ISSN 2278-7763

The Effect of Investment in Telecommunication on Economic Growth: Evidence from Nigeria

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Abstract

This study examines the impact of real investment in telecommunication on economic growth in Nigeria. The study includes labour employed, capital stock, real investment in telecommunication and electricity supply to be the regressors and real economic growth to be the regressand using a time series data from 1980 – 2010. The study's model is based on Solow's augmented growth theory where labour, capital and technology are the sole determinants of economic growth. Thus, economic growth is estimated through classical least squares and fully modified ordinary least squares techniques – cointegration and error correction model. The finding shows that labour employed, capital stock, real investment in telecommunication and electricity supply are statistically significant to economic growth in the short run equilibrium in Nigeria. Therefore, positive economic growth is attainable when efficient and well coordinated policies are implemented on labour productivity, price management, investment promotion and constant electricity supply.

Key Words: Investment in Telecommunication, Economic Growth, Error Correction Model (ECM) and Nigeria

1.0 INTRODUCTION

It is worthy of note that to date, the nation's telecommunications sector has shown leadership in the nation's overall ICT growth. In December 2000, Nigeria had 450,000 connected fixed lines, no connected digital mobile line, 1 national career, 18 operating Internet Service Providers, 9 active licensed fixed-line operators, and 1 licensed mobile line operator (Ndukwe, 2005). In the same period, Nigeria had 200,000 internet users (Ndukwe, 2005). In March 2004, the figure grew to become 888,854 connected fixed lines, 3.8 million connected digital mobile lines, 2 national careers, 35 operating Internet Service Providers, 30 active licensed fixed-line operators, and 4 licensed mobile line operators. In December 2004, Nigeria had 1.5 million internet users, a penetration rate of 1.3% and constituted about 5.6% of the total number of African internet users. Africa itself only boasts of 1.5% of global internet users even though it has 14% of the world's inhabitants. Private investment in ICTs also rose from an almost zero value to about $4 billion between 1999 and 2003 (Ndukwe, 2005).

Nigeria's ICT space has improved significantly from 400,000 lines in 1996 to over 14 million lines in 2005 owing to independent regulation through the Nigeria Communications Commission (NCC), private sector participation, and broadened competition. Teledensity improved from 0.37% in 1996 to 8.5% in 2004, several towns and cities estimated at 48% of the population and 18% of the land mass have potential access, grown from one player (monopoly) to hundred of the active players, and exceeded minimum International Telecommunications Union (ITU) recommended teledensity of 1% to 24.18% in 2006 (Sesan, 2007). The number of telephone lines in cell phone (fixed) has been on the increase from 702,000 in 2002 to 1,673,000 in 2006 but dropped steadily to 1,307,000 in 2008. Telephone line in cell phone (mobile) increased from 1,569,000 in 2002 to 62,988,000 in 2008 (NCC, 2011). The teledensity rose from 45.93% in 2008 to 63.11% by 2010 which reflects the

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increase in index of the population to telecommunication devices as a result of increase in investment in the telecommunications sector in Nigeria (ITU, 2011).

Presently, the two national careers, Nigeria Telecommunications Plc (NITEL) and Globalcom, are both private entities. NITEL was public ally owned until late 2006 when it was partially privatized and since then there have being crisis in the organization. There are five digital mobile (GSM) operators (MTN, Glo, Airtel, Etisalat and Mtel), and 20 other operators have been licensed to provide fixed wireless services at national and regional levels. All six geopolitical zones have Internet access, and efforts are being made to pursue to increase penetration. In 2000, the penetration rate was 1 in 100 persons; by 2006 the ratio had improved to 14.5 in 100. Nigeria is a member of the consortium that runs the SAT-3 submarine fibre optic cable. The country launched its first communications satellite NIGCOMSAT-1 on 13 May 2007 to provide telecommunications coverage, navigation, television distribution, direct broadcasting system (DBS), digital broadband, etc.

