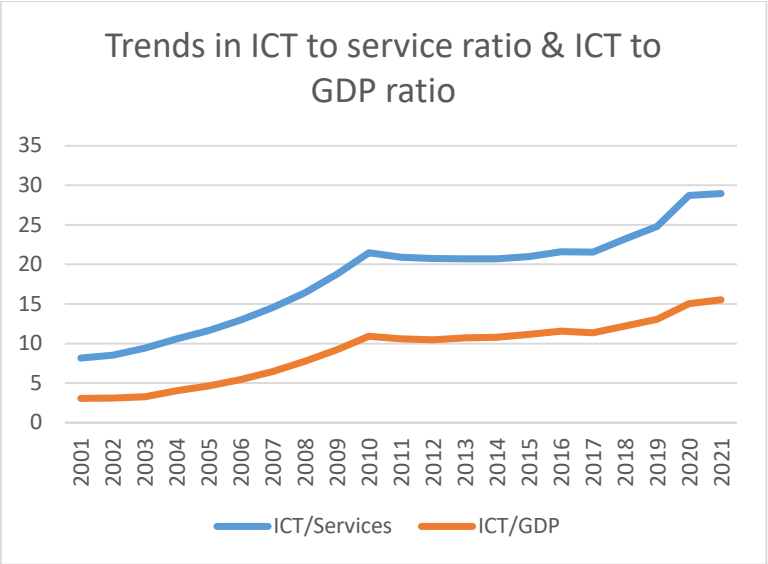

Figure 2: Contribution of ICT to services and GDP

As shown in Figure 2, the trends in ICT ratios rose steadily between 2001 and 2009, contributing less than 20% of the services sector and below 10% of GDP. The trend reached a peak in 2010 where the ICT exceeded 10% of GDP and 20% of the services sector; however, the trend remained relatively stable up to 2017. Beginning in 2018, the ICT experienced an unprecedented increase where it accounted for nearly 30% of the service sector and more than 15% of GDP in 2021. Following the implementation of the digital economy policy in 2019, the ratios ICT to service and GDP rose by 4 and 2 percentage points respectively between 2019 and 2020. This growth rate has never been experienced in the history of Nigeria's ICT sector which means the digital economy policy has been very effective in boosting confidence in the ICT industry.

Empirical Review

This section reviewed the extant theoretical and empirical studies on ICT and economic interconnections. Many empirical researches (e.g. Heshmati & Yang, 2006; Khuong, 2016; Kuppusamy, *et al.* 2009; Nasab & Aghaei, 2009; Sawng, *et al.* 2021) have established the organic role of ICT investment in influencing economic performance. However, Ishida (2015) and Seo, *et al.* (2009) revealed ICT investment was not as much influential in driving growth.

From a theoretical view, Avgerou (2003) contended that a big gap between developed and developing economies has a connection with low investment in ICT infrastructure in the latter. While the former invested heavily in ICT infrastructure and reaped the benefits of economic growth and structural change, the latter lagged leading to the widening economic gaps between the two.

In the empirics, Gomes, et al. (2022) assessed the interconnection between ICT and growth in OECD countries by applying the GMM panel model. They established that the digital economy promotes growth in the 36 OECD economies. Sawng, et al. (2021) used VECM to check the interdependence between ICT and growth in South Korea from 1999-2016. They

documented the short-run uni-directional causal effect running from ICT investment to economic growth, while in the long run, both ICT and growth were interdependent i.e. they have bi-directional causality. Similarly, (Latif et al., 2018) assessed the ICT-growth interlinkage in the BRICS member countries. The findings suggest that long-run elasticities exist between ICT and growth, which implies that ICT contributes positively towards sustainable growth in the BRICS countries. Another study by Albiman and Sulong (2016) focused on the role of ICT in fostering economic prosperity in Sub-Saharan Africa (SSA). The study used fixed telephone lines, mobile phone users, and internet users per 1000 inhabitants as the proxy of the digital economy. The result indicates that the internet and mobile phones positively influenced economic growth. A related study (Adeleye & Eboagu, 2019) explored the impact of ICT in driving the growth of Africa. The result indicated that ICT promotes growth.

