Original Research Article

Information Communication Technology and Economic Growth in Nigeria

Abstract

The study examined the impact of internet usage and telephone subscription on economic growth in Nigeria between 1996 and 2020. Auto Regressive Distribution lag (ARDL) method of estimation was used to achieve the objective of the study. The result established that, there exists a relationship between internet usage and telephone subscription on economic growth in Nigeria. Hence, the result shows that mobile telephone subscription has a positive and significant effect on economic growth both in short run and long run, while Internet Usage revealed a negative and insignificant relationship with the economic growth in Nigeria. Though it was expected that the result for Internet Usage should be positive and significant but it was otherwise; this could be as a result of numerous problems facing the Nigerian economy such as lack of power supply, high poverty lever and high ICT illiteracy rate.

Keywords: Internet Usage, Telephone Subscription and Economic Growth. ICT

1. Introduction

Information Communication Technology having its notable segment as Information Technology (IT) that includes radio, television, and the newest digitalize technology such as computer and the internet which are powerful tool that has experienced enormous growth in present-day times (Appiah-Otoo & Song 2021; Ukwuoma 2019; Stanley, et al 2018). This lays emphasis on the function of the role of consolidated communications and the modification of

telecommunications, which include computers telephone lines, wireless signals, as well as necessary applications software, storage, audio-visual systems and other electromagnetic system.

ICT can be described as a means electronically use for capturing, processing, storing and communicating information (Ukwuoma 2019). With so many importance to human comfort ability and sustainability, ICT has increase economic growth in both rich and poor countries of world (Appiah-Otoo and Song 2021) while, the developed countries have benefited more than the developing countries (Stanley, et al, 2018). However, ICT is also not void of some disadvantages which arises from the failure of cyber security that account for 39% respondent as a clear and present danger (0-2years) while the knock on effect that is the medium form risks (3-5years), having IT infrastructure breakdown and cyber security failure at 53.3 and 49% respectively. This made the former, a joint top ranking with Asset Bubble Burst and the later, making the top 8 ranking (The Global Risks Report 2021).

Notwithstanding, the significance of ICTs cannot be under-emphasize even at the expense of its disadvantages. It use can increase economic growth, productivity, employment opportunity and to achieve sustainable development (Stanley et al, 2018, Gomez-Barroso & Marban-Flores,2020a; Gomez-Barroso & Marban-Flores, 2020b; Vu, et al, 2020). Developing and underdeveloped countries have experienced tremendous growth in ICT investment (Dedrick et al. 2013, Myovella et al. 2020). In Nigeria according to NBC, ICT sector was regarded as the fastest growing throughout 2020 and it's critically driving infrastructural development that has resulted into the fast growth of technologies and their market. The world's developed and developing countries started immensely to harness ICT for economic growth and sustainable development (Hodrab et al., 2016).

Over the last decades, the great diffusion of information and communication technology (ICT) has caused a dramatic transformation of the world into an information society. Thanks to ICT infrastructure such as fixed-line telephones, mobile phones, Internet, and broadband, people, firms and governments now have much better access to information, knowledge, and wisdom than before in terms of scale, scope, and speed. ICT diffusion has substantially improved the efficiency of resources allocation, enormously reduced production costs, and promoted much greater demand and investment in all economic sectors (Pradhan et al. 2015). Recently, ICT is believed to foster sustainable long-term growth as a production technology through carefully designed ICT systems as level of productivity have a tendency to increase with time. (Alani, 2012; Cordona et al 2013). The principal function of ICT is in enabling humans, governments and organizations to transform information into knowledge as a strong driver in evolving lasting change in the economy and society (Kim, 2013; Lyon, 2013).

The role of ICT in economic growth has a critical place in economic research; although ICT has become an active area for investment because of its dwindling cost of services and equipment most especially with the innovation of cloud computing and the investment into ICT which includes computers and their peripherals, software, and telecommunications devices. (Hodrab et. al, 2016). Countries which comprise of the private and public-sector investors have invested in ICTs to improve their performance and to gain other benefits of ICTs thereby creating more jobs and information space for their citizens.

