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Telecommunication Infrastructure Investment and Economic Growth Nexus: Evidence from Nigeria

Mohammed Dansabo Usman[1] & Umaru Samaila Mazadu[2]

[1]*Department of Economics & Development Studies, Federal University Kashere, Gombe State, Nigeria*
[2]*Department of Economics, Borno State University, Borno State, Nigeria*

Correspondence Email: mazadu945@gmail.com

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Abstract
This study analyzes the nexus between telecommunication infrastructure investment and economic growth in Nigeria using time series data for the period of thirty-nine (39) years (1981-2019). In analyzing the data, the study used Autoregressive Distributed Lag (ARDL) approach and Granger Causality Test. The results reveal that telecommunication investment and telecommunication revenue exert a positive impact on economic growth in both long run and short run. The Granger causality analysis divulges the existence of a bidirectional causality between telecommunication investment and GDP, telecommunication revenue and GDP as well as telecommunication revenue and telecommunication investment. Furthermore, there is no causality between teledensity and the other variables; GDP, telecommunication investment and telecommunication revenue. The study therefore, recommends that government should give more licenses to GSM operators, provide concessionary fiscal incentives and aggressively promote investment in fixed telecommunication assets.

Keywords: Telecommunication, Investment, Growth, Teledensity, Nexus
JEL Classification: L96, R42, O47

1. Introduction

The telecommunication sector in Nigeria is one of the fastest-growing sector, this is due to the government’s deregulation policy in the year 2000 (Sadiq, Oyelade & Ukchukwu, 2011). The development of the sector in Nigeria had been a gradual process since independence. The sector in 1960 was under the jurisdiction of the Federal Government-owned Nigerian Post and Telecommunications (P&T) with only 18,724 telephone lines (Ndukwe, 2003). In the early 1980s, the Nigerian External Telecommunications (NET) was established to provide external communication services. Following the rising demand for commercialization of telecommunication services, the federal government merged NET and P&T's telecoms unit in 1985 to establish the Nigerian Telecommunications Limited (NITEL), which was given full responsibility for addressing the country's telecommunications needs. Even at this time, the telephone system was unreliable, crowded, costly, and unpleasant to customers. Regrettably, NITEL, which had a monopoly in the market for more than a decade could not meet the growing demand for telecommunication services by Nigerians. In 1992, the sector was partially deregulated with the establishment of the Nigerian Communication Commission (NCC) saddled with the responsibility of issuing a license to private telephone operators (Ajiboye, Adu & Wojuaye, 2007). With the restoration of democracy in 1999, the nation's telecommunications industry was freed and fully deregulated, as a result it grows in leaps and bounds.

The telecommunication sector in Nigeria has no doubt grown phenomenally ever since, mobile cellular subscriptions surged from 0.03 per 100 people in 2000 to 83 per 100 people in 2016, and mobile cellular subscriptions went from 30000 to a staggering 154.3 million users (World Bank Development Indicators, 2019). Furthermore, the percentage of people who use the internet have climbed from 0.06 percent in 2000 to 25.7 percent in 2016. While these achievements speak in volumes, subscribers who pay the bills running into trillions of naira via call cards and others are however, still hankering for improved services and lower tariffs, better network, affordable charges just to mention but few. Telecommunications has pervasive economy-wide effects on economy, most evidently, reducing transaction cost, increasing total factor productivity (TFP) of the private sector, and increasing the efficiency of interaction and coordination, hence influencing the success of economic activities (Belaid, 2002; Rickets, 2002).

