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DETERMINANTS OF TELECOMMUNICATIONS SECTOR CONTRIBUTIONS TO DOMESTIC OUTPUT IN NIGERIA

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Abstract

In Nigeria, there has been rising concern that telecommunications sector growth has not been sustainable over time given the rate of economic liberalization. In fact, Investment in telecommunications is among the factors that contribute to economic growth. This study therefore examined the determinants of telecommunications sector contribution to domestic output in Nigeria. Quarterly data for the period 1986Q1 to 2018Q4 were sourced from World Bank Development Indicators, National Bureau of Statistics and Central Bank of Nigeria annual publications. The study employed the Autoregressive Distributed Lag (ARDL) model and bounds test approach to co-integration developed by Pearsan, Shin, and Smith (2001). The results of the long-run estimate indicate that foreign direct investment, institutional framework and labour force have positive and significant impact on the growth of telecommunications

sector. Exchange rate, mobile phone subscription, trade openness proves otherwise, while gross fixed capital formation, medium and high-tech exports remain not significant in the long run. The speed of adjustment at which equilibrium is restored at any one point during disequilibrium is 7.35%. The chow test indicates that deregulation have significant impact on growth of the telecommunications.. Toda Yamamoto Granger-causality result indicates that there is a bi-directional relationship between foreign direct investment and telecom GDP. We recommend that the government should adopt effective policies that can promote the inflow of investment in Nigeria and also, the regulatory policy be further strengthened. These therefore will enable a sustainable growth of the telecommunications industry.
Keywords: GDP, FDI, Telecommunications, Mobile phone, capital formation, liberalization

INTRODUCTION

During the 1980s, the telecommunications sector utility was globally recognized and considered one of the prerequisites for economic growth. In most developing economies including Nigeria, various telecommunications sector regulatory reforms like the opening of boundaries for Foreign Direct Investm ent (FDI), liberalization and privatization were introduced. Nevertheless, the share of foreign direct investment in the telecommunications sector of Nigeria was averaged 2.3% and 17.4% in 1986-98 and 1998-2004 respectively (CBN, 2007). This trend has altered the communication structure of Nigeria leading to the privatization of the state monopoly, NITEL, and the licensing of private operators, and ultimately, the emergence of new telecommunications era.

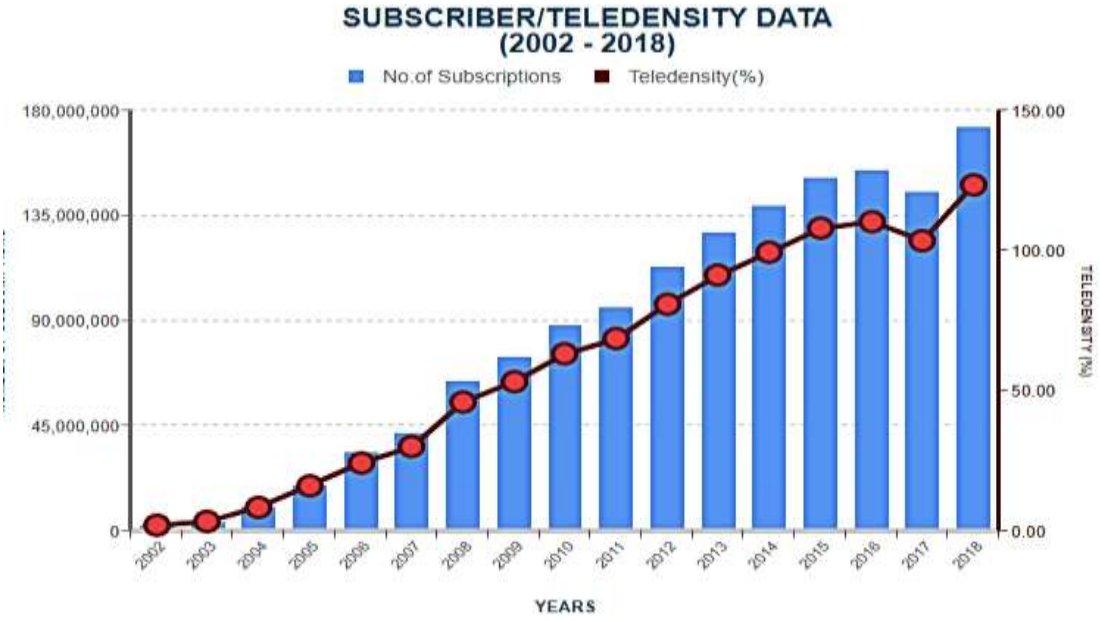
The emergence of this telecommunications prompted a new epoch in the communication industry. The internet, computer, mobile phone and smart gadgets have brought about a fundamental shift in ways of communication and human relation. Evolution in communication patterns has in addition caused amazing economic, social, cultural, and psychological metamorphoses. It has leveled the globe to a small village by means of space and time reduction (Keil and Johnson, in Asogwa, 2013).

In the Asia-Pacific region, telecommunications industry reform has continued to thrive briskly as developing economies like Philippines, Thailand and Taiwan further liberalize their markets to attract foreign direct investment. Similarly, in Latin America, many countries that first privatized their domestic operators in the beginning of the decade are now getting ready for a second round of liberalization and reforms (Chun, 2008). In Nigeria, the telecommunications sector is not an exception to this new development; the sector has been reformed within the past decades. The waiting lists for telephone lines have disappeared, while telephone call rates

for local, national and international calls are slowly ranking among the lowest in Africa. The liberalization of the telecommunications industry and the ensuing competition among private operators have caused significant and great benefits to fixed line and mobile phone subscribers in relation to lesser prices and enhanced choices (NCC, 2011).

