ANALYZING THE RELATIONSHIP BETWEEN DIGITALIZATION AND ECONOMIC GROWTH IN NIGERIA USING AUTOREGRESSIVE DISTRIBUTED LAG (ARDL) MODEL

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Abstract

This paper examines the relationship between digitalization and economic growth in Nigeria between 2012Q3 to 2020Q4 using the Autoregressive Distributed Lag (ARDL) approach. The rapid growth in information communication technologies (ICT) and the use of cellular technology in the expansion of digital financial transactions in Nigeria complicate undrstandings on how these have contributed to economic growth in the country. Thus, this study analyzed internet subscriptions and gross fixed capital formation data from telecommunications quarterly reports of the Nigerian Bureau of Statistics. Also, data on real gros domestic product (GDP), ICT contribution to GDP and digital financial services were sourced from the Central Bank of Nigeria statistics database. Empirical findings of this study revealed that there is a long-run relationship between digitalization and economic growth in Nigeria. Likewise, a long-run positive relationship was found between internet subscriptions, digital financial services, gross fixed capital formation and ICT contribution to GDP. However, the magnitude of the impact of digital financial services is low traceable to the slow pace at which the Nigerian population is adopting digital technologies and the diminished trust in digital financial services arising from the activities of Ponzi schemes. The study concludes that there is a positive relationship between digitalization and economic growth in Nigeria. Hence, targeted financial literacy campaigns should be carried out by financial institutions, Central Bank of Nigeria and civil society organizations to enable people better understand and make use of digital financial services that suit their needs and also increase their trust in these services.

Keywords: Digitalization, economic growth, financial services, globalization, CBN

Introduction

Digital technologies have shaped global economic progress over the past decades but their impact is just beginning to be felt by societies (Huawei & Oxford, 2017). The internet has brought about a profound and rapid digital transformation, thereby reshaping the global economy, as well as altering every facet of life (Huawei & Oxford, 2017). This in turn has led to an ever-widening global digital economy as people integrate technology into their everyday lives and economic activities. The Corana virus disease (Covid-19) pandemic further fast-tracked the pace of this transformation and added a sense of urgency to the adoption and use of digital technologies across countries of the world (Huawei & Oxford, 2017). United Nations Conference on Trade and Development (2021) reported that the Covid-19 pandemic had a dramatic impact on internet traffic as most activities increasingly took place online and the global internet bandwidth rose by 35% in 2020, the largest one-year increase since 2013. Countries with infrastructures that aid internet connectivity and advanced digital platforms were able to make use of these technologies to stay afloat, thus, withstanding the shocks imposed by the Covid-19 economic downturn. It is apparent that the 21st-century global economy is being driven by a fast-paced digital transformation covering all sectors and digital technology is increasingly redefining how economic activities occur across countries; thus, paving the way toward digital economies (International Telecommunication Union & United Nations Educational, Scientific and Cultural Organization [ITU & UNESCO], 2019).

The Nigerian government's over-dependence on crude oil with its volatile prices in this era of the fourth industrial revolution will limit the growth potential of the Nigerian economy, hence; a digital-led strategy for growth was adopted in the Economic Recovery and Growth Plan (2017–2020) to build a globally competitive economy (Ministry of Budget & National Planning, 2017). This was also intended to serve as a viable option for the diversification of the Nigerian economy. Several studies have been carried out globally that have established a positive relationship between information communication technologies (ICTs) and economic growth (Arendt 2015; Chakpitak et. al, 2018; Fernandez-Portillo et al., 2020; Niebel, 2018). In contrast, Pradhan, Mak and Neville (2015) and Yousefi (2011) found that economic growth in many countries and regions of the world is negatively affected by digital technology adoption. In Africa, the story of digitalization is dependent on and linked with the growth and development of its mobile ecosystem. Cross-country studies within Africa show that a positive relationship exists between digitalization and economic growth