(Ngozi et al.,) recorded the same result in their study of how ICT adoption influenced trade and economy in 54 African countries. The study used pooled OLS and difference GMM models and the outcome shows that trade is a positive and significant determinant of growth in these countries and that ICT adoption varies across the sub-regions. Similarly, the impact of ICT on poverty reduction and the growth of the economy in Nigeria has been investigated by (Yekini et al., 2012). The findings show that ICT positively affects growth and poverty. In the same vein, Oyeniran & Onikosi-Alliyu, (2016) investigated the relationship between ICT infrastructure and growth in Nigeria using the ARDL Bound test approach. The outcome of the bound test confirmed the long-run equilibrium between economic growth and all the remaining independent variables. The study suggests that FDI and ICT are more efficient in promoting growth in Nigeria. Okogun et al. (2012) analyzed the economic value of investing in the ICT sector in Nigeria and reported that government investment in the sector has significantly promoted economic growth.

A study by Amanasto, *et al.* (2019) examined the impact of investment policy on ICT in driving the digital economy and the sectoral performance of the Indonesian economy. The study covered four years between 2014 and 2017, and employed three models including input-output, social accounting matrix, and CGE. The authors used the CGE model to simulate the effect of ICT investment on macroeconomic variables. They found that ICT investment has the largest impact on total exports (2.39%), followed by nominal wages (2.27%). However, it has an impact on real wage (0.55%) because the rise in nominal wage was reduced by the rise in inflation (simulated price index rose by 1.71%). Thus, the greatest benefit of ICT investment in the Indonesian economy was the increase in exports which improves the foreign reserves of the economy. Apart from these economic indicators, it resulted in growth in real GDP (0.88%), total imports (1.03%), and real consumption (0.96%). In Pakistan, (Rahman et al., 2021) explored the role of investment in ICT on the growth of the country's economy. The result revealed that ICT development does not significantly affect growth. Similarly (Godil et al., 2020), reported that financial development and ICT negatively impacted CO2 in Pakistan.

Similarly, Jorgenson and Vu (2016) found that investment increases total factor productivity by improving the quality of labor and making capital more efficient. The authors found that countries with ICT-producing industries experienced rapid growth in productivity leading to higher growth rates. Nasab and Aghaei (2009) employed the GMM panel model to discover the link between ICT and growth in OPEC member countries between 1997 and 2007. It was revealed that investing in ICT propels economic growth as it diversifies the productive base of oil-dependent countries. However. Sound policies have to be put in place to actualize the economic potential of ICT. Kuppusamy, *et al.* (2009) employed the ARDL model to examine the effect of investment in ICT on growth in the Malaysian context between 1995 and 2006. The findings indicated that ICT investments by the manufacturing sector and wholesale sector are significantly pushing Malaysia's growth trajectories in both the short run and long run. Despite the government's investment in ICT, to improve operational efficiency, it did not significantly drive growth in the two periods.

However, Seo, *et al.* (2009) showed that ICT investment was not as important to growth as non-ICT investment, particularly in developing countries that have low total factor productivity. A similar study by Ishida (2015) supported Seo, *et al.* (2009)'s. Ishida (2015) applied ARDL to establish the reaction of energy usage, investment in ICT, and growth in Japan between 1980 and 2010. It was established that ICT reduced energy use over the two periods. In contrast, ICT did not drive growth in both the short run and long run.

Digital Economy and Productivity Growth

Digital economy is important for boosting factor productivity in the economy (Rui & Tang, 2023; Pan et al. 2022; Jinfang & Yiran, 2020; Tian & Liu, 2020). Tian and Liu (2020) surveyed digital economy firms in China and examined the connection between digital infrastructure and firms' productivity at the regional level. They documented that firms' productivity was positively driven by digitalization. In another study by (Aminu & Raifu, 2019) investigated the effect of ICT on employment and productivity in Nigeria after the liberalization of the sector in 2001. Digital innovations in recent have continued to redefine and transform the way of living of man. Several studies explained the digital economy on productivity and ICT.