Nigerian communications commission which was initiated in 1992 was further empowered, strengthened and restructured in 1999 to control the activities of the private operators in the industry to guarantee improved quality of service and fair play in the sector. Furthermore, the advent of democracy which gave birth to deregulation and the introduction of mobile telephony to Nigeria in 2001 radically altered the country's telecommunications landscape from a base of 0.73% teledensity in 1999 to 16.27% in 2005 (CBN, 2007). By 2018, as shown in Fig 1, Nigeria has 172,871,094 active mobile subscribers as compared to just 2,271,050 in 2002. The country as of 2018 has reached 123.48% teledensity compared to 1.89% in 2002. This phenomenal growth was believed to have been driven by deregulation, FDI and the introduction of mobile telephone in 2001. It was reported that in 2007, Nigeria surpassed South Africa as Africa's largest mobile phone market (Ezeanyaeji and Ifebi, 2016).

Figure 1 Subscribers and Teledensity Trend in Nigeria



Source: NCC, 2018

These recent developments in telecommunications technology have been a driving force for information exchange to develop as a valuable commodity for moving the country into post-industrial and information based economy. In this present era, telecommunications

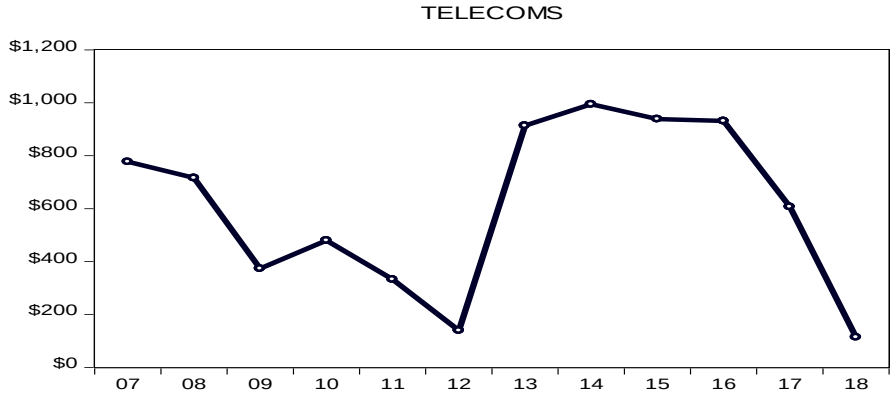
infrastructural expansion is not just vital for domestic economic growth, but also, a prerequisite for participation in increasingly competitive global market and for attracting foreign investments (Asogwa, 2013).

Statement of the Problem

In Nigeria, the deregulation of the telecommunications industry introduced private sector participation which has helped in the improved services and relatively cheaper costs (Nebo, 2015). However, the sector experienced a stalled growth during the second half of 2016 causing deferrals and delays of expansions and upgrades of network facilities. This trend has continued into the 2017Q2 recording 1.92% GDP fall. The major challenges facing the industry are currency movements, low consumer purchasing power and loss of investors' confidence. Foreign direct investment into the sector after deregulation has also been dwindling since 12 years with the sector recording its lowest in the fourth investment quarter of 2012 betokening 97.66 percent decline quarter-on-quarter. Year-on-year, the sector declined by 81.13 percent in 2018 from $606.63m that it had attracted in 2017. As shown in Fig 2a, annual foreign direct investment into the sector started its recent downturn in 2014 when it dropped by 5.65 percent. It also marginally decreased by 0.73% in 2016, 34.85% in 2017 and plummeted further by 81.13% in 2018 which is the highest annual percentage decline in 12 years (NBS, 2019). More so, capital inflow in telecoms is ranking among the lowest by sector which does not indicate so well of the industry (Fig. 2b).

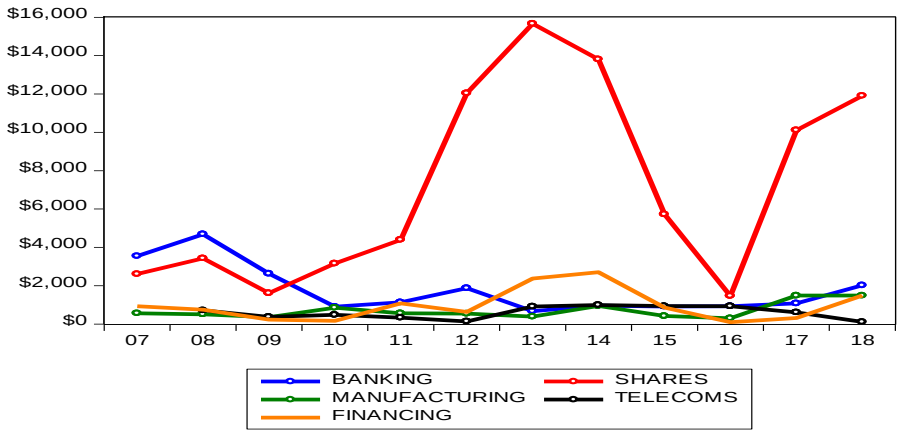
Technically, the inflow of capital into the sector has not been stable due to poor infrastructure, lack of policy transparency, power failure, and political instability (Ezeanyeji & Ifebi 2016). The downward trend thus, has invariably been translated into the low marginal productivity of the sector in the recent years.

Figure 2a Capital Inflows in Telecoms Sector of Nigeria



Source: NBS, 2019

Figure 2b Capital Inflow over Time by Sector in Nigeria



Source: NBS, 2019

LITERATURE REVIEW

Theoretical Literatures

The **Neoclassical Growth Theory** as propounded by American economists Solow (1956) and Swan (1956) are the two well-known contributors to the theory of growth. The Solow (1956) model depicts the productivity (Y) of a business as a function of three variables: capital (k), labour (L), and technological advancement (At).

$Y = K^{a}(A_{t}L)^{1-a}$ (1)

$0 < a < 1$

Technical advancement or knowledge is assumed to be exogenous and thereby independent of both the capital and labour inputs and to be a non-rival entity, which is free for all businesses. The exponents a and (1-a) measure the relative contributions of the two factor inputs, capital and labour. These exponents add to unity, to comply with the constant-returns-to-scale assumption for production.