It has been argued that telecommunication investments have important spillovers and create externalities on economic growth, captivatingly a considerable number of studies on Nigeria attempted to identify telecommunication infrastructure as an essential component of the economic infrastructure, fostering productivity and economic growth. Most of these studies found a positive and significant impact of telecommunication infrastructure on Nigerian economic growth **(**Lola, 2011**;** Onakoya, Tella & Osoba, 2012**;** David, 2013**;** Akanbi, Ogunleye, Akanbi & Isah, 2013**;** Isa & Adeniji, 2015**;** Oyeniran & Alliyu, 2016**;** Okon & Abel, 2016). However, the major deficiency in the studies is lack of a precise causal mechanism between telecommunication infrastructure and economic growth, which is usually assumed rather than explored. This study fills the gap by disentangling the direction of causality between telecommunication infrastructure investment and economic growth in Nigeria. This is another empirical concern yet to be study. Given the foregoing, this study is set to analyze the nexus between telecommunication infrastructure investment and economic growth in Nigeria within the framework of the Autoregressive Distributed Lag (ARDL) estimation technique and the Granger causality test. The findings of this study will therefore contribute to knowledge and serve as reference material to potential academic researchers. It will hopefully help the appropriate authorities to take actions that will further intensify investment in the Nigerian telecommunication industry.

The paper is structured into five sections including this introduction, section two reviews related literature, section three deals with methodology, section four is the results and discussion of findings while section five is the conclusion and recommendations.

2. Literature Review

Previous studies had investigated the relationship between telecommunication infrastructure and economic growth. Ding and Haynes (2006) investigated the impact of telecommunication infrastructure on economic growth in China from 1986 to 2002. The study revealed that telecommunications infrastructure has a significant impact on regional economic growth in China. The results further indicate that the telecommunications investment is subject to diminishing returns, suggesting that regions at an earlier stage of development are likely to gain the most from investment in telecommunications infrastructure. Lola (2011) investigated the effects of telecommunication infrastructural development on the economic growth of Nigeria from 2001 to 2008. The study employed the Ordinary Least Square method (OLS) and found that GSM connected lines (GSM) and Tele-density (TELED) which proxy telecommunication infrastructure have a significant positive effect on the gross domestic product (GDP). Onakoya *et al.* (2012) empirically analyzed the impact of telecommunications infrastructure investment on economic growth in Nigeria from 1970 to 2008 and a three-stage least squares (3SLS) was deployed. The study found that telecommunications infrastructural investment has a significant impact on economic growth. The results also show a bi-directional causal relationship between telecommunications infrastructure and economic growth. The study recommended the need for a more effective telecommunications infrastructure that will further impact on economic growth in Nigeria. David (2013) studied the impact of telecommunication investment on economic growth in Nigeria from 1980 to 2010. Ordinary Least Squares techniques, Johansen Juselius cointegration technique and error correction model were employed and the study found that the labour employed, capital stock, real investment in telecommunication and electricity supply have a statistically significant effect on economic growth in the long run and short run in Nigeria. The study recommended that the Promotion of investment policy targeted at telecommunication infrastructures to reduce the digital divide rate in Nigeria is necessary.

Akanbi *et al.* (2013) investigated the impact of telecommunication service expansion on economic growth in Nigeria, Ordinary Least Squared (OLS) regression methods were used and the result showed that there exists a positive relationship between economic growth and telecommunication (GSM) variables (teledensity, telecommunication contribution to GDP, private investment in telecoms and mobile subscribers) in Nigeria. The study recommended the need for government to implement policies that could lead to continual expansion in teledensity rate through the provision of a supportive infrastructural base in the sector. Isa and Adeniji (2015) used an autoregressive distributed lag model (ARDL) estimation technique to examine the relationship between telecommunication infrastructure and economic growth in Nigeria from 2002 to 2014. The study revealed that a long-run relationship exist between telecommunication infrastructure and economic growth in Nigeria. The study recommended that government should implement policies that will enhance the development of the telecommunication sectors and complementary factors such as electrification.