(Adeleye & Eboagu, 2019; Bahrini & Qaffas, 2019; Myovella et al., 2020; Solomon & Klyton, 2020). Even though the relationship between digitalization and economic growth has been established, there seem to be conflicting findings that question the validity of 'leapfrogging' through ICT by developing economies (Adeleye & Eboagu, 2019; Niebel, 2018). In Nigeria, there are few studies in this genre (Chiemeke & Imafidor, 2020; Oladipo et al., 2016; Oyeniran & Onikosi-Alliyu; 2016; Ukwuoma, 2019) as research in this area is still in the infancy stage. Therefore, more research has been called for to establish the link and impact of digital technologies on the economy (Bahrini & Qaffas, 2019; Chiemeke & Imafidor, 2020). In addition, this study seeks to fill the following lacunae in the literature. First, most of the studies used annual data (Adeoye & Alenoghena, 2019; Akinwale et al., 2018; Ukwuoma, 2019); hence, greatly limited by their sample size due to the unavailability of data for ICT before the time of liberalization of the telecommunications sector. Even though Oladipo et al. (2016) used quarterly data, they could not capture core ICT variables such as internet usage. Likewise, Chiemeke and Imafidor (2020) used quarterly data but they were interpolated. Therefore, this study significantly differs from these studies by using raw quarterly data and including internet usage variables (a fundamental requirement upon which changes in the digital technology space depends). Finally, existing literature on the impact of digital technologies on economic growth in Nigeria only used traditional ICT variables such as internet usage, mobile telephone subscribers and fixed telephone lines to examine this impact (Chiemeke & Imafidor, 2020; Ukwuoma, 2019). This study differs from all other studies by including the digital financial services variable. The rapid growth in ICT and the use of cellular technology in the expansion of digital financial transactions in Nigeria necessitates the inclusion of this variable. Wamboye et al. (2015) reported that sub-Saharan African countries will sustain their growth performance in the future by investing in mobile communication technology and its applications in the financial sector. Therefore, this study seeks to analyze the relationship between digitalization and economic growth in Nigeria using the Autoregressive Distributed Lag (ARDL) Model.

Digitalization and Economic Growth in Nigeria

Digitalization is the use of digital technologies and data as well as interconnection that result in new activities or changes to existing activities (OECD, 2019). It describes the growing application of ICT across the economy. Therefore, digitalization focuses on the adoption and use of these digital technologies in broader individual, organizational and societal contexts. Economic growth has been simply defined as an increase in the production of economic goods and services, compared from one period of

time to another. Traditionally, this is measured in terms of Gross National Product (GNP) or Gross Domestic Product (GDP). It can also be nominal and real (when adjusted for inflation). Todaro and Smith (2012) defined a country's economic growth as a long term sustained increase in capacity to supply increasingly different economic goods to its population which is based on technology, institutional arrangement and ideological adjustments that it demands. Several studies have been carried out on digitalization and the economic growth. The fast pace at which digitalization is progressing has further attracted the attention of researchers to study its impact on economic growth of both developed and developing nations. In examining the economic value of ICT investment in Nigeria, Okogun, et al. (2012) used secondary data and OLS as an estimation technique. They found that ICT investment has a significant impact on Nigeria's economic growth. Wamboye et al. (2015) explored the transmission mechanism from ICTs to growth. With a sample of 43 SSA Countries between 1975-2010 and 1995-2010 and using the Generalized Method of Moments and non-parametric regression, empirical findings reveal that fixed-line telephones and mobile cellular telephones have a positive and significant impact on labour productivity growth but only after penetration rates reach a certain critical mass. They also found that foreign direct investment and trade openness improve productivity as well as help ICTs boost growth whereas, financial development is a potential transmission channel of the positive effect of ICTs on growth. In a similar study, Oladipo et al. (2016) investigated the role of ICT investment on economic growth in Nigeria. Using quarterly data and Johansen cointegration, the results showed a positive and significant impact of ICT investment on economic growth hence, ICT can complement the important role of human capital, Foreign Direct Investment (FDI) and others in economic growth and development. Oyeniran and Onikosi-Alliyu (2016) also empirically examined the effect of investment in telecommunication infrastructure on economic growth in Nigeria using time series data from 1980 to 2012. The Autoregressive Distributed Lag (ARDL) model was employed and the findings reveal that a long run relationship exists between investment in telecommunications infrastructure and economic growth. The results also show that foreign direct investment in ICT is more effective in improving and raising economic growth than government investment. Akinwale et al. (2018) examined the relationship and impact of ICT on economic growth in Nigeria.