In Nigeria, at the wake of 2000 with just 200,000 users that account for 0.1% penetration according to ITU (The International Telecommunication Union), the Federal Government of Nigeria embarked on an aggressive drive towards the provision of more efficient services in the nation through its privatization and deregulation policies. The policy thrives led to the

establishment of National Telecommunication Policy in December 2001. The policy, among other things, recognized the need for the establishment of an enabling environment for deregulation and rapid expansion of the telecommunication services in the country. The introduction of the GSM in Nigeria was to expand the tele-density in the country and to make telephone services cheaper and accessible to the common person as it had been introduced in some African countries like South Africa, Ghana, and Benin Republic among others. To date, at least four competitive GSM service providers have been fully licensed in the country. These Telecommunication Networks have created significant effects on the gross domestic product (GDP) of Nigeria in terms of job creation, communication linkages, connectivity, security of lives, and reduced transport costs among other and according to the Internet World Stats(IWS), the internet usage in Nigeria has 3.1% penetration with 5,000,000 users increased drastically to 51.1% penetration with over 92,000,000 and in 2020 Nigeria hit over 154,000,000 users with penetration and internet growth at strategic 73% and 101,484% respectively in 2022.

In Nigeria, ICT has contributed hugely to the country's Gross Domestic Product (GDP), at 13.8 per cent as at the end of the second quarter, 2019 and its regarded as the fastest growing sector throughout 2020 and its critically driving infrastructural development that has resulted into the fast growth of technologies and their market, while its sub-arm, telecoms have remained a "Star Performer", according to the Nigeria Bureau of Statistics (NBS). However, other sub-sectors, including software, hardware, e-learning, e-commerce, among others are, however, struggling to live up to expectations and make Nigeria more competitive, not only in Africa but across the globe. She has also outperform South Africa by emerging as a premier investment destination with 55 active tech hubs raising a total of US$ 94.9 million to South Africa at US$60.0 million with 59 active start-ups (Usman, Choi, & Dutz, 2019). However, Nigeria is still

very much a consuming nation. The country's technological prowess is abysmally low. she has consistently, in the last seven years ranked lowest in the Global Innovation Index (GII) and had not fared better even before then.

Despite, the huge investment made from both government and private sector with the view of making the country a tech infrastructural economy. As indicated by Ramachandran et al (2019) Nigerian tech firms are still very much constrained by the fundamental problem that as affected other sectors; poor electricity, low access to finance, political instability, and corruption are severe constraints that were indicated by tech firms, while the gender inequality in science education and computer literacy are also regarded as major problem (Federal Ministry of Women Affairs and Social Development, 2019). Other aspects of the business domain, such as taxes, tax administration, courts, and labor regulations, do not apparently importance constraints, even though they raise some concerns.

Economists assume a positive impact on economic performance of any nation, but some empirical literature on this topic reveals the mixed evidence within three identified categorize as indicated by Rahman et al 2021; Technology innovation have no impact on the economy growth of any country (Avgerou 1998; Wang 1999; Pohjola 2002). The second category emphasize that technological innovations have a positive impact on the economic growth of an economy (Rahman et al 2021; Appiah-Otoo & Song 2021; Bahrini & Qaffas 2019; Bilan et al 2019; Haftu 2018; Maurseth 2018; Gruber & Koutroumpis 2011; Lau & Tokutsu 1992; Kraemer & Dedrick 1994; Dewan & Kraemer 2000; Nour & Satti 2002; Choi & Yi 2009). The third category of literature on the impact of ICT developments on economic growth reveals the negative and ambiguous relationship between technological innovation and economic growth (Hassan 2005); Freeman and Soete (1997); Hassan (2005); Shahiduzzaman and Alam (2014) ; Ishida (2015). A

closer look at the existing literature reveals that there is no empirical evidence studying the impact of internet usage and telephone subscription on economic growth in Nigeria. This awaiting issue is the focus of this study to fill the existing gap in the empirical literature.