The **Endogenous Growth Theory** was propounded by Arrow (1965), Romer (1986) and Lucas (1988) as a response to shortcomings and defects in the Solow-Swan neoclassical growth model. The theory explains the long-term growth rate of an economy as a function of endogenous factors as against exogenous factors of the neoclassical growth theory. The Solow-Swan neoclassical growth model describes the long-term growth rate of output based on two exogenous factors which are population growth rate and the rate of technological advancement which are independent of the saving rate (Jhingan, 2010). The new growth theory does not; simply criticize the neoclassical growth theory. It fills a gap by introducing endogenous technical progress in growth models. The endogenous growth models were developed by Arrow, Romer and Lucas, among other scholars.

Unlike neoclassical growth models, the endogenous growth models add that economic growth is driven by two main endogenous factors: human capital stock and technological advancement (Lucas, 1988; Romer, 1986). Nair-Reichert and Weinhold (2001) argue that the new growth models considered long-run growth or productivity as a function of technological advancement and therefore they provided a framework in which investment in telecommunications can persistently boost the rate of economic growth in developed countries through a steady technology shifts or transfer.

Empirical Literature Review

Writing on telecommunications sector and Foreign Direct Investment, Ezeanyaeji and Ifebi (2016); Chia and Ogbaji (2013) revealed that foreign direct investment has contributed significantly to the performance of the telecommunications sector in terms of its contribution to the GDP of Nigeria. Their results are in line with the findings of Shumalia and Khair (2009), Onakoye (2012), Opaluwa et.al (2013), Asogwa, Ohaleme and Ugwuanyi (2013), Isa and Adeniji (2015), Ajala and Adesanya (2015), Oji-Okoro (2015). Asogwa et.al showed that foreign direct investment and telecommunications expenditure have positive and significant impact on economic growth of Nigeria. They observed that electricity consumption and degree of openness have negative and significant impact on the economy. Emma-Collins (2015) used Error Correction Model (ECM) to demonstrate how Foreign Direct Investment (FDI) influenced the growth of the telecommunications sector in Nigeria. The researcher's co-integration result revealed that the degree of openness has a significant positive impact on the telecommunications sector of Nigeria. In India, Azher and Satyanarayana (2017) found that the impact of FDI on the growth of subscribers in telecommunications sector is insignificant. Similarly, Onakoye, Tella, and Osoba (2012) investigated the impact of investment in telecommunications infrastructure on economic growth in Nigeria. Their findings showed that investment in telecommunications infrastructure has a significant impact on output of the economy.

Egwaikhide (2012); Uwazie, Igwemma and Nnabu (2015); Adokwe, Agu and Maduka (2019) indicated the evidence of long-run relationship between foreign direct investment and economic growth in Nigeria. Malik and Imran (2015) investigated the Pakistan economy and discovered that FDI, trade openness and domestic capital positively affected the economic growth of Pakistan. On the contrary, Areej and Ahmed (2017) assessed the impact of foreign direct investment on sectoral growth of Indian economy and discovered that FDI does not have an impact on growth.

Opaluwa et.al (2013) showed that private investment in telecommunications sector and FDI significantly promote the telecommunications sector of Nigeria. Onakoye et. al (2012) showed that investment in telecommunications infrastructure has a significant impact on output of the economy directly through its industrial output. Their result also shows a bi-directional casual relationship between telecommunications infrastructure investment and economic growth.

RESEARCH METHODOLOGY

Model Specification

In this study the endogenous growth theory is adopted to build a model that gives -Foreign Direct Investment (FDI), Gross Fixed Capital Formation (GFCF); proxy for domestic investment, labour force, and medium and high-tech exports- role in telecommunications sector growth. The standard and simplest endogenous growth model is prescribed as:

$Y_t = A(K)F(K_t,L_t)$ (3.0)

Where, Y_t is output (GDP), K_t is capital stock, K without subscript denotes the aggregate stock of capital, A is the technological factor, t is time period, and L_t is stock of labour (labour force). The choice of endogenous growth theory is that it can explain distinctively the long run growth of the telecommunications industry on the basis of endogenous factors as against the exogenous factors of the neoclassical theory.

Contribution of the Telecommunications sector to GDP of Nigeria (LCTGDP) serves as the sector's growth indicator (Yt), foreign direct investment in telecommunications sector of Nigeria and gross fixed capital formation (Domestic investment) are adopted in place of capital (K_t), labour force as a substitute for labour (L_t) and medium and high-tech export (% of manufacturing export) as technological expansion (A). Other variables introduced include; mobile phone subscription, internet users, trade openness, institutional framework and exchange rate. All the variables are in their natural logarithm. Given the empirical literatures and the theoretical exposition of the endogenous growth theory, the model for the study is mathematically expressed as:

$LCTGDP = \alpha 0 + \gamma LFDIT + \tau LLF + \sigma LMHTE + \theta LGFCF + ßLMOPS + \infty LINTU + \Omega LTOPN + \lambda LINST + \mu EXCR + ¥DUM$ (3.1)

Where, LCTGDP is contribution of telecommunications industry to GDP of Nigeria, LFDIT is foreign direct investment in telecommunications sector of Nigeria, LLF denotes log of labour force of Nigeria, LMHTE is the log of medium and high-tech export (% of manufacturing export), LGCFC is the log of gross fixed capital formation, LMOPS is the log of mobile phone subscription, LINTU is the log of internet users, LTOPN is log of trade openness, LINST is log of

institutional framework and LEXCR is log of exchange rate. While *γ*, τ, σ, *θ,* ß, ∞, Ω, λ, μ and ¥ represent the explanatory powers of the variables.