Nigeria intends to use NIGCOMSAT-1 to create 150,000 jobs, save the country hundreds of millions of dollars a year, provide Internet access to remote rural areas, and to specifically help tele-education (educational television and e-learning) for the distance learning initiative. An agreement has also been signed with Patriot Inc (USA) to invest in VSAT manufacturing within Nigeria as a means to reduce the cost of antenna/VSAT on the local market. Private investment in the telecommunications sector exceeded USD$8 billion (N1.2 trillion) in 2006 from USD$150 million in 2000, this figure later rose to USD$12 billion (N1.8 trillion) in 2010 (allafrica.com, 2011). MTN, the leading GSM operator , with about 43.43% market share has completed building a 3,500 kilometre, ultra modern nationwide fibre optic transmission network which will help accelerate ICT projects and values in the economy (NCC, 2011). Other private operators are engaged in similar initiatives and projects in the country. Glo, market share stood at 22.22% in 2010 while Airtel stood at 17.92% at same period (NCC, 2011).

In spite of the absolute and tremendous investment in the telecommunication industry in Nigeria, there are still frequent network problems; the cost of making calls is still high let alone using internet services provided by telecommunication companies. The telecommunication companies refer poor and costly services to unconducive business environment possess by institutional factors like government policy, insufficient social infrastructural facilities (energy, security, water etc.) in Nigeria.

The internet has become an important tool for business growth, social activities and research in Nigeria. While the interest is well integrated into education, business and social activities in North America, Europe and part of Asia, Nigeria can be said to be attempting giant strides in embracing its usefulness and applications. Internet has sprung in major cities, a large majority of internet access is provided by telecommunication sector and very few business organizations could afford them.

These problems militating against the telecommunication sector have strong impact on the income generation of the Nigerian economy. And, the more problem the telecommunication sectors faced, the costlier it becomes to use the services of the telecommunication sector. This will increase the cost of production, since business firm is a customer to the telecommunication sector and the profit of the business sector could shrink. Therefore, gross domestic product (GDP) will be affected since it is a function of the sum of productivity of individual firms. Thus, this study intends to proffer answers to these research questions.

1. What are the factors that determine economic growth in Nigeria?

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2. What are the effects of investment in telecommunication sector on economic growth in Nigeria?

The central aim of this study is to measure the effect of investment in telecommunication sector on economic growth in Nigeria. Thus, the specific objectives are;

1. To identify the determinants of economic growth in Nigeria.
2. To investigate the impact of investment in telecommunication on Economic Growth in Nigeria.

2.0 THEORETICAL AND EMPIRICAL FRAMEWORK

ICTs are embedded in networks and services that affect the local and global accumulation and flows of public and private information. According to the United Nations Economic Commission for Africa (1999), ICTs cover Internet service provisions, telecommunications and information technology equipment and services, media and broadcasting, libraries and documentation centers, commercial information providers, network-based information services, and other related information and communication activities. The Commission admits the definition as being quite expansive. It is not uncommon to find definitions of ICTs that are synonymous with those of information technology (IT). Drew and Foster (1994) defined IT as the group of technologies that is revolutionising the handling of information. It is taken to embody a convergence of interest between electronics, computing and communication. Chowdhury (2000) posited that ICTs encompass technologies that can process different kinds of information (audio, video, text, and data), and facilitate different forms of communications among human agents, and among information systems. Duncombe and Heeks (1999) simplify the definition by describing ICTs as an “electronic means of capturing, processing, storing, and disseminating information”. These definitions directly or indirectly emphasised the impact of ICT devices on economic growth in either the short or the long run.

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The impact of technological revolution is discussed by two schools of thought on a theoretical basis, the Technophilic and the Technophobic views. The two schools of thought try to draw a priori expectations between information and communication technology (ICT) and economic growth. The Technophiles believed that ICTs impact positively on economic growth and development. This perspective argues that in the various communities and sectors of the economy ICTs will expand productivity, improve employment opportunities and upgrade the quality of work in many occupations. Moreover, ICT will offer many opportunities for Small scale, independent and decentralized forms of production. Regarding developing countries like Nigeria, Technophiles envision that technology will aid developing countries to leapfrog stages of development (Castells, 1999; Mansell and Wehn, 1998; Nulens and Van-Andenhove, 1998; Todaro and Smith, 2009).