2. Literature Review

There are numerous studies on the impact and association of ICT and economic growth. Some of the early studies (Solow 1987; Baily 1987; Parsons, et al 1990) could only find a negative impact of ICT on productivity. Solow (1987) asserted that US economy was experiencing a 'productivity paradox', where one can see the 'computer age' everywhere but in the productivity statistics. These periods were dominated by little or no impact of ICTs on the nation's productivity. However, there had been reversed trends in recent studies on the impacts of ICT on productivity. For example, Appiah-Otoo and Na Song (2021) address the question: which countries-rich (high-income countries) or poor (middle-income and low-income countries) which category of country profits more from ICT growth. The rich countries category benefited less from the revolution. Although ICT enhance economic growth in all categorized countries. Gruber and Koutroumpis (2010) found significant positive effects of mobile telecommunications diffusion on GDP and productivity growth. They use data from 192 countries for the 1990 to 2007 period. Vu (2013), using econometrics and growth accounting, find that the intensity of ICT use in Singapore has a significant a significant positive link with the value-added and economic growth, especially in the manufacturing sector. Toader, et al, and Anton (2018) examine the impact of Information and Communication Technology Infrastructure on Economic Growth in EU countries.

The study aims to identify and evaluate the effect of using ICT infrastructure on economic growth in European Union (EU) countries for a period of 18 years (2000–2017). Using

panel-data estimation techniques, they investigated empirically how various indicators of ICT infrastructure affect economic growth, using GDP per capita. The results show a positive and strongly effect of using ICT infrastructure on economic growth in the EU member states. The research reveals that ICT infrastructure, along with other macroeconomic factors, is an important driver of economic growth in EU countries.

Similar results were found by Papaioannou and Dimelis (2007); Yousefi (2011) using a panel generalized method of moments (GMM) and a fixed effect model for 42 developing and developed countries over the period (1993–2001). They found that ICT investments boost growth only in developed countries. Pradhan et al. (2015) confirmed that neither ICT infrastructure plays a significant role in the long-term economic growth of western Asian countries, which includes rich Arab oil producers. This was explained by the great dependence of these economies on oil revenues. Albiman and Sulong (2016) examined the long-run impact of ICT on economic growth in the SSA region for a 27-year period (1990–2014). They proxy ICT with fixed telephone lines, mobile phones, and Internet usage, have a positive and statistically significant impact on economic growth when they used a linear effect analysis. However, when they considered a nonlinear effect analysis, they found that mass penetration of ICT proxies seems to slow economic growth in the SSA region.

Nath and Liu (2017) observed a positive impact of ICT on service trade among 49 countries for the period 2000 to 2013. Niebel (2018) analyzed the impact of ICT on economic growth in 59 developing, emerging and developed countries for the period 1995 to 2010. The panel data regressions showed that there is a positive relationship between ICT capital and GDP growth for the combined sample, but the results of the subsamples showed that developing and emerging countries are not gaining more from investments in ICT than developed economies are.

This indicates that the emerging and developing economies are not 'leapfrogging' through ICT for economic development.

Jakhar (2016) postulated that the Information and Communication Technologies (ICTs) play a major role in economic growth and economic development of India. He examined and analyzed how ICT has driven economic growth of India. More so, secondary data was to draw conclusion on data sourced collected from numerous statistical report and government websites. Findings showed an assessment of sectors of the IT industry and its effect on the economy. Oju and Onyebuka (2016) investigated the major roles that ICT can contribute in enhancing the economies of rural areas in emerging countries, with its main focus on rural areas. ICT has had a great impact on the economic development by enhancing the business activities of rural areas.

Farhadi, et al (2012) also examined the impact of information and communication technology (ICT) use on economic growth among 159 countries for the period 2000 to 2009. They used the number of internet users, fixed broadband internet subscribers and the number of mobile subscriptions per 100 inhabitants as proxies for ICT, using generalization method of moments (GMM), the results reveled that ICT is positively related to economic growth in the countries sampled. Nath and Liu (2017) observed positive impact of ICT on service trade among 49 countries for the period 2000 to 2013; they also found that ICT use is found to be more important than access and skills for trade in a number of services.

Chen et al. (2018) investigates how Internet use affects the access of entrepreneurs or small and micro-businesses to external financing. Empirical results indicate that Internet use plays a positive role in accessing companies' external finance by mitigating financing difficulties, thus contributing to their sustainable development. The authors also point out that

using the Internet would allow more profitable projects to have access to external funding, so that access to the Internet can improve social welfare altogether.