Foreign direct investment in the telecommunications sector of Nigeria (LFDIT), domestic investment proxied as gross fixed capital formation (LGFCF) and medium and high-tech export (LMHTE) are regarded as endogenous factors as justified by the endogenous growth theory. FDI is attracted greatly by the high rate of return on investment in developing countries (Ghose, 2004).

Method of Analysis (Auto Regressive Distributed Lag Model)

The ARDL procedure is conducted in two stages. The first stage is the co-integration analysis by means of the bounds testing developed by Pesaran and Shin (1997) and Pesaran, Shin, and Smith (2001). In the second stage, long-run relationship is determined in the model by estimating the co-integration part of the ARDL model. At this point, if the model is found to be co-integrated, error correction model illustrating the short-run dynamics is estimated afterwards. While our main variable of interest is the determinants of telecommunications sector to the Gross Domestic Product (CTGDP), we included nine other quantitative variables to control the macroeconomic policy and four covariates DUM, DUML_LFDIT, DUM_LMOPS and DUM_INTU to capture how deregulation influenced the growth of the telecommunications sector quantitatively through the interacted variables.

To do the bounds test, the following ARDL model is used:

$$\Delta LCTGDP_t = a_0 + \sum_{i=0}^{P} \delta_i \Delta LCTGDP_{t-i} + \sum_{i=0}^{P} \gamma_i \Delta LFDIT_{t-l} + \sum_{i=0}^{P} \tau_i \Delta LLF_{t-l} + \sum_{i=0}^{P} \sigma_i \Delta LMHTE_{t-i} + \sum_{i=0}^{P} \theta_i \Delta LGFCF_{t-i} + \sum_{i=0}^{P} ß_i \Delta LMOPS_{t=i} + \sum_{i=0}^{P} \infty_i \Delta LINTU_{t-i} + \sum_{i=0}^{P} \Omega_i \Delta LTOPN_{t-i} + \sum_{i=0}^{P} \lambda_i \Delta LINST_{t-i} + \sum_{i=0}^{P} \mu_i \Delta LEXCR_{t-i} + \sum_{i=0}^{P} ¥_i \Delta DUM + \sum_{i=0}^{p} \phi_i \Delta DUM\_LFDIT + \sum_{i=0}^{p} þ_i \Delta DUM\_LMOPS + \sum_{i=0}^{p} Þ_i \Delta DUM\_INTU + \mu_1 LCTGDP_{t-1} + \mu_2 LFDIT_{t-1} + \mu_3 LLF_{t-1} + \mu 4 LMHTE_{t-1} + \mu_5 LGFCF_{t-1} + \mu_6 LMOPS_{t-1} + \mu_7 LINTU_{t-1} + \mu_8 LTOPN_{t-1} + \mu_9 LINST_{t-1} + \mu_{10} LEXCR_{t-1} + \mu_{11} DUM + \mu_{12} DUM\_LFDIT + \mu_{13} DUM\_LMOPS + \mu_{14} DUM\_INTU + \varepsilon_t \quad (3.2)$$

Where, a_0 is the intersect and ε_t the stochastic term, while Δ is the first difference operator. The short-run relationships are estimated by δ, *γ*, τ, σ, *θ,* ß, ∞, Ω, λ, μ and ¥ while long-run relationships are measured by μ_s.

DUM= 1 for the period after deregulation

= 0 for otherwise

The test has the null hypothesis of H_0: μ1= μ2 = μ3 = μ 4= μ5 = μ6 = μ7 = μ8 = μ9 = μ10 = μ11= μ12 = μ13 = μ14 = 0 against the alternative hypothesis H_1: μ1 ≠ μ2 ≠ μ3 ≠ μ4 ≠ μ5≠ μ6 ≠ μ7≠ μ8 ≠ μ9 ≠ μ10 ≠ μ11 ≠ μ12 ≠ μ13 ≠ μ14 ≠ 0. Null hypothesis shows the absence of co-integration.

To carry out the test, which is a familiar coefficient restriction test (F-test), critical values provided by Pesaran, Shin, and Smith (2001) are used. To reduce the risk of multi-collinearity in the model, m-1 dummies were introduced and the covariates in the model were excluded from the lag mechanism in 3.2, where m is the number of categories of the dummy variable. In other words, the dummies or the control variables were not lagged. This is similar to the work of Gile (2015). Also, to ascertain the effect of pre and post eras of deregulation on some the variables of our interest, the dummy variable was interacted with the quantitative regressors in the model.

In the second step, long-run relationship is estimated by using the following equation 3.3

$$LCTGDP_t = a_0 + \mu_1 LCTGDP_{t-1} + \mu_2 LFDIT_{t-1} + \mu_3 LLF_{t-1} + \mu 4 LMHTE_{t-1} + \mu_5 LGFCF_{t-1} + \mu_6 LMOPS_{t-1} + \mu_7 LINTU_{t-1} + \mu_8 LTOPN_{t-1} + \mu_9 LINST_{t-1} + \mu_{10} LEXCR_{t-1} + \mu_{11} DUM + \mu_{12} DUM\_LFDIT + \mu_{13} DUM\_LMOPS + \mu_{14} DUM\_INTU + \varepsilon_t \quad (3.3)$$

Estimating equation for the Error Correction Model (ECM) can be expressed as follows:

$$\Delta LCTGDP_t = a_0 + \sum_{i=0}^{h} \delta_i \Delta LCTGDP_{t-i} + \sum_{i=0}^{i} \gamma_i \Delta LFDIT_{t-I} + \sum_{i=0}^{j} \tau_i \Delta LLF_{t-I} + \sum_{i=0}^{k} \sigma_i \Delta LMHTE_{t-i} + \sum_{i=0}^{l} \theta_i \Delta LGFCF_{t-i} + \sum_{i=0}^{m} ß_i \Delta LMOPS_{t=i} + \sum_{i=0}^{n} \infty_i \Delta LINTU_{t-i} + \sum_{i=0}^{o} \Omega_i \Delta LTOPN_{t-i} + \sum_{i=0}^{P} \lambda_i \Delta LINST_{t-i} + \sum_{i=0}^{q} \mu_i \Delta LEXCR_{t-i} + \sum_{i=0}^{r} ¥_i \Delta DUM + \sum_{i=0}^{s} \phi_i \Delta DUM\_LFDIT + \sum_{i=0}^{t} þ_i \Delta DUM\_LMOPS + \sum_{i=0}^{u} Þ_i \Delta DUM\_INTU + ₽ECM_{t-I} + E_t \quad (3.4)$$