Liu et al. (2022) explored the link between the digital economy, industrial activities, and environmentally friendly operations in China between 2011 and 2019. The findings established higher green total factor productivity in the context of an upgraded digital economy. The implication is an upgrade in the quality of industrial activities. Also, Sun et al. (2023) observed that ICT is a driving force for an improved green economy. Chen et al. (2023) found a non-linear relationship between the digital economy and regional green total factor productivity. In a scenario of quality innovative technologies and a strong industrial base, the digital economy speeds up the productivity of the green economy. Dredrick et al. (2013), documented the benefits of productivity growth in emerging economies as they invest more in ICT.

METHODOLOGY

Data and Variable

The sources of data include the Central Bank of Nigeria (CBN) and World Development Indicators (WDI). The dependent variable is labor productivity, while ICT, a proxy of digital economy, is the independent variable. ICT has recently been a vibrant sector of Nigeria's economy. As a component of GDP, the ICT is classified as a service sector which has 4 components consisting of i) telecommunication and information services, ii) publishing, iii) motion pictures, sound recording and music production, and broadcasting. Furthermore, recent studies (Gomes, *et al.* (2022) use internet penetration, mobile phone subscription, and fixed broadband as proxies of digital economy. Other control variables include per capita GDP, gross fixed capital formation, and trade openness. Table 1 summarizes the description of the research variables.

Model Specification

There are important cases for developing the model for this study. Firstly, the OLS model demands that all series be stationary at level I(0). Secondly, the OLS model is in the form of the first difference, this happens when the series are integrated but no long-run relationship (cointegration) is established when the series are integrated. In addition to that, if the error correction term shows that series are cointegrated, then Engle and Granger (1987) causality tests are carried out to assess the causal relationship among the variables. Thirdly, in a situation whereby some series I(0) while others are I(1), the ARDL bound test approach can be employed (Pesaran et al., 2001). Therefore, this study is aimed at investigating the role of the digital economy on economic growth and productivity. To achieve this, two models were set up and presented as follows:

$$\Delta GDP\_GRWT = \alpha_0 + \sum_{i=1}^{p} \delta i \Delta GDPGRWTt - 1 + \sum_{j-i}^{3} \sum_{i=0}^{q,k,l} \theta ji \ \Delta Xjt\text{-}1 + \sum_{j=1}^{2} \sum_{i=0}^{m,n} \gamma ji \Delta Zjt - i + \varphi 1 GDPGRWTt\text{-}1 + \sum_{j=1}^{3} \varphi 2 Xjt - 1 + \sum_{j=1}^{2} \varphi 3 jZjt - 1 + \omega ECT - 1 \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\Delta PRODGRWT = \alpha_0 + \sum_{i=1}^{p} \delta i \Delta GDPGRWTt - 1 + \sum_{j-i}^{3} \sum_{i=0}^{q,k,l} \theta ji \ \Delta Xjt\text{-}1 + \sum_{j=1}^{2} \sum_{i=0}^{m,n} \gamma ji \Delta Zjt - i + \varphi 1 GDPGRWTt\text{-}1 + \sum_{j=1}^{3} \varphi 2 Xjt - 1 + \sum_{j=1}^{2} \varphi 3 jZjt - 1 + \omega ECT - 1 \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where X represents the two indices of the digital economy which includes Internet penetration and ICT; Z represents the three control variables in the model which include Capital, Inflation, and Unemployment. The dependent variable's lag begins to lag one up to its optimal lag length (p). on the other hand, the independent variables start from zero lag up to their optimal which is determined by Akaike Criterion. The ECT_{-1} represents the one-period lag value of the residual which measures the speed of adjustment towards the long-run equilibrium. The ECT is expected to be negative and statistically significant.

RESULT AND DISCUSSION

This section provides the summary statistics and stationarity tests, and autoregressive distributive lag model (ARDL) model, and the ARDL Bound test.