Najarzadeh et al (2014) focuses on investigating the influence of the Internet on labor productivity for 108 countries in the period 1995–2010. The results indicate a positive and significant effect of the Internet on labor productivity, and the authors support the need for governments to take different measures to increase the demand for the Internet and to expand its use. Using data for 62 countries with different levels of development, Yousefi (2011) investigates whether ICT contributes to improving economic growth. The results of the study show that ICT has a bigger impact on GDP growth in upper-middle income countries than in low-income countries. The author points out that for developing countries, growth in GDP is not conditional on investment in ICT. Veeramacheneni et al. (2011) analyze empirically, a sample of 10 Latin American countries during 1975–2003, for is a causal relationship between ICT and economic growth. The authors find that there is a two-way causality between ICT and economic growth in two thirds of the examined countries, and that ICT contributes to economic growth in eight of the 10 countries included in the sample.

Majeed and Ayub (2018) analyze how different ICT indicators influence economic growth in 149 countries for the period 1980–2015. The empirical results indicate that the use of ICT infrastructure has a positive and significant impact on economic growth. Using panel data for 40 Sub-Saharan Africa countries covering the period 2006–2015, Haftu (2018) examines the impact of telecommunication infrastructure on the region's economic growth. The author finds that expanding ICT in the form of mobile phone subscriber's growth has been an important contributor to increasing the per capita income of the region for the period under review. This is the reason for why the results indicate that a 10% increase in mobile phone penetration leads to a

1.2% change in GDP per capita.

Oladimeji and Folayan (2018) reviewed the growth benefits that the ICT sector has provided and its impact on the Nigerian economy and postulated that the growth rate as an apparatus to the progression of economies of emerging countries likes Nigeria in the 21st century. Gadzama, et al (2019) carried out a study on utilization of ICT and Technology Transfer: a panacea to Nigeria's Economic Development. The Nigeria's Vision 2020 seeks to place the country among the 20 leading global economies. This can only be achieved if Nigerian government can effectively integrate Information and Communication Technology (ICT) and technology transfer via innovation in modern technology and industrialization into virtually all the facet of the country's economy. The discussion in the paper is centered on the utilization of ICT and technology transfer in Nigeria's economy. In pursuit of her economic development, Nigeria have seen the need to acquire novel technologies, equipment, skills and license for intellectual property rights that is readily available in the advanced foreign countries. The drive for attainment of economic growth and development mentioned above has resulted to the introduction of technology transfer in Nigeria; the huge success achieved in the country's ICT sector over the years for instance in the aspect of telecommunication have helped in improving the stability of the country's economy.

3. Data and Methodology

3.1 Source of Data

The study utilized time series secondary data ranging from 1996 to 2020 to obtain the variables in the model. Data on real gross domestic product, internet usage, inflation rate, mobile cellular subscription and terms of trade were obtained from World Bank indicators (2021). The result of the augmented Dickey-Fuller (ADF) test was employed to determine the existence of

unit root. This however, helps to influence the choice of estimation technique. The research uses autoregressive distribution lag (ARDL) bounds testing model (Paseran & Shin 1999; Paseran et al. 2001).

3.*2Trends of Internet Usage and Mobile cellular subscription in Nigeria between 1996 and 2020*

Below are the trends of internet usage and mobile cellular subscription presented in below