Where, Error Correction Term (ECM_{t-1}) captures the short-run dynamics of the model. ECM_{t-1} guides the variables in the model to restore back to the long-term equilibrium which shows at what rate the short-run disequilibrium is eliminated. The coefficient of the ECM should be negative and as well statistically significant after the estimation, which subsequently confirms that there is a long-run equilibrium relationship among the variables.

Before performing the ARDL estimation and co-integration test, we employed the Augmented Dickey-Fuller (ADF) unit root test to make sure that we do not have any variables that are I(2). After the estimation, the overall stability of our model is checked by applying the cumulative sum CUSUM and CUSUM of squares. We also checked for serial correlation, normality, heteroskedasticity and functionality.

Data Sources

Secondary time series data (1986q1 – 2018q4) were sourced mainly from World Bank Development Indicators between 1986 and 2018. Macroeconomic variables such as contribution of telecommunications sector to GDP (CTGDP0, Gross Fixed Capital Formation, Degree of Openness and Foreign Direct Investment in telecommunications sector (FDIT) were sourced from CBN Statistical Bulletin, CBN Annual Report and Statement of Accounts (2004, 2007, & 2017). E-view 10 econometric package was used to estimate the model.

ARDL EMPIRICAL RESULTS

Unit Root Test

We used the conventional Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests for stationarity. In ADF and PP methods, the null hypothesis states that the time series data have a unit root, that is, they are non-stationary. If the calculated test-statistic for our variables in their level forms are more than the critical values or one of the critical values in absolute terms, as the case maybe, the null hypothesis will be declined, implying that the variables are stationary in their level forms, that is, they are 1(0). In cases where variables are not stationary at levels, we investigated their stationarity in the first differencing. The results of Augmented Dickey-Fuller and Phillips Perron tests are summarized in Table 1.

Table 1 Summary of the Unit Root Test Results (Intercept with no trend)

Variables	ADF	PP
LCTGDP	I(1)	I(1)
LFDIT	I(1)	I(1)
LLF	I(1)	I(1)
LMHTE	I(1)	I(1)
LINST	1(1)	I(1)
LMOPS	1(1)	1(1)
LINTU	1(0)	1(0)
LGFCF	1(1)	1(1)
LEXCR	1(0)	1(1)
LTOPN	1(0)	1(0)

Note: ADF is the Augmented Dickey Fuller test and PP is Phillips-Perron test.

Source: Author's computation from E-views

The Augmented Dickey Fuller and Phillips-Perron test results indicate that Log of contribution of telecommunications sector to GDP of Nigeria (LCTGDP), log of foreign direct investment in telecommunications sector of Nigeria (LFDIT), gross fixed capital formation (LGCFC), mobile phone subscription (LMOPS), institutional framework (INST), labour force of Nigeria (LLF) and medium and high-tech export (LMHTE) are stationary at first differencing while and internet users (LINTU), trade openness (LTOPN) and exchange rate (LEXCR) are stationary at level. None of the variables was stationary at second differencing.

Bounds Test

Table 2 ARDL Bounds Test to Co-Integration

Test Statistic	Value	K
F-statistic	14.25997	13
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	1.76	2.77
5%	1.98	3.04
2.5%	2.18	3.28
1%	2.41	3.61

Source: Author's computation from Eviews 10.

Table 2 above shows the ARDL bounds test result. If the estimated F-statistic is larger than the upper bound of the critical values, then the null hypothesis of no co-integration is declined. If the estimated F-statistic is less than the bottom bound of critical values, that is, the null hypothesis of no co-integration relationship among the variables cannot be rejected. If the calculated F-statistic is between the bottom and upper critical values, then, no exact opinion can be made and we can conclude that it is indeterminate or inconclusive. If the estimate at 5% level of significance indicates the existence of co-integration among the variables, the short-run and long-run models are estimated, however, when the estimate indicates otherwise, only the ARDL model is estimated. The critical values shown in Table 2 are for the case of unrestricted intercept and no trend at 5% significance level. The calculated F-statistic is 14.25997 which is greater than the upper critical value at the 5% level of significance (14.25997 > 3.04). Consequently, we conclude that there is a long-run relationship in the model. In this case, we estimated both the ARDL and ECM.

Long-Run Estimate

Table 3 Summary of Long Run Result

Dependent Variable: LCTGDP

Variables	Coefficient	Std. Error	T. statistic	Prob.
LFDIT	0.268847	0.115446	2.328775	0.0239
LGFCF	0.049311	0.153219	0.321834	0.7489
LMOPS	-1.671850	0.605776	-2.759846	0.0080
LINTU	1.682581	0.428780	3.924113	0.0003

Table 3…

LTOPN	-0.356691	0.162535	-2.194549	0.0328
LINST	1.283379	0.198349	6.470300	0.0000
LEXCR	-0.102884	0.077382	-1.329554	0.1896
DUM	3.323689	1.375035	2.417167	0.0193
DUM_LFDIT	-1.65E-10	6.29E-11	-2.623744	0.0114
DUM_LMOPS	2.185963	0.569909	3.835636	0.0003
DUM_LINTU	-1.524489	0.395464	-3.854937	0.0003
LLF	4.783640	1.021195	4.684354	0.0000
LMHTE	0.032506	0.026333	1.234403	0.2227
C	-89.96056	15.47933	-5.811656	0.0000

Source: Computed by the author from Eviews 10.