Table 1. Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
ICT	6.37	4.72	1.04	15.51
Internet	10.00	12.01	0.00	35.50
Capital	27.87	10.96	14.17	53.12
Unemployment	4.00	0.56	3.70	5.99
GDP Growth	4.24	3.59	-2.03	15.33
Productivity Growth	1.95	3.48	-4.71	12.32
CPI	93.14	89.36	2.41	354.30

Source: Authors' computation using E-Views

In Table 1, the mean of ICT to GDP ratio (ICT) was 6.37, with a minimum of 1.04 and a maximum of 15.51. The average internet penetration was about 10% between the first quarter of 1990 and the fourth quarter of 2021, with a high standard deviation (12.01) exceeding the mean value. This was due to zero to very low internet connectivity between 1990 and the fourth quarter of 2000. Around 2010 and beyond, there was a tremendous rise in the percentage of the population using Internet services in the country. Nearly 0.00% of the population accessed the internet in the first half of the 1990s when telecommunication services were under public monopoly. However, with the deregulation of telecommunication services at the dawn of the millennium, internet users reached a maximum of 10 in the country. Similarly, gross fixed capital formation (GFCF) a ratio of GDP, which stands for capital, was an average of 27.87%. Throughout the 32 years, the capital ratio ranged from 14% to more than half of real GDP. Unemployment was 4% on average, recording a maximum of almost 6%. The mean real GDP and labor productivity were in log form; hence their mean values would not give meaning.

Further, the study conducts unit root tests to examine whether the research variables are stationary and at what level. This is important as it serves as a guide for determining the appropriate model(s) to be employed. The

results of Augmented Dickey-Fuller (ADF), Philips Peron, and Kwiatkowsky-Phillips-Schmidt-Shin (KPSS) tests for stationarity are presented in Table 2.

Table 2. Augmented Dickey-Fuller and Philipps Perron Stationary Tests

Variables	ADF		PP		KPSS		Order of Integration
	Level	1st Diff.	Level	1st Diff.	Level	1st Diff.	
ICT	2.527	3.465**	1.986	3.390**	0.195	0.105	I(1)
Internet	2.164	0.878	1.846	0.633	0.336**		I(0)
Capital	1.265	3.582**	1.778	3.507**	0.258**		I(1)
Unemploymt	1.360	1.729	2.390	3.358	0.277**		I(0)
GDP Growth	2.693	3.350**	2.547	4.810**	0.232**		I(1)
Productivity Growth	2.535	3.479**	1.818	3.507**	0.237**		I(1)
CIP	4.620**		10.27**		0.313**		I(0)

Note: ** denotes a 5 Percent significance level respectively.
Source: Author's computation using E-Views

As Table 2 revealed, internet penetration and GDP growth were stationary at a level based on a 5% significance level. This was consistent across the various stationarity tests; ADF, PP, and KPSS. Hence, these variables have an I(0) order of integration. Conversely, ICT, unemployment, capital, and productivity growth were non-stationary at level but stationary at first difference using ADF, PP, and KPSS tests for stationarity. Therefore, the series is integrated into order one i.e. I(1). Therefore, we can safely perform an autoregressive distributed lagged (ARDL) model with a combination of I(0) and I(1) variables.

Table 3. Long run output

Variables	Dependent Variable: GDP GROWTH	Variables	Dependent Variable: PROD GROWTH
INTERNET	-0.591661** (0.0239)	INTERNET	-0.521327**

			(0.0465)
CAPTAL_GDP	-0.368282 (0.1256)	CAPTAL_GDP	-0.295215 (0.2155)
ICT_GDP	-0.707100 (0.3187)	ICT_GDP	-0.449618 (0.4963)
UNEMP	2.416652 (0.7844)	UNEMP	0.894796 (0.9212)
CPI	0.146839 (0.0591)	CPI	0.126633 (0.1049)
Constant	6.480389 (0.8005)	Constant	13.489260 (0.6090)