Oyeniran and Alliyu (2016) employed the autoregressive distributed lag (ARDL) bounds testing approach in their study to examine the effect of investment in telecommunication infrastructure on economic growth in Nigeria from 1980 to 2012. The study found the presence of a long-run relationship between the dependent and all the explanatory variables and that foreign direct investment in information and communication technology is more effective in improving and raising economic growth in Nigeria than government investment. The study recommended the need for the Nigerian government to increase its expenditure on telecom as well as attract more foreign investment in telecommunication to boost the economic growth of the nation. Okon and Abel (2016) analyzed the relationship between telecommunication infrastructural development and the economic growth of Nigeria in the period after deregulation. The Ordinary Least Square (OLS) technique was used and the study revealed that telecommunication has significantly influenced the country's economy by increasing market access and reducing distribution costs. The study recommended the need for government to issue more licenses to GSM operators to allow for healthy competition among the GSM operators. Pradhan, Arvin, Nair, Mittal & Norman (2017) evaluated the causal link between telecommunication infrastructure, foreign direct investment and economic growth in the Asian-21 countries from the period of 1965 to 2012. The study used a panel vector auto-regression model to reveal the nature of Granger causality and found that telecommunications infrastructure/usage, FDI, and economic growth appeared to be cointegrated and that FDI and telecommunications infrastructure/usage are general long-run causes for economic growth. However, the short-run causality results revealed a wide range of short-run adjustment dynamics between the variables including the possibility of feedback between them in several instances.

Matalqah and Warad (2017) examined the impact of telecommunication infrastructure investment on economic growth in the 12 Arab countries from 1996 to 2015. The study found evidence that telecommunication infrastructure investment has a positive and significant effect on economic growth in non-oil producing countries in the long-term while in oil-producing countries no impact was noticed. The study recommended the need for government to review the utilization of telecommunication services to be more efficient in the business and social environment. Sharif (2017) studied the relationship between telecommunication and economic growth in Bangladesh, India, Pakistan, Srilanka and Nepal as members of SAARC countries from 1975-to 2015. Ordinary Least Square method (OLS) regression model was used and the study reveals that the telecommunication industry had a strong and positive relationship with economic growth. The study concluded that the positive relationship between telecommunication and economic development indicates that higher investment in economic development will enhance economic development and that telecommunication help to minimize the digital and economic gap between developed countries and SAARC members. Johnson, Olabisi and Folake (2021) investigated the impact of telecommunication on economic growth in Nigeria from 1999 to 2018. The study used fully modified ordinary least squares techniques, cointegration and error correction model and found that teledensity and telecommunication sector revenue had an insignificant impact on Gross Domestic Product, while Investment in telecommunication Sector had a significant impact on Gross Domestic Product in Nigeria. The study recommended the need for government to expand teledensity and the interests of the consumer of telecommunication services should be protected.

3. Methodology

This study used secondary data to analyze the relationship between telecommunication infrastructure investment and economic growth in Nigeria. An annual time series data for Nigeria from 1981 to 2019 as sourced from the Central Bank of Nigeria Statistical Bulletin, the World Bank World Development Indicators (WDI) and the World Telecommunication Union Telecommunication/ICT Indicators were employed. Since this research involves time series macroeconomic variables, it's necessary to check for unit root in each of the variables. The study used the Augmented-Dickey Fuller (ADF) and Philip-Perron (PP) test for stationarity test.

The model of the study is used to analyze the relationship between telecommunication infrastructure investment and economic growth in Nigeria. Therefore, the model is specified following the lead from Sharif (2017). Our model is stated below.

GDP = f (TELINVEST, TELREV, TELD) ………………………………………. 1

Where GDP denotes gross domestic product which is a proxy for economic growth, TELINVEST stands for telecommunication infrastructure investment measured by the annual investment in telecommunication services, TELREV is the telecommunication revenue measured by the revenue from all telecommunication services, TELD represents telecommunication density measured by the number of telephones per 100 inhabitants, including both fixed-line and mobile subscribers.