Selected ARDL (4,2,2,1,2,2,1,1,2,1,2,2,2,1) by Akike information criterion.

The long-run coefficients in equation (3.2) calculated from the ARDL (4,2,2,1,2,2,1,1,2,1,2,2,2,1) are shown in Table 3. The result indicates that, ceteris paribus, without deregulation policy, the log of foreign direct investment in telecommunications sector (LFDIT), internet users, Institutional framework and labour force in Nigeria have positive and significant impact (p-values < 0.05) on the contribution of telecommunications sector to GDP of Nigeria (LCTGDP). Mobile phone subscription and trade openness have significant and negative impact on the sector. Medium and high-tech exports of Nigeria (LMHTE) and Gross Fixed Capital Formation (LGFCF) have positive and insignificant impact while exchange rate (LEXCR) has negative and insignificant impact.

By implication, 1percent increase in foreign direct investment in telecommunications sector of Nigeria (LFDIT), internet users (LINTU), Institutional framework (LINST), and labour force of Nigeria (LLF) before deregulatory policy, increase the contribution of telecommunications sector to GDP of Nigeria (LCTGDP) by 0.26.8847, 1.682581, 1.283379 and 4.783640 percent respectively in the long-run. Contrarily, 1percent increase in mobile phone subscription (LMOPS) and trade openness of Nigeria (LTOPN) shrink the telecommunications sector growth by 1.671850 and 0.356691percent respectively in the long-run. The negative direction of the trade openness suggests that, ceteris paribus, if Nigeria opens up her economy, the competition among local operators will be affected and consequently affecting the growth of the sector negatively. The mobile phone subscription (LMOP) surprisingly indicates that it negatively affects the growth of telecommunications sector. The coefficient of institutional framework is positive and statistically significant. As

indicated in the result, when the institutional framework is strengthened, telecommunications sector grows by 1.283379 percent in Nigeria.

Medium and high-tech export of Nigeria, gross fixed capital formation and exchange rate are not significant in the model. The control variable (DUM) suggests that the deregulatory policy generally has affected the growth of telecommunications sector of Nigeria significantly in the long-run (p-value < 0.05). By implication, ceteris paribus, a slight deepening of the deregulation policy by the National Communications Commission (NCC) in Nigeria grows the sector by about 3.32 percent. DUM_LMOPS which is mobile phone subscription interacted with the dummy represents the effect of mobile phone subscription on the telecommunications sector after deregulation. The result indicates that deregulation affected the number of mobile phone subscribers, which in turn, significantly affects the growth of telecommunications sector positively by about 2.185963 percent which before deregulation has a negative and insignificant impact on the sector.

DUM_LFDIT which is foreign direct investment interacted with the dummy represents the effect of foreign direct investment after deregulation. The result as shown in Table 4.3, ceteris paribus, suggests that deregulation although, significant, is ineffective in attracting foreign direct investment into the sector in the long-run ($-1.65e^{-10}$). The reasons behind the ineffectiveness might be as a result of some factors which include: multi taxation, political instability, lack of business friendly environment to boost investors' confidence etc. The ineffectiveness of the deregulation policy on FDI in Nigeria as indicated by our result could be one of the reasons why the sector experienced a slight downturn between 2014Q4-2018Q3 as discussed in the problem statement.

DUM_INTU which is the internet users interaction with the control variable is statistically significant, though has negative effect on the growth of telecommunications sector of Nigeria after deregulation. This is a clear indication that the number of internet users in Nigeria declined by 1.682581 percent when the policy was introduced or deepened. Deregulation does not effectively promote the internet users base in Nigeria. This suggests that the policy in place is not effectively executed as there maybe malpractices on the part of telecommunications operators in Nigeria. This is evident in the incidents of poor internet network experienced across Nigeria. Medium and high-tech industry export (LMHTE) is positive but not significant in the model. The under-developed nature of Nigeria's technology industry; low expenditure on R&D- could be the cause of its not being significant in the model.

Short-Run Dynamics

Table 4 Summary of Error Correction Model

Dependent Variable: LCTGDP

Variables	Coefficient	Std. Error	T. statistic	Prob.
CointEq(-1)*	-0.073549	0.028999	-2.536267	0.0126

Source: Author's computation from Eviews 10. Note: CoinEq is ECM.

We employed the parsimonious error correction representation for the selected ARDL (4,2,2,1,2,2,1,1,2,1,2,2,2,1) to proceed with the short-run estimation. Table 4 shows the result of the estimation of equation (3.4). The result indicates that the Error Correction Coefficient (ECM) is negative and statistically significant (p-value < 0.05). It measures the speed of adjustment back to long-run equilibrium following a shock or deviate from equilibrium at any point in time. The coefficient -0.073549, implies that 7.35% of the departure from equilibrium is corrected back to long-run equilibrium in each time period.

Diagnostic Tests

The ARDL model as shown in table 5 passes the diagnostic tests, such as the Lagrange multiplier test of residual serial correlation, Jarque-Bera normality test, functionality test and failed Breusch-Pagan-Godfrey test of heteroskedasticity which is not problematic in a dynamic model like ARDL. We also checked the correlograms of residuals squared, and found no evidence of serial correlation.

Table 5 Summary of the Diagnostic Tests

Test	Test Statistic	d.f	Probability
A: Serial correlation	0.858551	13	0.0828
B: Normality		13	0.0409
C:Heteroscedasticity	10.84186	13	0.0194
D: Functional form		(1, 50)	0.2914

Notes: Based on ARDL (4,2,2,1,2,2,1,1,2,1,2,2,2,1) model selected by using Akaike information criterion. A: Breusch-Godfrey Lagrange multiplier test of residual serial correlation; B: Jarque-Bera residual normality test; C: Breusch-Pagan-Godfrey test of heteroscedasticity D: Ramsey's RESET test.