On the other hand, the technophobes regard ICTs as having negative effects on economic growth and development. Thus, ICT widening the information gap between the rich and the poor, the literate and the illiterate, while admitting that ICTs could have profound changes on societies. Van-Dijk (1999), believes that applications of ICTs and their transformative nature have been greatly exaggerated. ICTs may destroy more jobs than they create; the gap between the rich and the poor may widen. Mansell (1999) saw huge capital investments required on ICTs as diverting resources from other sectors of the economy that could have great development impacts. On economic level, this perspective forecasts a perpetration of the capitalist mode of production, with further managerial control over the means of production. In most countries, it foresees massive job displacement and ‘de-skilling’.

Before the growth theory proposed by Romer, there were other growth theories which thrived. Solow growth theory was one of such theories which was then in vogue. The Solow growth theory was also known as the exogenous theory because it professed technology as an exogenous factor which determines growth. One of the basic assumptions of the Solow model is the diminishing returns to labour and capital and constant returns to scale as well as competitive market equilibrium and constant savings rate. However, what is crucial about the Solow (1964) model is the fact that it explains the long run per capita growth by the rate of technological progress, which comes from outside of the model.

The endogenous growth theory or new growth theory was developed as a reaction to the flaws of the neoclassical (exogenous) growth theory. Romer endogenous growth theory was first presented in 1986 in which he takes knowledge as an input in the production function. The theory aimed at explaining the long run growth by endogenizing productivity growth or technical progress. The major assumptions of the theory are:

1. Increasing returns to scale because of positive externalities.
2. Human capital (knowledge, skills and training of individuals) and the production of new technologies are essential for long run growth.
3. Private investment in Research and Development is the most important source of technological progress
4. Knowledge or technical advances are non-rival good.

Several empirical studies have been conducted on the impact of telecommunication infrastructure investment on economic growth. However, while much have been written about the experiences of developed countries on the linkages between telecommunication and economic growth, there have been few corresponding studies from developing countries especially those in Africa whose economies are vulnerable to disruption associated with gross inadequacy of infrastructure service.

Many economists have observed a positive correlation between the level of telecommunication use and some index of economic well being. For instance, Jipp (1963) studies the relationship between the income of a nation and telephone density, using data for different countries, and found a positive correlation between the two. According to Saunders, et al (1994), the role of telecommunication in economic development was examined and some positive results discovered in the late 1970s. Also, Bebee and Gilling (1967) studied the relationship between telephone facilities and their use and economic performance using data from 29 countries at different stages of development. There is a clear evidence in literature that telecommunication infrastructure serves as a primary sources of economic development.

Empirical studies on this topic and the interest on the impact of telecommunications on economic growth has been on the increase (Norton 1992, Canning, Fay and Perotti, 1994; Canning 1997 and 1999; Cronin et al, 1991 and 1993, Cohen, 1992, Greestein and Spiller, 1995, Nadiri and Nandi, 1997; Wang, 1999; Yilmaz et al, 2002; Bezmen et al, 2003; Alleman et al, 2004; Posu, 2006 and Osotimehin et al, 2010). Most of these studies find a positive and significant casual link between telecommunication infrastructure and aggregate output. Greenstein and Spiller (1995) also found that a positive and significant effect exist by investigating the impact of telecommunication infrastructure on economic growth in the United State. Roller and Wavernman (2001) found a statistically positive relationship between economic growth and telecom infrastructure investment. A study of Yilmaz, et al (2001) indicated that the accumulation of telecommunication infrastructure improves the overall productive capacity at the regional level by examining the impact of telecommunication infrastructure on economic output both at the aggregate and sectoral levels in the United States.