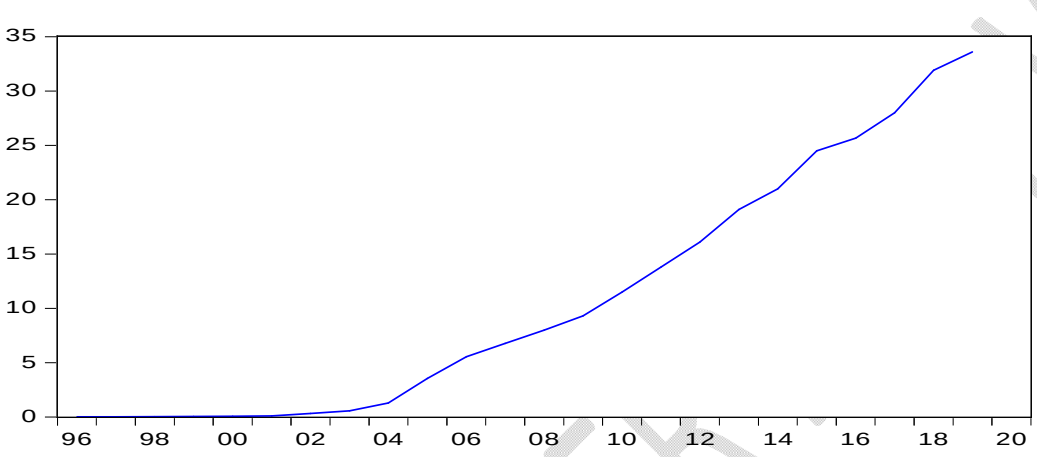

Figure 1: Trend of Internet Usage

From the figure 1 above it is observed that the value of Internet Usage is stagnant from the year 1996 to 2001/2002 and in 2002 it surges up has been increasing till date.

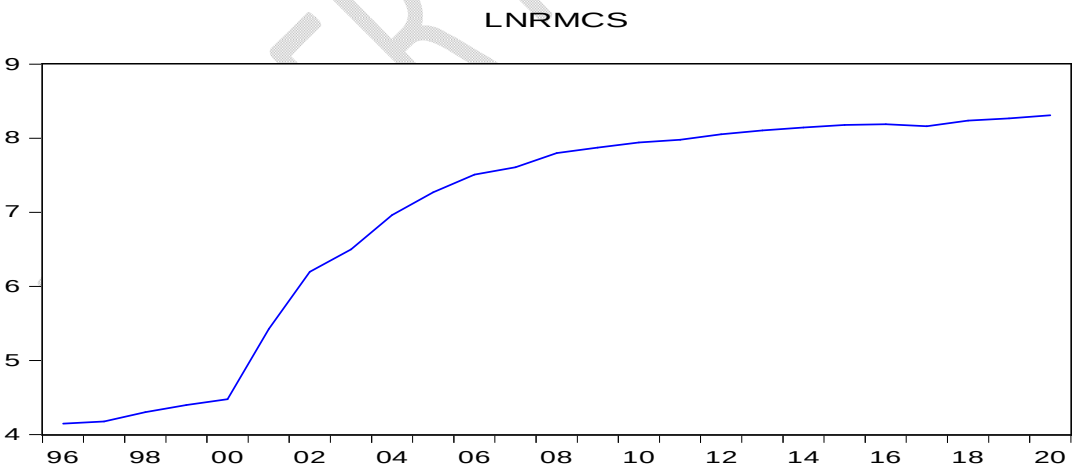

Figure 2: Trend of Mobile Cellular Subscription

From the figure 2 above it is seen that mobile Cellular Subscription is increasing from 1996 to 2000/2001 and then skyrocketed in 2001 and has been increasing till date.

3.2 Model Specification

The model is specified as an implicit function will be;

The functional model that will be used in this analysis is represented below;

GDP = f (IUI, INF, MCS, TRD) (3.1)

Where;

GDP – Gross Domestic Product, IUI – Internet Usage , INF – Inflation Rate ,MES – Mobile cellular subscription, ,TRD – Trade

According to Green 2003, the generalized ARDL (p,q) model is shown as follows;

$$Y_t = \gamma_{0i} + \sum_{i=1}^{p} \delta_t Y_{t-i} + \sum_{i=0}^{q} \beta_i^I \; X_{t-i} + \varepsilon_{it} \qquad (3.2)$$

Where γ and ε_{it} are constant and vector of the error terms respectively, Y_i^I is vector and X_t^i are variables which are purely I(0) and I(1) or co-integrated ,p and q are optimal lag orders, where i = 1,..., k.