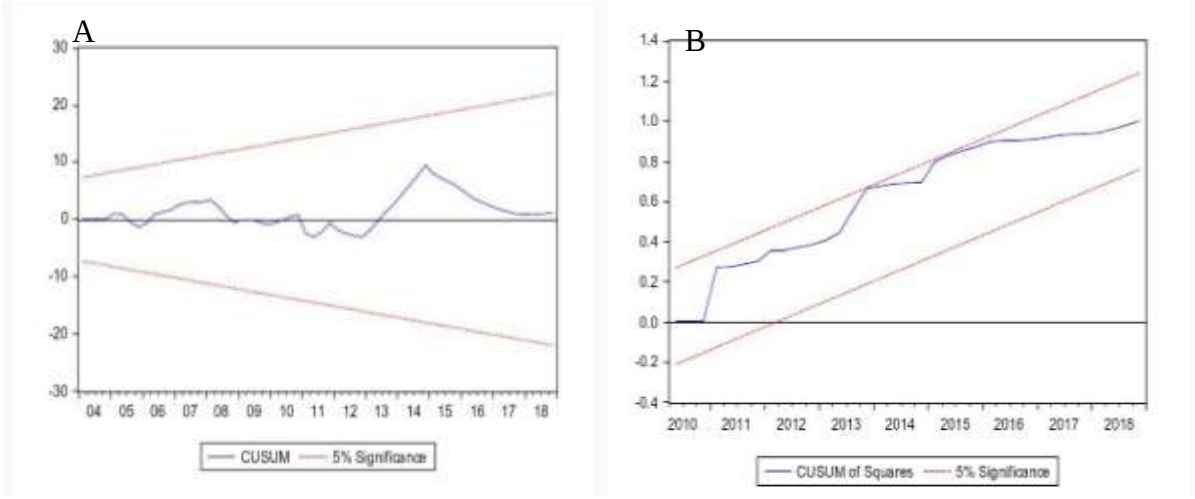
Source: Author's computation from Eviews 10.

As shown in table 5, the p-value of Breusch-Godfrey Lagrange multiplier test of residual is more than 5per cent (0.0828 > 0.05), so we cannot reject null hypothesis. We therefore conclude that there is no evidence of serial correlation among the variables. The p-value of Breusch-Pagan-Godfrey test of heteroscedasticity is slightly less than 5per cent (0.0194 > 0.05), so we reject the null hypothesis and conclude that there is an evidence of heteroskedasticity in the model. The Jacque Bera test result of normality is contained in table 5. If the p-value is less than or equal to the significance level (0.05), the decision is to reject the null hypothesis and conclude that the model did not follow a normal distribution.

The normality test result indicates that the model is not normally distributed (0.409 < 0.05). In other words, since the p-value is less than 0.05, we reject the null hypothesis and conclude that the model is not normally distributed. However, the cases of a little presence of heteroskedasticity and non-normality are not a threat to the dynamic model, provided that there is an absence of serial correlation in the model as indicated in Table 5. Gile (2015) noted that non-normality and heteroskedasticity are not likely to be problems in a dynamic model like ARDL model. In order to validate this, Ramsey Reset test was introduced to test for functionality of the model. If the p-value of the Reset F-statistic is lower than 0.05, we fail to accept the null hypothesis that the y* have zero coefficients. The Reset F-statistic has a p-value greater than 0.05 (0.2914 > 0.05). In this case, we cannot decline the null hypothesis that the functional form of the model is correctly specified.

Stability Test

Figure 3 CUSUM Stability Test Plot



Source: Author's computation from Eviews 10

Fig. 3 displays the stability test result of our model obtained by applying the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) by Brown, Durbin, and Evans (1975). The plots indicate that the dependent variable (log of contribution of telecoms sector to GDP (LCTGDP)) and short-run model parameters satisfied the stability condition of the model. This means that the null hypothesis that the entire coefficients in the regression models are stable cannot be declined because both plots of CUSUM and CUSUMQ test lie within the critical bounds of 5% significance levels.

Table 6 Summary of the Chow Test Results

Chow Breeakpoint Test: 2000Q1-2018Q4	**Value**	**Df**	**Prob.**
F-Statistic	823336.0	**Prob. F(76,6)**	0.0000

Source: Author's computation

The chow break-point test was carried out. In our analysis, we identified the key data at which the connection between our variables could have started to significantly vary. The date is 2000Q1 when deregulation policy was introduced in the Nigerian telecommunications industry. Three major telecommunications operators started operating properly after licenses had been issued a year earlier. Table 6 shows that the p-value recorded in chow test result is less than 5 per cent (0.000 < 0.05). Thus, we reject the null hypothesis of no breaks at the specified breakpoint and we therefore conclude that the implementation of deregulation policy in the telecommunications industry has a significant impact on the growth of the industry in Nigeria.

The Toda and Yamamoto Causality Analysis

Granger-causality is a statistical concept for causality check that is based on prediction. According to Granger-causality, if a variable S1 Granger-causes another variable S2, then past values of S1 should contain information that helps predict S2 above and beyond the information contained in past values of S2 alone. If the p-value is lower than 5% (p value < 0. 05), we reject the null hypothesis that the lagged x-values do not explain the variation in Y. In other words, it suggests that x(t) does not Granger-cause y(t). In the Toda and Yamamoto analysis, an extra lag for all the variables must be included in the model. The lag length is determined by the maximum order of integration in the model (dmax). Since dmax = 1, we estimate (p + dmax) = (6+1) = 7th order VAR. This step can be done by treating the extra lags as exogenous variables in estimations just like the constant. VAR Granger causality/Block Exogeneity Wald Test results

which are based on the asymptotic chi-square distribution are given in Table 7. For simplicity, we checked Granger-causality for just four variables in the model.