Some more recent analyses by researchers indicate that telecommunication infrastructure plays a positive and significant role in economic growth in 22 OECD countries from 1980-1992 (Datta and Agarwal 2004), facilitates economic development (Waverman, et al 2005), combats poverty (Calderon and Serven, 2004) and promotes expansion in economic activities (Posu, 2006; Chiemeke and Longe, 2007; Nasab and Aghaei 2009 and Osotimehin et al, 2010). A wide range of studies have indicated that expanded telecommunication investment is essential but not the only determinant of economic growth. Dholakia and Harlam (1994) showed the relationship between investment in telephone infrastructure and economic growth by examining the connection among a number of factors such as education, energy, telephone, other physical infrastructure and economic growth. The result of their multiple regressions suggests that simultaneous investment in development input such as education, telecommunications and other physical infrastructure are complementary in helping to promote economic development. However, Canning (1999) in his study takes a broader perspective, evaluating the contribution of investment in various kinds of infrastructure to the aggregate output of the economy. He found that telephones have a larger impact on aggregate output than other kinds of infrastructure. While power generation and transportation infrastructure produce approximately the same productivity effect of other capital investment, the productivity effect of telephone infrastructure is surprisingly higher in comparison. According to Canning (1999), this suggests that telecommunications infrastructure generates larger spillover to other sectors of the economy.

Exploring another branch of the empirical literature, some empirical studies attempted to use a transaction-cost approach to evaluate the relationship between ICT expansion and economic growth. In a cross-sectional study, Hulten and Schwas (1991) conclude that expansion of telephone infrastructure provides “substantial growth – and investment- enhancing activity and thus facilitates economic development. Norton’s explanation for this finding is grounded in the argument that access to telecommunications reduces transaction cost. However, his study does not rule out other possible explanations for the positive impact of telecommunications on economic growth.

Generally, majority of the studies on the impact of telecommunications infrastructure on economic output focused exclusively on developed countries and the empirical evidence on the relationship

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between telecommunication and economic growth in developing countries is scattered and far without conclusive results. In fact the clues on the link between telecommunication infrastructure stock and economic growth in developing countries stem mainly from cross-country studies. The comparability between developed and developing countries in literature also raises many questions because telecommunications investment may have various effects for economies at different stages of development. As a result, the conclusion drawn from those wealthy countries may not be directly relevant to those of less developed economies. Thus, the need for empirical studies in this direction using single country data in a developing economy has become apparent in view of the desirability and even inevitability of telecommunication infrastructure investment as a tool for meaningful economic growth.

3.0 METHODOLOGY

Empirical studies revealed that investment in telecommunication is statistically significant to economic growth (Bezmen et al, 2003; Alleman et al, 2004; Posu, 2006; Nasab and Aghaei 2009 and Osotimehin et al, 2010). These literatures uphold the Solow's augmented theory of economic growth that technological advancement, labour and capital stock are exogenous components of economic growth (Solow, 1964). The theory (augmented economic growth) employs Cobb – Douglas production function to explain the impact of technology on economic growth. This study follows the footpath of these literatures with modification by determining the short and long run equilibrium in economic growth, capital stock, labour employed, investment in telecommunications and electricity supply through Error Correction Model (ECM). The scope of the study includes 1980 – 2010, which are thirty one observations for each of the indicators.

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Model Specification

This study adopts the Solow's Augmented Growth model with modification;

$$G = \gamma(CF, LB, \overline{Tm}, RInvT, EL) \quad (3.1)$$

The equation (3.1) shows the functional relationship between the Economic Growth, Capital Stock, Labour Employed, Technological Improvement, Real investment in Telecommunication and Electricity Supply. And, the Technological Improvement is assumed constant in short run.

Assumptions of the Model

1. Labour, Capital Stock and technological improvement determine economic growth.
2. Technological Improvement is constant in the short run and long run.
3. There is full employment in the economy
4. There is inclusion of investment in telecommunication and electricity production.

Hypothesis Statement

H_0 = Investments in telecommunication do not have impact on economic growth in Nigeria

H_1 = Investments in telecommunication have impact on economic growth in Nigeria

Stating the model linearly,

$$G_t = \mathbf{\Phi}_0 + \mathbf{\Phi}_1 CF_t + \mathbf{\Phi}_2 LB_t + \mathbf{\Phi}_3 RInvT_t + \mathbf{\Phi}_4 EL_t + \Psi_{3t} \quad (3.2)$$

Where G = Economic Growth rate proxied by rate of change in real Gross Domestic Products (GDP), CF = Capital Stock proxied by Gross Fixed Capital Formation as a share of Gross Domestic products (GDP), LB = Labour Employed proxied by labour force employed as percentage of total labour force and labour force defined as person between the age of 15 and 64 years, RInvT = Rate of