However, to perform the bound test which is necessary to ascertain the co-integration; the condition ARDL (p, q_1,q_2 q_3,q_4)

Hypothesis

H_0:$\beta_{1i} = \beta_{2i} = \beta_{3i} = \beta_{4i} = \beta_{5i} = 0$

H_1: $\beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq \beta_{4i} \neq \beta_{5i} \neq 0$

where i =1,2,3,4,5

$$\Delta lnRGDP_t = a_{01} + \sum_{i=1}^{p} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta lnRMCS_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-i} + \alpha_{11} lnRGDP_{t-1} + \alpha_{21} IUI_{t-1} + \alpha_{31} INF_{t-1} + \alpha_{41} lnMCS_{t-1} + \alpha_{51} TRD_{t-1} + \varepsilon_{1t} \quad \text{.....} (3.3a)$$

$$\Delta IUI_t = a_{02} + \sum_{i=0}^{p} \beta_{2i} \Delta IUI_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta lnRMCS_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-i} + \alpha_{12} lnRGDP_{t-1} + \alpha_{22} IUI_{t-1} + \alpha_{32} INF_{t-1} + \alpha_{42} lnMCS_{t-1} + \alpha_{52} TRD_{t-1} + \varepsilon_{2t} \quad \text{.....} (3.3b)$$

$$\Delta INF_t = a_{03} + \sum_{i=0}^{p} \beta_{2i} \Delta INF_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta lnRMCS_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-i} + \alpha_{13} lnRGDP_{t-1} + \alpha 1_{23} IUI_{t-1} + \alpha_{33} INF_{t-1} + \alpha_{43} lnMCS_{t-1} + \alpha_{53} TRD_{t-1} + \varepsilon_{3t} \quad \text{.....} (3.3c)$$

$$\Delta lnRMCS_t = a_{04} + \sum_{i=0}^{p} \beta_{2i} \Delta lnRMCS_{t-i} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-i} + \alpha_{14} lnRGDP_{t-1} + \alpha_{24} IUI_{t-1} + \alpha_{34} INF_{t-1} + \alpha_{44} lnMCS_{t-1} + \alpha_{54} TRD_{t-1} + \varepsilon_{4t} \quad \text{.....} (3.3d)$$

$$\Delta TRD_t = a_{05} + \sum_{i=0}^{p} \beta_{2i} \Delta TRD_{t-1} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta lnRMCS_{t-i} + \alpha_{14} lnRGDP_{t-1} + \alpha_{24} IUI_{t-1} + \alpha_{34} INF_{t-1} + \alpha_{44} lnMCS_{t-1} + \alpha_{54} TRD_{t-1} + \varepsilon_{5t} \quad \text{.....} (3.3e)$$

Where, $\alpha_1 \alpha_{2,} \alpha_3, \alpha_4, \alpha_5$are coefficients that measure long run relationships While, $\beta_1, \beta_2, \beta_3\ \beta_4\ and\ \beta_5$ are the coefficients that measure short run dynamic relationships.

4. Results and Discussion

4.1Unit Root Test Result

Table 1: Augmented Dickey-Fuller (ADF) Test

ADF Statistics at Level			ADF Statistics at First Difference		
Variables	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Order of Integration
RGDP	0.4247	0.9437	0.0038	0.0067	I(1)
IUI	1.0000	0.2342`	0.1598	0.0055	I(1)
INF	0.0000	0.0003	0.0020	0.0130	I(0)

MCS	0.0950	0.0000	0.0960	0.7124	I(0)
TRD	0.1658	0.0705	0.0001	0.0007	I(1)

Source: Author's computation (2022).

The unit root test (using Augmented Dickey-Fuller) from Table above shows that the stationarity of the variables was a combination of I(0) and I(1). As such, the appropriate estimation technique to employ for inference is the Auto-regressive Distributed Lag (ARDL) Model.

4.2 ARDL Bound Co-integration Test

In response to the mixture of unit root tests result presented in table 1 above, the study carried out the co-integration test using the ARDL Bound Co-integration test. Pesaran and Shin (1999) and Pesaran,et al (2001) provide two asymptotic critical values (lower and upper) bounds for testing the existence of co-integration when the regressors are purely I(0) or I(1). A lower value assumes the regressors are purely I (0) while an upper value assumes the regressors are purely I (1).