Secondary data from World Bank development indicators from 1997 to 2016 was used in the study and an autoregressive distributed lag (ARDL) was used as the estimation technique. The results revealed that there was a long run relationship between ICT and economic growth. In the short run, secure internet servers per 1 million people and mobile cellular subscriptions

per 100 people both had a positive and significant impact on the economic growth whereas investment in telecommunications with private sector participation was negative. The Granger causality test showed that there was bidirectional causality between secure internet servers per 1 million and economic growth. In a similar study, Niebel (2018) studied the impact of ICT on economic growth in 59 developing, emerging and developed economies using secondary data from 1995 to 2010. The panel data regressions revealed that there is a positive relationship between ICT capital and GDP growth for all samples. Results from the subsamples however showed that emerging & developing countries are not gaining more from investments in ICT than developed economies hence questioning the argument of "leapfrogging" through ICT. However, in a country-specific study; Chakpitak et al. (2018) in examining how increases in digital technologies impact the Thai economy used the stochastic frontier model estimated by the entropy approach to model the production function. Their established results show that technologies can contribute positively to the Thai economy although the magnitudes are small. They found out that digital technologies are not being used at the maximum capacity; therefore, there is still room for improvement in Thailand. In another study, Bahrini and Qaffas (2019) evaluated the impact of information and communication technology (ICT) on economic growth in developing countries. The study used secondary data and Generalized Method of Moment (GMM) as a method of analysis. Empirical results show that mobile phone, internet usage and broadband adoption are the main drivers of economic growth in the Middle East and North Africa and sub-Saharan Africa with mobile phones having the most significant positive impact in SSA countries. They also confirmed the relative superiority of the Middle East and North African countries over the Sub-Saharan countries in the areas of internet usage and broadband adoption.

Taking a step further to investigate if the 'leapfrogging' hypothesis holds for Africa, Adeleye and Eboagu (2019) evaluated the impact of ICT on the economic growth of 54 African countries between 2005 and 2015. Using a system Generalized Method of Moments and pooled OLS the result indicated that ICT development has a positive relationship with economic growth and that mobile subscription has the biggest potential to enable Africa to skip traditional development stages. Hence, leapfrogging exists for Africa. Adeoye and Alenoghena (2019) investigated the relationship between internet usage, financial inclusion and economic growth in Nigeria using annual time series data for the period 1999 to 2016. The Engle Granger cointegration test and Fully Modified Ordinary Least Squares (FMOLS) methods of analysis were used. The results indicated that internet usage and broad money have a positive and significant effects on financial inclusion

likewise internet usage and economic growth in Nigeria. In addition, the positive effect of internet usage on economic growth in Nigeria is not transmitted through the mechanism of financial inclusion. In a qualitative study, Ajah and Chigozie-Okwum (2019) conducted a study on the prospects of ICT for digital growth and national development in Nigeria. Primary data was used in the study and a field survey was carried out. The result of the study identified artificial intelligence, robotics, cloud computing, ubiquitous computing, Internet of Things (IOT), big data analytics and block chain technology as key ICTs technologies that are driving the digital economy and fostering digital growth and national development. It found out that the prospects of ICTs for digital growth and national development in Nigeria include: an increase in revenue, elimination of the black economy, reduction in corruption, increase in trust, privacy and integrity.