Table 7 Summary of Toda-Yamamoto Granger-Causality Test Result

Dependent Variable: LCTGDP			
Excluded	Chi-sq	Df	Prob.
LFDIT	93.91250	6	0.0000
LMHTE	1.909126	6	0.9279
LLF	8.981165	6	0.1746
All	96.93983	18	0.0000
Dependent Variable: LFDIT			
Excluded	Chi-sq	Df	Prob.
LCTGDP	16.53810	6	0.0111
LMHTE	1.402890	6	0.9657
LLF	2.276320	6	0.8926
All	18.57354	18	0.4185
Dependent Variable: LMHTE			
Excluded	Chi-sq	Df	Prob.
LCTGDP	6.468878	6	0.3728
LMHTE	3.452136	6	0.7503
LLF	17.55657	6	0.0074
All	34.33274	18	0.0115
Dependent Variable: LLF			
Excluded	Chi-sq	Df	Prob.
LCTGDP	16.60650	6	0.0108
LFDIT	15.82506	6	0.0147
LMHTE	2.312919	6	0.8888
All	22.28039	18	0.2178

Notes: The null hypothesis is x does not cause the dependent variable (x being one of the variables listed in the first column). There were 94 observations used from 1986Q1 to 2018Q4.

Source: Author's computation from Eviews 10.

DISCUSSION AND POLICY IMPLICATIONS

The long-run estimate of LFDIT in our model conforms to the a-priori expectation. Not surprising, the estimates obtained by Oyeniran and Onikosi-Alliyu (2016), Ezeanyaeji and Ifebi (2016), Opaluwa et.al (2013), Oji-Okoro (2015), Adigun (2015), Adeleke et. al. (2014), Olawumi

and Olufemi (2016) etc using annual time series data and ordinary least squares technique do not only conform to the apriori expectation, but also are consistent with the estimates we obtained using quarterly data. More so, Asogwa et.al (2013) and Onakoye et.al (2012) used co-integration and Three Stage Least Squares technique respectively and FDI results obtained conform to our findings. It is evident from the findings that, ceteris paribus, foreign direct investment in telecommunications promotes the growth of telecommunications industry and the Nigerian economy at large.

The long-run result suggests that Labour Force (LLF) significantly promoted the growth of telecommunications sector in Nigeria. This is consistent with the a-prori expectation and the results obtained by previous studies reviewed like Olawumi and Olufemi (2016) and Maltaqah and Warad (2008). Contrarily, the estimate obtained by Oyeniran and Onikosi-Alliyu (2016) showed that labour force is not significant in the growth of the Pakistan and Nigerian economy respectively. The estimate of the trade openness which is negative and significant suggests that it negatively affects the growth of the telecommunications sector of Nigeria. This estimate is similar to the estimates obtained by Maltaqah and Warad (2008) for Arab countries and Asogwa, et.al (2013) for Nigeria using different techniques.. The gross fixed capital formation estimate conforms to the theoretical expectation and is similar to Malik and Imran (2015). Our finding indicates that domestic investment in Nigeria is developing the telecommunications sector of Nigeria.

Most of the literature we assessed employed trend analysis and descriptive statistics in evaluating the impact of deregulation on telecommunications sector, only Salisu and Ibrahim (2014) employed a more analytical approach. However, our findings have a general consensus that deregulation of the telecommunications sector 'generally' has enhanced the growth of the sector since privatization. We observed that deregulation is not particularly effective in attracting FDI into the sector and boosting internet users. It shows that the policy is ineffective and malpractices by network operators could be the cause of the latter. The Toda-Yamamoto causality test shows that there is a presence of bi-directional causal effect between LFDIT and LCTGDP which is contrary to the prediction of Nazifi and Mohammed (2016). Our estimation that deregulation in Nigeria has contributed to telecommunications growth, although not effective in attracting Foreign Direct Investment into the sector, also conforms to the works of Chidozie, Lawal, and Ajeyi (2015), Olumide (2011), Babatunde (2013), Moniruzzaman and Mikail (2008), Gbandi and Ijewere (2012), Ologunde et.al (2006), Akinyomi and Tasie (2011), Nebo (2015), Kirkpatrick et. al. (2006), Mawoli (2009), Olufemi (2018) and Adeyemi, et. al. (2017).

CONCLUSION

The study primarily examines the determinants of telecommunications sector contribution to domestic output in Nigeria between 1986Q1 and 2018Q4. From our findings, it can be reasonably concluded that the foreign direct investment in telecommunications sector has improved and significantly impacted on the growth of telecommunications in Nigeria. We discovered that foreign direct investment in telecommunications and institutional framework to be more effective in improving and raising the contributions of telecommunications sector to GDP in Nigeria than other variables in the long-run.

This finding lends support to the endogenous growth theory which claims that FDI, technological advancement (MHTE) and Labour Force (LF) endogenously promote the long run growth or productivity of an economy (Todaro and Smith, 2011). Although medium and high-tech factor is insignificant in the model, it has theoretical relevance. Its' not being significant could be as a result of low finance and the underdeveloped nature of the sector.

Recommendations

To ensure a sustainable growth of telecommunications industry, the industry needs reform that should center on how to regulate and promote not just the quality and reliability of internet services, but also, check the ill-practices of the operators. The government should also set machinery in motion to improve the quality of the labour force through improved educational system and qualitative and continuous manpower training..

Suggestion for further studies

The study, determinants of telecommunications sector contribution to domestic output in Nigeria could be replicated at regional and state level to verify if these determinants still apply and ways to inform specific policies. On the other hand, this study could be carried out in Sub Saharan Africa that face the same plight as Nigeria. Most studies used OLS technique for their analysis, there is need to go beyond this to employ more robust technique that account for most econometric vices and reduces spurious results like the instrumental variable method and the propensity score matching analysis.

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