Table 2; Result of ARDL Bound Co-integration Test

Dependent Variable	**F statistics**	**Lower Bound @ 5%**	**Higher Bound @ 5%**	**Co-Integration**
LNRGDP	5.511148	2.86	4.01	YES
IUI	7.914971	2.86	4.01	YES

INF	1.559910	2.86	4.01	NO
LNRMCS	6.416570	2.86	4.01	YES
TRD	1.908293	2.86	4.01	NO

Source: Author's computation (2022).

The result of the bounds test Case 3: Unrestricted Constant and No Trend showed that the F-statistic values are higher than the lower bound (I(0)) and upper bound (I(1)) critical values of 2.86 and 4.01 at 5% significance level except for TRD variable which the F-statistic value is lower than the lower bound (I(0)) and upper bound (I(1)) critical values of 2.86 and 4.01 at 5% significance level . Hence, there exit a long-run relationship between the variables when LNRGDP, IUI, INF and LNRMCS are dependent variables while there exist no long-run relationship when TRD is the dependent variable. After confirming that there exists a long run relationship among the variables when LNRGDP, IUI, INF and LNRMCS are the independent variable, and there exist no long-run relationship when TRD is the dependent variable.

The following models are estimated;

Short Run Model Specification

$$\Delta INF_t = a_{05} + \sum_{i=0}^{p} \beta_{2i} \Delta INF_{t-1} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta lnRMCS_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-1} + \varepsilon_{5t} \quad \ldots .3.4a$$

$$\Delta TRD_t = a_{05} + \sum_{i=0}^{p} \beta_{2i} \Delta TRD_{t-1} + \sum_{i=1}^{q} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{4i} \Delta INF_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta lnRMCS_{t-i} + \varepsilon_{5t} \quad \ldots .3.4b$$

Long Run Model Specification

$lnRGDP_t = a_{01} + \alpha_{11} lnRGDP_{t-1} + \alpha_{21} IUI_{t-1} + \alpha_{31} INF_{t-1} + \alpha_{41} lnRMCS_{t-1} + \alpha_{51} TRD_{t-1} + \varepsilon_{1t}$ ..... (3.4c)

$IUI_t = a_{02} + \alpha_{12} lnRGDP_{t-1} + \alpha_{22} IUI_{t-1} + \alpha_{32} INF_{t-1} + \alpha_{42} lnRMCS_{t-1} + \alpha_{52} TRD_{t-1} + \varepsilon_{2t}$ ..... (3.4d)

$lnRMCS_t = a_{04} + \alpha_{14} lnRGDP_{t-1} + \alpha_{24} IUI_{t-1} + \alpha_{34} INF_{t-1} + \alpha_{44} lnRMCS_{t-1} + \alpha_{54} TRD_{t-1} + \varepsilon_{4t}$ ..... (3.4e)

Error Correction Model Specification

$\Delta lnRGDP_t =$
$a_0 +$
$\sum_{i=1}^{p} \beta_{1i} \Delta lnRGDP_{t-i} + \sum_{i=0}^{q} \beta_{2i} \Delta IUI_{t-i} + \sum_{i=0}^{q} \beta_{3i} \Delta INF_{t-i} +$
$\sum_{i=0}^{q} \beta_{4i} \Delta lnRMCS_{t-i} + \sum_{i=0}^{q} \beta_{5i} \Delta TRD_{t-i} + \delta ECT_{t-1} + \varepsilon_t$ ..... (3.5)

4.3 The ARDL Result

Therefore, the study presents both long and short run ARDL regression estimates below. From the long run estimate presented on table 3 below;

ARDL Cointegrating And Long Run Form
Dependent Variable: LNRGDP
Selected Model: ARDL(1, 1, 0, 1, 1)
Date: 09/28/22 Time: 11:44
Sample: 1996 2020
Included observations: 23

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IUI)	0.010951	0.007869	1.391733	0.1857
D(INF)	-0.004786	0.001983	-2.413259	0.0301
D(LNRMCS)	0.130400	0.036717	3.551489	0.0032
D(TRD)	0.001158	0.000725	1.597236	0.1325
CointEq(-1)	-0.923751	0.209616	-4.406876	0.0006