Fernandez-Portillo et al. (2020) in a study of 23 Organization for Economic Cooperation and Development (OECD) European countries between 2014 and 2017 investigated the impact of ICT on economic growth using Partial Least Squares. The study found that the deployment and use of ICT drive the economic growth of countries that are within the framework of developed European economies. In addition, it was found that the number of internet users provides the highest return to GDP. In Nigeria, Chiemeke and Imafidor (2020) investigated the impact of digital technology adoption on economic growth and labour productivity in Nigeria. It employed a Structural Vector Autoregressive (SVAR) framework from which the Impulse Response Function (IRF) was extracted, Forecast Error Variance Decomposition (FEVD) and VAR Granger causality. The study found that the impact of shocks to digital technology adoption on economic growth and labour productivity is negative and significant in the short-term but positive in the medium term and above. It further revealed that the direction of causality runs unidirectional from digital technology to economic growth, and labour productivity.

Myovella et al. (2020) in a comparative study of Sub-Saharan Africa (SSA) and the Organization for Economic Cooperation and Development (OECD) economies examined how diffusion of digital technologies affect economic growth. Using a system Generalized Method of Moments (GMM), they analyzed a sample of 41 SSA countries and 33 OECD countries. They found that digitalization positively contributes to economic growth independent of a country's development level. The findings also revealed that the effect of mobile technologies is positive and significant for SSA countries but not significant for OECD countries. However, the contribution of the internet though positive in both groups of countries, had a minimal effect in SSA countries due to underdeveloped internet infrastructure. Solomon and Klyton (2020) examined the impact of the usage of digital

technology on economic growth in 39 African countries. Secondary data was used for the period 2012 to 2016 and the system generalized methods of moments (GMM) was used in the analysis. By distinguishing between the impacts of business, individual and government usage of ICT, they found out that only individual usage had a positive relationship with growth and after disaggregating it, only social media and the importance of government vision were significant for growth. The following gaps were identified in the literature: First, most of the studies used annual data (Adeoye & Alenoghena, 2019; Akinwale et al., 2018; Ukwuoma, 2019) hence greatly limited by their sample size due to the unavailability of data for ICT before the time of liberalization (2001) of the telecommunications sector. Second, the existing literature on the impact of digital technologies on economic growth in Nigeria only used traditional ICT variables such as internet usage, mobile telephone subscribers and fixed telephone lines in their models with none of the studies including digital financial services (at least to the best of our knowledge).

Theoretical Framework

Romer's Model of Endogenous Technological Change

In this model, based on research and development, growth is driven by technological change, resulting from intentional investment decisions of companies that seek to maximise profits (Romer, 1990). The model is based on three premises as outlined by him. The first is that technological change provides the incentive for continued capital accumulation, and together, capital accumulation and technological change account for much of the increase in output per hour worked. The second premise is that technological change arises in large part because of intentional actions taken by people who respond to market incentives. Thus the model is one of endogenous rather than exogenous technological change. The third and most fundamental premise is that instructions for working with raw materials are inherently different from other economic goods. Once the cost of creating a new set of instructions has been incurred, the instructions can be used over and over again at no additional cost. Developing new and better instructions is equivalent to incurring a fixed cost.

Technology as an input in this model is neither a conventional good nor a public good; it is a non-rival, partially excludable good. By non-rivalry, Romer (1990) asserts that the use of an idea by one producer to increase efficiency does not preclude its use by others. While the same unit of labour or capital cannot be used by multiple producers, the same idea can be used by many, potentially increasing everybody's productivity. Therefore, in

responding to incentives, market structure and policies, technological progress acts as the engine of long-run growth.