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change in real investment in Telecommunication and EL = electricity supply proxied by rate of change in electricity production. And, the relationships that exist between the regressand (Economic Growth) and the regressors (Capital Stock, Labour Employed, real investment in Telecommunication and Electricity Supply) are measured at present period. And, $\mathbf{\Phi}_0$ = intercept, $\mathbf{\Phi}_1$–$\mathbf{\Phi}_4$ = partial slopes and Ψ_{3t} = unobserved components and $\mathbf{\Phi}_1 - \mathbf{\Phi}_4$ are expected to be positive i.e. $\mathbf{\Phi}_1 - \mathbf{\Phi}_4 > 0$. The Classical Least Squares (CLS) techniques will be employed to estimate the parameters of the model in which the assumptions of classical least squares technique will be adhere to strictly.

The study's data are time series, stationarity test is inevitable, and therefore, the sationarity test follows the Augmented Dickey-Fuller (ADF) unit root test. The ADF models for the research variables are;

$$\Delta G_t = \beta_{11} + \beta_{12}t + \delta_1 G_{t-1} + \Sigma\beta_{13}\Delta G_{t-i} + \varepsilon_{1t} \quad (3.3)$$

$$\Delta CF_t = \beta_{21} + \beta_{22}t + \delta_2 CF_{t-1} + \Sigma\beta_{23}\Delta CF_{t-i} + \varepsilon_{2t} \quad (3.4)$$

$$\Delta LB_t = \beta_{31} + \beta_{32}t + \delta_3 LB_{t-1} + \Sigma\beta_{33}\Delta LB_{t-i} + \varepsilon_{3t} \quad (3.5)$$

$$\Delta RInvT_t = \beta_{41} + \beta_{42}t + \delta_4 RInvT_{t-1} + \Sigma\beta_{43}\Delta RInvT_{t-i} + \varepsilon_{4t} \quad (3.6)$$

$$\Delta EL_t = \beta_{51} + \beta_{52}t + \delta_5 EL_{t-1} + \Sigma\beta_{53}\Delta EL_{t-i} + \varepsilon_{5t} \quad (3.7)$$

These models are to validate the stationarity of the time series data use for this study, if the data are not stationarity at level, there will be a need to transform the data by order of integration. Thus, cointegration test will validate the short run equilibrium of the data. The long run equation is stated as equation (3.2) i.e. $G_t = \mathbf{\Phi}_0 + \mathbf{\Phi}_1 CF_t + \mathbf{\Phi}_2 LB_t + \mathbf{\Phi}_3 RInvT_t + \mathbf{\Phi}_4 EL_t + \Psi_{3t}$

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Transforming this model will yield introduction of first difference (Δ) and lag of error term by one period to measure the rate of adjustment in the equilibrium of the model. The lag of error term by one period is the error correction mechanism (ECM) that measures the rate of adjustment of the variables from long run to short run. The ECM was used by Engle and Granger to correct disequilibrium for this study to tie the short run behavior of economic growth to its long run. Stating the short run model for economic growth,

$$\Psi_{3t} = G_t - \boldsymbol{\Phi}_0 - \boldsymbol{\Phi}_1 CF_t - \boldsymbol{\Phi}_2 LB_t - \boldsymbol{\Phi}_3 RInvT_t - \boldsymbol{\Phi}_4 EL_t + \boldsymbol{\Phi}_5 t \qquad (3.8)$$

Take lag of error term;

$$\Psi_{3t-1} = G_{t-1} - \boldsymbol{\Phi}_0 - \boldsymbol{\Phi}_1 CF_{t-1} - \boldsymbol{\Phi}_2 LB_{t-1} - \boldsymbol{\Phi}_3 RInvT_{t-1} - \boldsymbol{\Phi}_4 EL_{t-1} \qquad (3.9)$$