Cointeq = LNRGDP - (-0.0010*IUI -0.0052*INF + 0.0970*LNRMCS -0.0007 *TRD + 13.0383)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IUI	-0.001013	0.001083	-0.935708	0.3653
INF	-0.005181	0.002022	-2.561931	0.0226
LNRMCS	0.097002	0.007225	13.425126	0.0000
TRD	-0.000719	0.001008	-0.713423	0.4873
C	13.038324	0.060990	213.778458	0.0000

Table 3: ARDL cointegrating and long run form results

4.4 Discussion of the result

The result shows that (LNMMCS) Log of Mobile cellular subscription had positive and significant effect on economic growth (LNRGDP); both in short run and long run in Nigeria. This indicates that increase in Mobile cellular subscription has the tendency to increase the level of economic growth in Nigeria in a significant manner. Hence a unit increase in the Mobile cellular subscription in the country will increase the economic growth both in the short run and long run. However, both short run and long run result for (INF) Inflation Rate and (TRD) Trade revealed a negative relationship with the economic growth in Nigeria but while Trade was statistically insignificant, at both short and long run, Inflation rate is otherwise significant

statistically at both run. Though it was expected that the relationship between Internet Usage and Economic Growth should be positive and significant both at long and short run, however, it was discovered that at short run there exist a positive relationship between Internet Usage and Economic Growth but insignificant. This means that, although there exist an increase in the variable which will have a positive effect on the economic growth but such effect may not be significant as revealed by the result. Furthermore, the relationship between them at the long run is negative and insignificant. This could be as a result of lack of power supply, poverty, high level of ICT illiteracy, and lack of internet ready PC's.

Finally, (ECM term (-1)) had the expected negative signed and is statistically significant. The coefficient estimate of the error correction term of -0.923751 implied that the regression estimate corrects its short-run disequilibrium by about 92 percent speed of adjustment in order to return to the long-run equilibrium.

4.5 Diagnostic Test Statistic

To ensure the robustness, the normality and heteroskedasticity ARCH tests were conducted. The normality test results showed that the probability value of the Jarque-Bera statistics is greater than 5% at 0.415936, which indicate the residuals from the estimates are normally distributed while the heteroskedaticity ARCH test at 0.7681 also shows the absence of serial correlation in the estimation. This is because the probability value is greater than 0.05. The results shows appropriateness of the regression estimates.

V. Conclusions and Policy Implications

5.1 Conclusion

The study reviewed the roles of ICT has played on Economic Growth using Internet Usage and Mobile cellular subscription as a proxy. The level of Internet Usage and Mobile cellular subscription in Nigeria has increased overtime as shown by the trend of Internet Usage and Mobile cellular subscription in figure 1 and 2 above, also by the ARDL analysis. Mobile cellular subscription has the tendency to increase the level of economic growth in Nigeria in a significant manner both in the short run and long run while in both short run and long run, Internet Usage revealed a negative and insignificant relationship with the economic growth in Nigeria suggest that the underlined problem facing the economy need immediate and accurate intervention to experience the true dividend of internet access and its usage Farhadi et al (2012).

5.2 Policy implications

ICT in Nigeria has had a slow growth according; as a result this study proffers the following recommendations in order to solve the problems of ICT in Nigeria.

1. The Government should allocate more funds for the realization of an ICT driven Nigeria.
2. Government should work on our power supply in order to foster ICT development.
3. Companies should educate their workers on the trends of ICT, seminars and overseas programmes for ICT should be considered an option.
4. Awareness and Provision of ICT services in rural areas.
5. Any individual suspected to be involved in duping and cybercrimes should be reported to the police immediately.
6. The provision of cheaper Internet facility can be achieved with the collaboration with the private sector (Telecommunication Companies)

7. Development of a knowledge base with developed ICT driven economies, thus the promotion of indigenous ICT products and services which can be exported to other countries.
8. Encourage youth to go into ICT by creating an enabling environment.
9. Research on ICT driven economy with the collaboration of the Academics.
10. The application of ICT services in all sectors of the country thus promoting accountability

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