Methodology

The study used quarterly data from 2012Q3 to 2020Q4. This is due to the unavailability of data for some variables before that period. The data on internet subscriptions and gross fixed capital formation were sourced from telecommunications and GDP based on expenditure quarterly reports of the Nigerian Bureau of Statistics for various years. The data on real GDP, ICT contribution to GDP and digital financial services were sourced from the Central Bank of Nigeria statistics database. The selection of variables was guided by the current report on the measurement of the digital economy (OECD, 2021) and the Nigerian Digital Economy diagnostic report (World Bank, 2019). The value of all transactions using e-payment channels was used as a proxy for digital financial services. Real GDP, ICT contribution to GDP, gross fixed capital formation and digital financial services were seasonally adjusted using the Seasonal and Trend decomposition using Loess (STL) so as to filter the data and still allow for seasonal patterns to change through time.

Table 1: Variables and their Descriptions

Variable	Label	Description
Economic Growth	LNRGDP	Gross Domestic product at constant prices (billions of naira)
Gross fixed Capital Formation	LNGFK	Gross Fixed Capital Formation. Formerly gross domestic investment. Includes land improvements, plant, machinery, and equipment purchases, construction of roads, commercial and industrial buildings. (billions of naira)
Digital Financial Services	LNDFS	The value of all transactions using digitally enabled payment systems such as Automated Teller Machines, Point of Sale, Online transfers etc. (billions of naira)
Internet Subscribers	LNINS	The total number of internet subscribers
ICT contribution to GDP	LNICT	The contribution of ICT to Gross domestic product(billions of naira)

Source: Authors' Compilation

Model Specification

The ARDL model used for this study is specified below with a slight adjustment (addition of internet subscribers and digital financial services

based on the OECD measurement of the digital economy and Nigerian Digital Economy diagnostic report) from Akinwale et al. (2018).

$$LNRGDP_t = \beta_0 + \beta_1 LNDFS_t + \beta_2 LNINS_t + \beta_3 LNGFK_t + \beta_4 LNICT_t + U_t \dots\dots\dots (1)$$

Where $LNRGDP_t$ = log of Real Gross Domestic Product, β_0 = constant parameter, β_i = coefficient of the explanatory variables I= 1, 2, ……, 4., U_t = stochastic disturbance term, $LNDFS_t$ = log of digital financial services, $LNINS_t$ = log of number of internet subscriptions, $LNGFK_t$ = log of Gross Fixed Capital Formation, $LNICT_t$ = log of ICT contribution to GDP, t = time subscript.

ARDL Bound Approach

$$\Delta LNRDGP_t = \beta_0 + \beta_1 LNRGDP_{t-1} + \beta_2 LNDFS_{t-1} + \beta_3 LNINS_{t-1} + \beta_4 LNGFK_{t-1} + \beta_5 LNICT_{t-1} + \sum \lambda_1 \Delta LNRGDP_{t-i} + \sum \lambda_2 \Delta LNDFS_{t-i} + \sum \lambda_3 \Delta LNINS_{t-i} + \sum \lambda_4 \Delta LNGFK_{t-i} + \sum \lambda_5 \Delta LNICT_{t-i} + \mu_t \dots\dots\dots (2)$$

Where B_0 is the drift component, Δ is the First difference operator. β_i, $\boldsymbol{\lambda}_i$ are parameter coefficients of the variables. U_t is white noise with zero mean. All the variables are transformed into logarithmic forms so as to make the residuals normally distributed. The terms with the summation signs (∑) above represent the error correction dynamics while the part of the equation with β_i corresponds to the long-run relationship. The null hypothesis in the equation is H_o: $\alpha_1=\alpha_2=\alpha_3=0$. This denotes the absence of long-run relationship while the alternative hypothesis is H_1: $\alpha_1\neq\alpha_2\neq\alpha_3\neq0$. The calculated F statistics will be compared with the critical values and if it exceeds the upper critical value, the null hypothesis of no co-integration will be rejected irrespective of the variables being I (0) or I (1) (Pesaran et al., 2001).

It is expected that digital financial services, gross fixed capital formation, internet subscriptions and ICT's contribution to GDP will all have a positive impact on economic growth.

Results and Discussions

Unit Root Analysis

In other to check for the stationarity of the series, the Augmented Dickey Fuller test proposed by Dickey and Fuller (1979) and Phillips and Perron (1988) were employed. The results are shown in Table 2.