Transforming (3.2) to a Cointegration and Error Correction Model;

$$\Delta G_t = \boldsymbol{\Phi}_0 + \boldsymbol{\Phi}_1 \Delta CF_t + \boldsymbol{\Phi}_2 \Delta LB_t + \boldsymbol{\Phi}_3 \Delta RInvT_t + \boldsymbol{\Phi}_4 \Delta EL_t + (G_{t-1} - \boldsymbol{\Phi}_0 - \boldsymbol{\Phi}_1 CF_{t-1} - \boldsymbol{\Phi}_2 LB_{t-1} - \boldsymbol{\Phi}_3 RInvT_{t-1} - \boldsymbol{\Phi}_4 EL_{t-1}) + \theta_{1t} \qquad (3.10)$$

Since; $G_{t-1} - \boldsymbol{\Phi}_0 - \boldsymbol{\Phi}_1 CF_{t-1} - \boldsymbol{\Phi}_2 LB_{t-1} - \boldsymbol{\Phi}_3 RInvT_{t-1} - \boldsymbol{\Phi}_4 EL_{t-1} = \Psi_{3t-1}$

Therefore,

$$\Delta G_t = \boldsymbol{\Phi}_0 + \boldsymbol{\Phi}_1 \Delta CF_t + \boldsymbol{\Phi}_2 \Delta LB_t + \boldsymbol{\Phi}_3 \Delta RInvT_t + \boldsymbol{\Phi}_4 \Delta EL_t + \Pi \Psi_{3t-1} + \theta_{1t} \qquad (3.11)$$

And, equation (3.11) is the Cointegration and Error Correction Model, Π is the parameter employed to assess the time of adjustment of equilibrium.

Table 1: Summary of Dataset

Variable	Indicator	Variable Definition	Unit of Measurement	Source of Data
G_t	Rate of change in real Gross Domestic Products	$G_t = \frac{RGDP_t - RGDP_{t-1}}{RGDP_{t-1}} \times 100$	Rate	Central Bank of Nigeria Statistical Bulletin, 2011
CF_t	Gross Fixed Capital Formation as a share of Gross Domestic products (GDP)	$CF_t = \frac{GFC_t}{GDP_t} \times 100$	Percentage	Central Bank of Nigeria Statistical Bulletin, 2011
LB_t	Labour Force Employed as percentage of total labour force and labour force defined as person between the age of 15 and 64 years	$LB_t = \frac{LFE}{TLF} \times 100$	Percentage	World Bank Indicators, 2012
$RInvT_t$	Rate of change in real investment in Telecommunication	$RInvT_t = \frac{RInvT_t - RInvT_{t-1}}{RInvT_{t-1}} \times 100$	Rate	Nigerian Communication Commission, 2011
EL_t	Rate of change in electricity production	$EL_t = \frac{EL_t - EL_{t-1}}{EL_{t-1}} \times 100$	Rate	World Bank Indicators, 2012

Note: RGDP = Real Gross Domestic Product, LFE = Labour Force Employed, TLF = Total Labour Force,

4.0 PRESENTATION OF THE RESULTS AND DATA ANALYSIS

Table 2: Unit Root Test

Variable	Augmented Dickey Fuller (ADF)						Integration Order
	LEVEL			FIRST DIFFERENCE			
	Without Drift	With Drift	With Drift and Trend	Without Drift	With Drift	With Drift and Trend	I(d)
G	-1.482711 (0.1266)	-2.689436* (0.0884)	-2.878209 (0.1840)	-4.462975*** (0.0001)	-4.466649*** (0.0016)	-4.500413*** (0.0069)	I(1)
CF	-2.983683*** (0.0043)	-5.180262*** (0.0002)	-5.056490*** (0.0018)	-3.886548*** (0.0004)	-3.686126** (0.0103)	-3.281595* (0.0907)	I(1)
LB	-1.260105 (0.1860)	-2.380073 (0.1561)	-2.853091 (0.1917)	-4.219626*** (0.0002)	-4.462582*** (0.0016)	-4.472752*** (0.0074)	I(1)
RInvT	-2.162021** (0.0317)	-2.506168 (0.1248)	-2.449391 (0.3485)	-5.745736*** (0.0000)	-5.630346*** (0.0001)	-5.555741*** (0.0006)	I(1)
EL	-2.613192** (0.0110)	-3.199258** (0.0307)	-3.230504* (0.0990)	-6.007229*** (0.0000)	-5.871672*** (0.0000)	-5.729713*** (0.0004)	I(1)

Source: Investigator's Computation, 2012.
Note: ***, ** and * indicated at least significance at 1%, 5% and 10% level.