For econometric analysis, equation (1) is restated as thus:

$$\mathrm{GDP} = \beta_0 + \beta_1\,\mathrm{TELINVEST} + \beta_2\mathrm{TELREV} + \beta_3\mathrm{TELD} + \mu_t \; \ldots\ldots\ldots\ldots 2$$

The semi log-linear specification of equation (2) is expressed as:

$$\mathrm{LGDP} = \beta_0 + \beta_1\,\mathrm{LTELINVEST} + \beta_2\mathrm{LTELREV} + \beta_3\mathrm{LTELD} + \mu_t \ldots\ldots\ldots 3$$

The a priori expectation is that a positive relationship exists between the independent variables and the dependent variable. In mathematical terms, we expect $\beta_1, \beta_2, \beta_3 > 0$.

An ARDL representation of equation (3) above is specified in equation (4) below:

$$\Delta LGDP_t = \alpha + \sum_{i=1}^{q}\beta_{i,1}\Delta LGDP_{t-i} + \sum_{i=0}^{q}\beta_{i,2}\Delta LTELINVEST_{t-i} + \sum_{i=0}^{q}\beta_{i,3}\Delta LTELREV_{t-i} + \sum_{i=0}^{q}\beta_{i,4}\Delta LTELD_{t-i} + GDP_1 LGDP_{t-1} + GDP_2 LTELINVEST_{t-1} + GDP_3 LTELREV_{t-1} + GDP_4 LTELD_{t-1} + \mu_t \ldots\ldots 4$$

The ECM representation takes the following form:

$$\Delta LGDP_t = \alpha + \sum_{i=1}^{q} \beta_{i,1} \Delta LGDP_{t-i} + \sum_{i=0}^{q} \beta_{i,2} \Delta LTELINVEST_{t-i} + \sum_{i=0}^{q} \beta_{i,3} \Delta LTELREV_{t-i} + \sum_{i=0}^{q} \beta_{i,4} \Delta LTELD_{t-i} + ECM_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where ECM is the error correction version of the ARDL model and all other variables are as explained under equation (2).

The study employed the Autoregressive distributed lag estimation technique (ARDL) to examine the linkage between telecommunication infrastructure investment and economic growth in Nigeria. The ARDL procedure can be employed when the variables are integrated of order zero. The procedure is also relatively more efficient in small or finite sample data sizes as is the case in this study (Giles, 2013). The ARDL cointegration procedure involves several stages. In the first stage, the stationary properties of time series variables were examined by using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. The second stage involves testing for the existence of a long-run relationship between the dependent and independent variables. The last step of an ARDL procedure is to obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates.

Finally, our approach follows Granger (1969), who proposed a time-series data based approach to determine causality between economic variables. A question that frequently arises in time series analysis is whether or not one economic variable can help forecast another economic variable. In the Granger-sense therefore, a time series x is a cause of y if it is useful in forecasting y. More precisely, variable X is said to Granger-cause another variable, Y, if the current value of Y (y_t) is conditional on the past values of X.

4. Results

Descriptive Statistics

Table 1: Summary Statistic of Variables

Statistics	GDP	TELINVEST	TELREV	TELD
Mean	27568.69	143.4605	799.2518	0.408799
Median	6102.422	157.64	854.17	0.326851
Maximum	127736.8	238.47	1369.17	1.184223
Minimum	144.8312	44.9	156.8	0.071725
Std. Dev.	37733.05	58.12827	447.915	0.283057
Skewness	1.279753	-0.36888	-0.107389	1.197249
Kurtosis	3.322305	1.772077	1.38955	3.63539
Jarque-Bera	10.53701	3.249135	3.179493	9.717458
Probability	0.005151	0.196997	0.123718	0.00776
Sum	1047610	5451.5	30371.57	15.53438
Sum Sq. Dev.	5.27E+10	125019.1	7423231	2.964477
Observations	38	38	38	38

Source: Authors' computation

The descriptive statistics in Table 1 indicate that the mean of GDP is 27568.69, the standard deviation is 37733.05, the highest and lowest values are 127736.8 and 144.8312 correspondingly. Then its coefficients of skewness and kurtosis are 1.279753 and 3.322305 respectively. It indicates that GDP is positively skewed and the distribution is leptokurtic (a distribution with kurtosis greater than 3). The result is not normal due to the significant probability value of the Jarque-Bera.