Table 2: Unit-root Test Result

Augmented Dickey Fuller (ADF)					Phillips Perron (PP)			
	Constant		Intercept with Trend		Constant		Intercept with Trend	
Variables	Level	FD	Level	FD	level	FD	Level	FD
LNRGDP	-2.168	-5.708***	-2.833	-5.725***	-3.73***	-7.76***	-5.27***	-8.19***
LNINS	-3.192**	-3.120**	-4.111**	-3.481*	-4.32***	-2.97**	-3.48*	-3.52*
LNDFS	2.259	-5.432***	-2.252	-6.880***	3.53	-5.66***	-2.45	-6.87***
LNGFK	-3.045**	-5.963***	-3.515*	-6.124***	-4.36***	-11.50***	-4.95***	-12.21***
LNICT	0.949	-8.906***	-0.526	-9.037***	-2.79*	-33.25***	-8.04***	-32.96***

Source: Extract from ADF & PP test result estimated using E-views 12

Note: ***, ** and * represent significance level at 1%, 5% and 10% respectively. The figures are the *t*-statistics for testing the null hypothesis that the variable has unit root. The critical values for intercept without trend are -3.653, -2.957 and -2.617 whereas, for intercept with trend the values are -4.285, -3.563 and -3.215 for 1%, 5% and 10% respectively.

From the result in Table 2, the ADF test shows that two of the variables (LNINS, LNGFK) were stationary at level whereas the other three (LNRGDP, LNICT, LNDFS) were stationary at first difference. On the other hand, the Phillips Perron test shows that all the variables are stationary at level except LNDFS which is stationary at first difference. This gives us a mixture of order of integration. Therefore, the use of ARDL will be appropriate to test for cointegration and estimate the long run and short run dynamics. The ARDL also gives desirable statistical properties even in small samples and provides information about the long-run relationship between the model's variables while retaining the information about the short-run adjustment in the variables.

Table 3: Lag Length Selection Criteria Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	92.01872	NA*	0.000255	-5.438670	-5.209648	-5.362756
1	94.07718	3.345001	0.000239*	-5.504824*	-5.229998*	-5.413727*
2	94.47841	0.626929	0.000249	-5.467401	-5.146771	-5.361121

Source: Researchers' computation using E-views 12

From Table 3, the lag length selected by all the criteria is one except LR. Since the majority of the selection criteria chose one (1), it is therefore considered to be the optimal lag length. The Akaike Information Criterion was chosen to be the criterion with the least value.

Bounds Test for Co-integration

Table 4: Bounds Test for Co-integration Result

Model	F-Stat.	Significance Level	Critical Value	
			I(0)	I(1)
LNRGDP	4.222**	10%	2.45	3.52
		5%	2.86	4.01
		1%	3.74	5.06

Source: Researcher's computation using E-views 12

The bound test for cointegration result is shown in Table 4 to ascertain a cointegration or not; Pesaran et al. (2001) stated that the computed F-statistic should be compared with the lower and upper-bound values at chosen significance levels. From the result above, the computed F-statistic, which is 4.222, is more than the upper bound value (4.01) at the 5% significance level. Therefore, the null hypothesis of no cointegration is rejected. This shows that there is a long-run relationship between digitalization and economic growth in Nigeria.

Table 5: Long-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNDFS	0.024	0.011	2.151	0.042
LNINS	0.122	0.022	5.506	0.000
LNGFK	0.194	0.051	3.815	0.001
LNICT	0.255	0.089	2.878	0.009