Source: Authors compilation using Eviews

The study uses five important variables which include internet penetration (INTERNET), gross fixed capital formation (CAPITAL_GDP), information and communication technology index (ICT_GDP), unemployment (UNEMP), and consumer price index (CPI) to estimate the impact of digital economy on economic growth (model 1) and on productivity growth (model 2) in Nigeria. After running the ARDL Bound test to determine whether the variables are cointegrated or otherwise. The result (in Table 6) indicated that F-statistic values are greater than upper and lower critical values. And gives room for long-run estimation, and the result is presented in Table 3. For model 1, the findings show that capital, internet penetration, and ICT negatively influence GDP growth, indicating that one unit increase in capital, internet penetration, and ICT the GDP will decrease by 0.37, 0.59, and 0.71 respectively. While unemployment and CPI have a positive impact on GDP growth. The result of model 2 also shows a negative effect of capital, internet, and ICT on productivity growth. But unemployment and inflation which serve as controlled variables have a positive impact on the dependent variables, suggesting that a 1% increase in both variables will cause the productivity growth to increase by 0.89 and 0.13 respectively.

Table 4. Short-run Estimation Output

Variables	Dependent Variable: GDP GROWTH	Variables	Dependent Variable: PROD GROWTH
GDP_GROWTH(-1)	1.526415*** (0.0000)	PROD_GROWTH(-1)	1.619375*** (0.0000)
GDP_GROWTH(-2)	-0.625377 (0.0000)	PROD_GROWTH(-2)	0.709595*** (0.0000)
INTERNET	-0.058552 (0.0782)	INTERNET	-0.047034 (0.1241)
CAPITAL_GDP	-0.572964*** (0.0001)	CAPITAL_GDP	-0.639167*** (0.0000)

CAPITAL_GDP(-1)	0.870919*** (0.0008)	CAPITAL_GDP(-1)	1.037851*** (0.0000)
CAPITAL_GDP(-2)	-0.334401** (0.0179)	CAPITAL_GDP(-2)	-0.425318*** (0.0014)
ICT_GDP	-0.069976 (0.2866)	ICT_GDP	-0.040564 (0.4829)
UNEMP	-16.17108*** (0.0000)	UNEMP	-9.616619*** (0.0000)
UNEMP(-1)	26.47660*** (0.0000)	UNEMP(-1)	16.47367*** (0.0000)
UNEMP(-2)	-10.06636*** (0.0007)	UNEMP(-2)	-6.937781*** (0.0068)
CPI	-0.142073 (0.0991)	CPI	-0.089085 (0.2422)
CPI(-1)	0.156605 (0.0684)	CPI(-1)	0.100510 (0.1842)
Constant	0.641313 (0.8034)	Constant	1.216998 (0.6284)
ECT_{-1}	-0.098962*** (0.0001)	ECT_{-1}	-0.090220 (0.0004)

In Table 4, the second column shows the short-run estimation of model 1. The first period lag value of GDP growth has a significant positive influence on its current value, unlike its second lag value which is negative though significant. Based on the Wald test result in Table 5, lag 1 and lag 2 can jointly influence the current value of GDP growth. Furthermore, internet penetration has a negative influence on GDP growth. So also does capital at the level and second lag period, but the second lag value has a significant positive impact on GDP. However, the Wald test shows that capital at level, lag 1, and lag 2 can jointly influence GDP growth. In addition to that, ICT, CPI at level, and unemployment at level and at second lag period negatively affect GDP growth, Whereas, one lag period of UNEMP and CPI positively influences GDP growth. The ECT-1 is the error correction term that measures the speed of adjustment towards long-run equilibrium. Therefore, the ECT of the first model is negative and with a coefficient estimate of -0.09962 statistically significant. This suggests that the speed of adjustment towards long-run equilibrium is 9.8% within one period of time.

The fourth column in the Table 4 presents the short-run results of the model 2. The first lag and second lag values of PROD growth have a positive impact on its current values. And this has also been corroborated by the result from the Wald test which suggested that lag values can jointly influence productivity. Internet is insignificant and negatively affects productivity growth. Additionally, capital at level and at lag 2 is negative whereas capital at

lag 1 is significant and positive. However, the lags can jointly influence Productivity growth. Finally, the coefficient of ECT is -0.090220 which suggests that the system corrects its previous period disequilibrium at a speed of 9.0% within one period of time.