The ADF test is conducted to test the stationarity of the data set and the findings show that

The table 2 shows the stationarity estimates of rate of change in real Gross Domestic Products, Gross Fixed Capital Formation as a share of Gross Domestic products (GDP), Labour Force Employed as percentage of total labour force, rate of change in real investment in Telecommunication and rate of change in electricity production respectively. The ADF test conducted without drift, with drift alone and with drift and trend shows that Fixed Capital Formation as a share of Gross Domestic products (GDP) and rate of change in electricity production are stationary at 1% and 10% MacKinnon significance level respectively at level. But, rate of change in real Gross Domestic Products, Labour Force Employed as percentage of total labour force and rate of change in real investment in Telecommunication are stationary at 1% MacKinnon significance level at first difference. For uniformity, Fixed Capital Formation as a share of Gross Domestic products (GDP) and rate of change in electricity production are integrated to order of one i.e. first difference, so as to integrate all the variables to the same order. And, Fixed Capital Formation as a share of Gross Domestic Products (GDP) and rate of change in electricity production are still stationary at 10% and 1% MacKinnon significance level respectively at first difference.

Table 3: Cointegration Test

Johansen Cointegrating Tests					
Eigen Values	0.859133	0.802859	0.530099	0.282739	0.189131
Hypothesis	r=0	r=1	r =2	r=3	r=4
Max-Eigen Test	54.87828* (0.0002)	45.46736* (0.0004)	21.14655 (0.1222)	9.304834 (0.4644)	5.870167* (0.0154)
95% critical value	37.16359	30.81507	24.25202	17.14769	3.841466
Trace Test	136.6672	81.78891	36.32155	15.17500	5.870167
95% critical value	79.34145* (0.0000)	55.24578* (0.0001)	35.01090* (0.0360)	18.39771 (0.1335)	3.841466* (0.0154)

Notes: VAR include one lag on each variables and a constant term. The estimated period is 1980-2010. None of the deterministic variable is restricted to the co-integration space and maximum Eigenvalue and Trace test statistics are adjusted for degrees of freedom. The critical values are taken from MacKinnon-Haug-Michelis (1999). The * indicates rejection of likelihood ratio tests at 5% significant level.

ISSN 2278-7763

Johansen procedure is used to identify a long-run economic growth amongst the cointegrating equations. Table 2 reports the estimates of Johansen procedure and standard statistics. In determine the number of cointegrating equations, the study used degrees of freedom adjusted version of the maximum eigenvalue and trace statistics, since the existence of small samples with too many variables or lag Johansen procedure tends to overestimate the number of cointegrating equations (Civcir, 2003). The Trace test statistics strongly rejects the null hypothesis of no cointegration in favour of three cointegration relationships while Max-Eigen test statistic rejects the null hypothesis of no cointegration in support of two cointegrating equations.

Table 4: Economic Growth Estimates for Long run Equilibrium

Dependent Variable: G

Variable	Coefficient	t – ratio	p - value	Decision
Constant	-2.749401	-0.133464	0.8949	-
CF	-0.421429	-5.524237***	0.0000	Reject H_0 (Statistically Significant)
LB	0.274312	0.600722	0.5534	Accept H_0 (Statistically Insignificant)
RInvT	-0.006555	-1.764197*	0.0899	Reject H_0 (Statistically Significant)
EL	0.281860	3.125931**	0.0045	Reject H_0 (Statistically Significant)
	R^2 = 0.723055	**F** = 16.31764 (0.000001)***	**DW** = 1.957801	

Source: Investigator's Computation, 2012.
Note: ***, ** and * indicated at least significance at 1%, 5% and 10% level

ISSN 2278-7763

Table 5: Economic Growth Estimates for Short run Equilibrium

Dependent Variable: ΔG

Variable	Coefficient	t – ratio	p - value	Decision
Constant	-31.46976	-1.629611	0.1181	-
ΔCF	-0.443667	-3.362295***	0.0029	Reject H_0 (Statistically Significant)
ΔLB	0.811037	2.006581*	0.0578	Reject H_0 (Statistically Insignificant)
ΔRInvT	-0.005852	-1.971194*	0.0620	Reject H_0 (Statistically Significant)
ΔEL	0.282409	3.623635***	0.0016	Reject H_0 (Statistically Significant)
ECM(-1)	-0.130260	-0.732611	0.4719	Accept H_0 (Statistically Insignificant)
	R^2 = 0.640092	**DW** = 1.692978		