The mean of TELINVEST has been 143.4605 with a standard deviation of 58.12827. The highest rate is 238.47 and the least is 44.9. The coefficients of skewness and kurtosis are -0.36888 and 1.772077 respectively. This shows the distribution is negatively skewed and platykurtic. TELINVEST is normally distributed due to the insignificance of the probability value of Jarque-Bera. TELREV is negatively skewed and the distribution is platykurtic, it is on average 799.2518 with a standard deviation of 447.915. The highest value is 1369.17 while the least value is 156.8. The distribution of TELREV is normally distributed. Lastly, TELD is on average 0.408799 with deviations of 0.283057. The least value of TELD reported is 0.071725 while the highest value is reported at 1.184223. The distribution of FOREV is not normally distributed.

Unit Root Test Result

The results presented in Table 2 revealed that the Augmented Dickey-Fuller test shows that LGDP and LINVEST are stationary at first difference while LTELREV and LTELD are stationary at level. Similarly, from the Philips Peron test, LGDP and LTELINVEST are stationary after the first difference whereas LTELREV and LTELD are stationary at level values. The conclusion of the unit root result shows that the variables are integrated of either order zero, i.e. I(0), or order one, i.e., I(1). The combination of both I(0) and I(1) series provide a strong reason for the application of the ARDL bound testing technique.

Table 2: Summary of Unit Roots Test Results

		ADF	PP
LGDP	Level	-0.1443	-1.1444
	1st	-3.1801**	-3.0962**
LTELINVEST	Level	-2.8926	-0.9016
	1st	-4.2506***	-4.0366***
LTELREV	Level	-3.6561***	-3.2594**
	1st	-6.4428***	-4.4079***
LTELD	Level	-3.9784**	-1.1914***
	1st	-3.1083**	-4.2722***

*Note: ***, ** and * indicate significant at 1%, 5% and 10% respectively*
Source: Authors' computation

Bound Test for Cointegration

The results of the bound test approach for cointegration is presented in Table 3. The rule of thumb is that, if the F-statistics is greater than the 1% and 5% upper limit, we accept the alternative hypothesis and conclude the existence of cointegration. The test result indicates that the value of the F-statistics (4.052205) is greater than the upper and lower critical values of 3.67 and 2.79 at 5 percent level of significance. We therefore, reject the null hypothesis and infer the presence of cointegration amongst the variables.

Table 3: ARDL Bounds Test

F-Statistics	4.052205	4
	Critical Value Bounds	
Significance	I0 Bound	I1 Bound
10%	2.37	3.2
5%	2.79	3.67
2.50%	3.15	4.08
1%	3.65	4.66

Source: Authors' computation

Result of the Estimated Long-Run Coefficients of the ARDL

This section contains the results of long run relationship among the variables. The results are summarized and presented in Table 4.

Table 4: Dependent Variable: LGDP

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTELINVEST	0.719878	0.961455	3.748738	0.0046
LTELREV	3.560632	0.745044	4.779092	0.0000
TELD	-0.671628	0.485018	-1.384749	0.1767
C	-9.838505	1.498741	-6.564512	0.0000

R^2 = 0.99; AIC = -1.962, SBC = -1.654, HQC = -1.855; DW = 2.077, ADJ. R^2 = 0.99; F-Stats = 4225.627, P (F-Stats) =0.000000.

Source: Authors' computation

The result as indicated above reveals that the coefficient of determination (R^2) of the model is 0.99, indicating that approximately 99 percent of the variations in economic growth are explained by variations in LTELINVEST, LTELREV and TELD. The F statistic value of the long-run model is also significant and implies that all the dependent variables included in the model are jointly significant. In the result, there exist a positive and significant relationship between telecommunication infrastructure investment and economic growth in Nigeria in the long run. The result indicates that holding all other variables constant, if telecommunication infrastructure investment in Nigeria increases by one percent, GDP will also increase by about 0.719878 percent. This finding implies that an increase in telecommunication infrastructure investment propels the economic growth of Nigeria. This result is consistent with the work of Oyeniran & Alliyu 2016, Sharif (2017), Johnson, Olabisi & Folake (2021). Nevertheless, the result is contrary to the observations of Olalekan (2013).