Table 5. Wald Tests

	Dependent Variable: GDP GROWTH		Dependent Variable: PROD GROWTH
Variables	F-statistics	Variables	F-statistics
GDP GROWTH	722.5902*** (0.0000)	PROD GROWTH	843.9688*** (0.0000)
INTERNET	3.160451 (0.0782)	INTERNET	-1.549786 (0.1241)
CAPITAL_GDP	6.540534*** (0.0004)	CAPITAL_GDP	8.930975*** (0.0000)
ICT_GDP	1.146679 (0.2866)	ICT_GDP	-0.704093 (0.4829)
UNEMP	15.47538*** (0.0000)	UNEMP	7.029571*** (0.0002)
CPI	3.167139** (0.0460)	CPI	1.902486 (0.1541)

Table 6. Bound Tests Results

	Model 1		Model 2	
F-Statistic	4.336579		3.399263	
Critical Values	I0	I1	I0	I1
5%	2.62	3.79	2.62	3.35

Source: Authors compilation using Eviews

Table 7. Diagnostic Tests Results

Tests	F-statistic (Model 1)	F-statistic (Model 2)
Serial Correlation	2.418021 (0.0939)	1.612021 (0.2042)
Heteroskedasticity	1.019287 (0.4365)	1.610570 (0.0988)
Stability (Ramsey Reset)	0.194627 (0.6600)	0.903073 (0.3441)

Source: Authors compilation using Eviews

Table 7, summarizes the diagnostic tests such as the serial correlation, heteroscedastici-ty, and stability tests. As the result shows, the models are free from any post-estimation problems. This is confirmed by looking at the p-values of the respective F-statistics where we see they are above the threshold of 0.05.

The results obtained from both the long-run and the short-run estimates show that the digital economy indicators are negatively impacting the growth of both GDP and productivity. This result is inconsistent with some of the earlier studies (Adeleye & Eboagu, 2019; Africa, 2015; Albiman & Sulong, 2016; Haseeb et al., 2019; Latif et al., 2018; Liu et al., 2021). This undesired result can be attributed to the dominance of the government in the ICT sector. Before the 2001 liberalization agenda, the sector was entirely owned and managed by the Nigerian Government through the Nigerian Telecommunications Limited (NITEL).

The company was accused of corruption and misallocation of resources meant for huge investments in the ICT sector (Raji et al., 2006). In addition to that, (Apulu et al., 2011) identified electricity constraints, infrastructural inadequacy, lack of skills and training, lack of policy and institutional framework, corruption, and lack of support from the government as some of the factors affecting Nigeria's digital economy policy. However, to boost its digital economy efforts, the government launched the National Digital Economy Policy and Strategy in 2020, to turn Nigeria into a digital hub for the entire African continent (Oxford Business Group, 2021).

CONCLUSIONS AND RECOMMENDATIONS

The study aims to investigate the relationship between the digital economy, economic growth, and productivity growth in Nigeria. Specifically, the study focuses on the role of digital economy indicators such as internet penetration, ICT, and growth fixed capital formation along with other indicators such as unemployment and consumer price index. We apply the Augmented Dickey-Fuller and Philips Peron unit root test and that the variables' order of integration is a mixture of I(0) and I(1), and this motivated us to apply the Autoregressive Distributive Lag Model to estimate the short run and long-run elasticities. The result from the ARDL Bound test shows that the variables have a long-run relationship. The result from long run technique shows that the digital economy indicators do not significantly stimulate economic growth productivity in Nigeria,

In the light of the above discussion, the following are recommended. While the performance of the digital sector in developed countries is attractive, in Nigeria some problems need to be addressed to ensure the sector contributes positively towards the growth and development of the country. The implementation of the National Digital Economy Policy and Strategy in 2019 is a great effort in the digitalization of the country's economy. Furthermore, this effort has to be complemented with stronger policies that will ensure the efficient distribution of electricity and other necessary infrastructure. Another

important to take into consideration the policymakers is the deployment 5G network across all 36 states of the country.

ADVANCED RESEARCH

There are some areas that this study has been unable to capture which we consider as the limitation of the study. The study ignores some important components of the digital economy such as digital literacy rates, e-commerce, and investment on digital infrastructure.

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