Source: Researchers' computation using E-views 12

Table 5 shows the long run results. Digital financial services have a positive and statistically significant effect on Nigeria's economic growth at a 5 percent level. A percentage increase in digital financial services will lead to an increase in Nigeria's economic growth by 0.02 percent. This implies that a 10 percent rise in digital financial services increases Nigeria's economic growth by 0.2 percent. It is expected that an increase in the supply and usage of digital financial services will lead to an increase in the growth of the economy. For instance, better digital financial services can mean stronger links with the Nigerians in the diaspora, which will eventually boost the inward remittance streams, encourage investments, and facilitate the exchange of human capital thereby translating into economic growth. The low magnitude of the contribution of digital financial services to economic growth can be traced to the slow pace at which the populace is embracing digital financial products. A survey by Enhancing Financial Innovation &

Access (2020), reports that only 45 percent of Nigerians are banked out of the estimated 106 million adults and only 28 percent are active digital financial services users. This shows that digital financial services are not being used at the maximum capacity and Nigeria is currently capturing just a small fraction of its digital financial services potential (World Bank, 2019). As expected, developing countries like Nigeria take time to learn and adapt to new technologies (Chiemeke & Imafidor, 2020). In addition, there seems to be a diminished trust in the use of these services due to the activities of Ponzi schemes that collected funds from their victims through instant payment channels (World Bank, 2019).

Internet subscription has a positive and statistically significant effect on Nigeria's economic growth at a 1 percent level. A 10 percent increase in internet subscriptions will increase Nigeria's economic growth by an average of 1.2 percent. The result is in line with the empirical studies of Myovella et al. (2020); Haini (2019); Bahrini and Qaffas (2019) that found a significant positive impact of internet penetration on economic growth. In addition, the results confirm previous theoretical studies suggesting that internet usage should improve economic growth by accelerating the development and adoption of innovation processes and thereby fostering competition which results in the development of new processes, products and business models (Aghion and Howitt 1998; Romer 1990).

Gross fixed capital formation also has a positive and statistically significant effect on Nigeria's economic growth at a 1 percent level. A 10 percent increase in gross fixed capital formation would yield an increase of 1.9 percent in Nigeria's economic growth. This is in line with the findings of Myovella et al. (2020). It is expected that an increase in capital formation should lead to an increase in the output of an economy since new equipment; plants and machinery etc. replace old ones and therefore enhance productivity.

ICT contribution to GDP was both positive and statistically significant at a 1 percent. A 10 percent increase in ICT contribution to GDP results in an average increase of GDP by 2.6 percent.

Table 6: Short-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNDFS)	-0.047	0.027	-1.763	0.091
D(LNINS)	0.089	0.042	2.148	0.043
D(LNGFK)	0.184	0.031	6.033	0.000
D(LNICT)	-0.114	0.074	-1.546	0.136
C	10.224	2.052	4.983	0.000
ECT(-1)	-0.945	0.189	-4.978	0.000

Source: Researchers' computation using E-views 12

Since the existence of a long-run relationship between digitalization and economic growth in Nigeria has been found by the bounds test, the short-run relationship was examined. From the result in Table 6, the error correction term (-0.945) which is the speed of adjustment is both negative and significant. It means that the system would adjust to equilibrium at a speed of 94.5% in the long-run. However, digital financial services had a negative relationship with GDP though weakly significant. This is because the usage of digital financial services requires some level of digital literacy which may not be readily available when those services are first introduced. It takes time for people to be enlightened on how to use these services. Also, the readiness to adopt and use these services by the people is usually very low at the beginning hence the negative relationship in the short run. ICT contribution to GDP was also negative but insignificant. Internet subscription and gross fixed capital formation were both positive and significant in the short-run.

Table 7: Diagnostics Test Result

Item	Test Applied	Chi-Square	P-value
Serial correlation	Breusch-Godfrey LM	0.202	0.297
Heteroscedasticity	Breusch-Pagan-Godfrey	0.174	0.171
Normality	Jarque-Bera	1.591	0.451
Linearity	Ramsey RESET	0.820	0.820

Source: Researcher's computation using E-views 12

The result in Table 7 shows no evidence of serial correlation or heteroscedasticity. The null hypotheses of no serial correlation and no heteroscedasticity were accepted as the probability values are not significant. Furthermore, the null hypothesis of normality distribution was accepted, showing that the residuals are normally distributed. The Ramsey RESET also shows that there is a linear relationship between the dependent variable and the independent variables which show that the model is well-specified. Since the variables have passed the tests, it can be relied upon to make inferences that could be useful for effective policy-making.