In addition, telecommunication revenue has a positive and significant impact on economic growth in Nigeria in the long run. This shows that a one percent increase in the telecommunication revenue leads to about 3.560632 percent increase in GDP provided other variables are kept constant. This finding implies that an increase in telecommunication revenue has the capacity of increasing economic growth. The finding is similar to the work of Sharif (2017), Johnson, Olabisi & Folake (2021). Finally, teledensity has an insignificant negative impact on economic growth in Nigeria. One percent increase in teledensity leads to about 0.671628 percent decrease in Gross Domestic Product in Nigeria provided other factors are kept constant. It is expedient to note that the result of a negative and statistically insignificant impact of teledensity on economic growth is not strange or novelty in the Nigerian economy because teledensity is still very low in rural areas to permit an overall boost in economic growth in Nigeria.

Result of the Estimated Short-Run Coefficients

The error correction term (ECT) explains how quickly or slowly in which the relationship is restored to its equilibrium path. The coefficient is expected to be negative and must be statistically significant. A highly significant ECT (-1) provides proof of the existence of a stable long-run relationship. The short-run result reveals that one percent change in telecommunication infrastructure investment in the short-run will lead to 0.094162 percentage change in economic growth. Also, one percent change in telecommunication revenue will lead to 0.020849 percent change in economic growth. The result further shows that one percent change in teledensity will lead to 0.046299 percent decrease in economic growth. The results are significant as indicated by their probability values except for teledensity. The estimated coefficient of the error correction term is -0.128136. This suggests a relatively low speed of adjustment to any disequilibrium in the short run. The negative value of the ECM coefficient confirms that there is disequilibrium in the short run which the set of variables in the model is trying to correct in the long run.

Table 5: Estimated Short-Run Coefficients of the ARDL Model

Dependent Variable: LGD				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LTELINVEST)	0.094162	0.145588	3.64677	0.0029
D(LTELREV)	0.020849	0.272485	3.46515	0.0095
D(TELD)	-0.046299	0.129258	-0.35819	0.7228
CointEq(-1)	-0.128136	0.029246	-4.38133	0.0001

Source: Authors' computation

Result of the Granger Causality Test

According to Table 6, the results suggest a bidirectional causality running from LTELINVEST to LGDP. This is because the respective probability values of (0.0125, 0.0017), are below the threshold of determination (0.05). This implies that telecommunication infrastructure investment granger cause economic growth and vice versa. Similarly, a bidirectional causality running from LTELREV to LGDP with probability values of (0.0246, 0.0122) is found. This means that telecommunication revenue granger cause economic growth and vice versa. Additionally, a bidirectional causal relationship running from LTELREV to LTELINVEST was found. This is because the respective probability values of (0.0161, 0.0397) are below the threshold of determination (0.05). This implies that granger causality runs from telecommunication revenue to telecommunication investment and vice versa.

However, there is no evidence of causality from LTELD to LGDP, LTELD to LTELINVEST, LTELD to LTELREV and vice versa. This is due to the respective probability values of more than 0.05. It clearly indicates that there exist no causal relationships running from teledensity to economic growth, teledensity to telecommunication investment, teledensity to telecommunication revenue and vice versa.

Table 6: Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
LTELINVEST does not Granger Cause LGDP	36	3.34667	0.0125
LGDP does not Granger Cause LTELINVEST		4.68681	0.0017
LTELREV does not Granger Cause LGDP	36	4.15573	0.0246
LGDP does not Granger Cause LTELREV		4.79827	0.0122
LTELD does not Granger Cause LGDP	36	0.60895	0.1503
LGDP does not Granger Cause LTELD		1.23200	0.1943
LTELREV does not Granger Cause LTELINVEST	36	4.41342	0.0161
LTELINVEST does not Granger Cause LTELREV		3.76399	0.0397
LTELD does not Granger Cause LTELINVEST	36	0.74779	0.4534
LTELINVEST does not Granger Cause LTELD		0.55190	0.2814
LTELD does not Granger Cause LTELREV	36	1.85933	0.3219
LTELREV does not Granger Cause LTELD		1.23062	0.1772

Source: Authors' computation

Post Estimation Diagnostics Test

To ensure the adequacy of the model, as well as the reliability of the results, a series of post-estimation diagnostic tests were carried out on the selected ARDL model.

Table 7: Results of the Diagnostics Tests

Normally test			
JarqueBera	0.435473	Prob.	0.704165
Breusch-Godfrey Serial Correlation LM Test			
F-statistics	0.189854	Prob. F(2,27)	0.8282
Breusch-Pagan-Godfrey Heteroscedasticity Test			
F-statistic	0.930543	Prob. F(8,29)	0.4881

Source: Authors' computation

From the result, the Breusch-Godfrey Serial Correlation LM test shows that the F statistics value of 0.189854 (corresponding to a p-value of 0.8282) is insignificant, thus confirming the presence of no serial correlation. For the Breusch-Pagan-Godfrey test above, the null hypothesis of no heteroscedasticity in the residual is accepted, since the probability of its F-statistic value is 0.4881, which is greater than the 5% level, hence concluding that the model is free from the problem of heteroscedasticity. Finally, the test for normality of residual was carried out using the popular Jarque-bera statistics. The normality test testified that the model is normally distributed. This has resulted from the fact that the probability value of the Jarque-Bera is not statistically significant even at 10% level of significance.

To determine the stability of the estimated ARDL model within the context of the coefficients of the long run and the short run relating to the link between telecommunication infrastructure investment and economic growth, the researchers use the Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Squares (CUSUMQ). Closer scrutiny of CUSUM depicts that the model and the estimated parameters are stable, given that the graph moves within the 0.05 critical lines. The CUSUMSQ also shows that the model is stable and confirms the stability of the coefficients, given that the blue line veers within the two red lines indicating 5% level of significance, although there was divergence in 2003, but was restored in 2005.

Figure 1

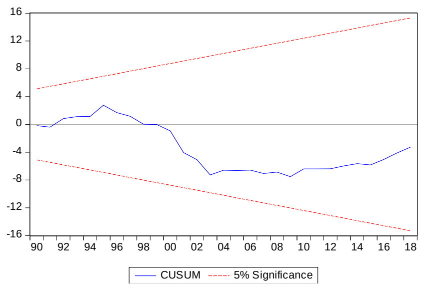
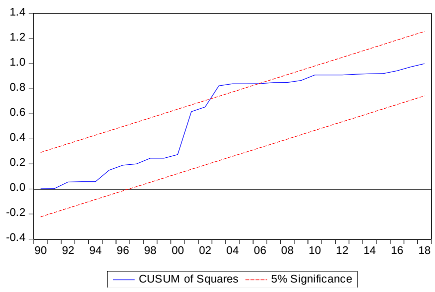


Figure 2



5. Conclusion and Recommendations

The conclusion emanating from the above research findings is that telecommunication infrastructure investment and telecommunication revenue have statistically significant impact on economic growth in Nigeria both in the short run and long run and a cointegration exist among the variables, therefore the telecommunication sector is fundamental and a prerequisite to the attainment of sustainable development in Nigeria.

Therefore, this study recommends that the government of Nigeria should give more licenses to GSM operators to allow for healthy competition, and further concessionary fiscal incentives should be provided to the investors. This will help in increasing the telecommunication revenue. In addition, the Nigerian Communication Commission should defend the interests of telecommunication customers by encouraging competitive pricing. Lastly, a strict policy should be in place to aggressively promote investment in fixed telecommunication assets. This is because more telecommunication assets can increase aggregate output hence fostering economic growth.

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