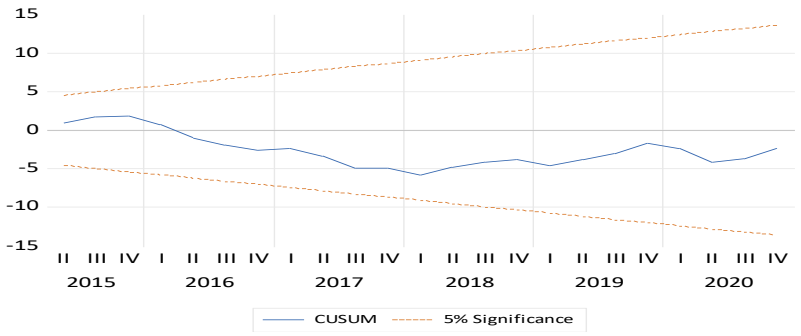

Figure 1: Plot of Cumulative Sum of Recursive Residual

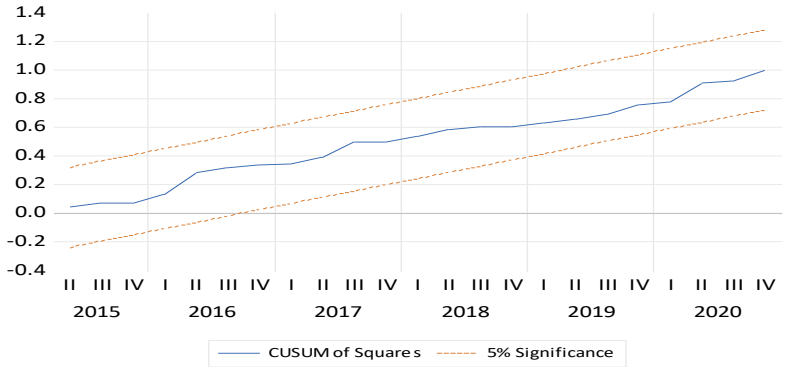

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residual

The result in Figures 1 and 2 show that our parameter estimates are stable because the CUSUM and CUSUM of Squares statistics fall within the critical bounds of the 5% confidence interval of parameter stability.

Conclusion and Recommendations

This paper investigates the relationship between digitalization and economic growth in Nigeria between 2012Q3 and 2020Q4 using the Autoregressive Distributed Lag (ARDL) approach. The empirical findings revealed that there is a long-run relationship between digitalization and economic growth in Nigeria and about 94.5 percent of the disequilibrium that occurred in the previous quarter's shock converges back to the long run equilibrium in the current quarter. Furthermore, a long run positive relationship was found between internet subscriptions, digital financial services, gross fixed capital formation and ICT contribution to GDP. However, the magnitude of the impact of digital financial services was minimally traceable to the slow pace at which the populace is adopting digital technologies and the diminished trust in digital financial services arising from the activities of Ponzi schemes. Therefore, the study concludes that there is a positive relationship between digitalization and economic growth in Nigeria.

Several policy implications and recommendations can be derived based on the findings. Financial institutions, the Central Bank of Nigeria, government agencies and civil societies should collaborate on enhancing financial literacy and capability. Targeted financial literacy campaigns should be carried out to enable people better understand and make use of digital financial services that suits their needs and also increase their trust in these services. The government should also stimulate the deployment and diffusion of digital infrastructure in the country through several policy

interventions such as tax reduction, subsidies, promotion of e-commerce and innovation hubs and developing public–private partnerships. Furthermore, the government should provide a stable power supply in the country to enable the mobile network operators lower their cost of operations. This will eventually translate into lower costs of internet hence an increase in affordability and usage of the internet.

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