Source: Investigator's Computation, 2012.
Note: ***, ** and * indicated at least significance at 1%, 5% and 10% level

Discussion of the Growth Model Results

The growth model were estimated in the long run and short run through Ordinary Least Squares (OLS) and Fully Modified Ordinary Least Squares (FMOLS) techniques respectively. The growth model results show that economic growth in the long run and short run is positively associated with Labour Employed (labour force employed as percentage of total labour force and labour force defined as person between the age of 15 and 64 years) and electricity supply (rate of change in electricity production) in Nigeria. These uphold the a priori expectation that labour employed and electricity supply are directly vary to economic growth. The positive marginal effect of labour employed and electricity supply to economic growth in Nigeria are 27.43% and 28.17% respectively in the long run equilibrium. But, capital stock (Gross Fixed Capital Formation as a share of Gross Domestic products (GDP)) and real investment in telecommunication (Rate of change in real investment in Telecommunication) are negatively associated with economic growth in Nigeria and these disagree with the a priori expectation that capital stock and real investment in telecommunication are directly vary to economic growth. The inverse marginal effect of capital stock and real investment in telecommunication in Nigeria are 22.14% and 0.65% respectively in the

ISSN 2278-7763

long run equilibrium. In the short run the same relationship exist between economic growth, capital stock, labour employed, real investment in telecommunication and electricity supply, but at different marginal effects. And, the error correction mechanism (ECM) is inversely related to economic growth in Nigeria which follows the a priori expectation.

The empirical result in the long run equilibrium shows that capital stock (Gross Fixed Capital Formation as a share of Gross Domestic products (GDP)), real investment in telecommunication (rate of change in real investment in Telecommunication) and electricity supply (rate of change in electricity production) are statistically significant to economic growth at 1%, 10% and 5% significance level due to the p – values of their t – ratios less than 1% (i.e. 0.0000 < 0.01), 10% (i.e. 0.0899 < 0.10) and 5% (i.e. 0.0045 < 0.05). But, the Labour Employed (labour force employed as percentage of total labour force and labour force defined as person between the age of 15 and 64 years) is statistically insignificant to economic growth at least 10% due to the p – value of the t – ratio of labour employed more than 10% (i.e. 0.5534 > 0.10). In the short run, capital stock (Gross Fixed Capital Formation as a share of Gross Domestic products (GDP)), real investment in telecommunication (rate of change in real investment in Telecommunication) and electricity supply (rate of change in electricity production) are statistically significant to economic growth at least 10% significance level.

The variation causation effect of the exact components on economic growth in Nigeria is ascertained at 72.31% and 64.01%, both at the long run and short run respectively, while the inexact components are responsible for 27.69% and 35.99% variations in economic growth respectively in Nigeria. The overall significance of the model is carried out through analysis of variance (ANOVA) in the long run equilibrium i.e. F test. The result shows that the F values is 16.32 which is significant at 1% (i.e. 0.000001 < 0.01) with degree of freedom $V_1 = K – 1 = 5 – 1 = 4$ and $V_2 = N – K = 30 – 5 = 25$. This

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is used to evaluate the research hypothesis statements that H_0 = Investments in telecommunication do not have impact on economic growth in Nigeria and H_1 = Investments in telecommunication have impact on economic growth in Nigeria. Based on the ANOVA result that p value **(**0.000001) is less than 0.01, reject the null hypothesis and conclude that Investments in telecommunication have impact on economic growth in Nigeria from 1980 – 2010. The autocorrelation test is carried out through Durbin–Watson test in which the values are 1.957801 and 1.692978 in the long and short run equilibrium respectively. If the Durbin–Watson is far less and more than 2, there is existence of serial correlation. The Durbin–Watson's result for this study is approximately equals to 2 and we conclude that there is no existence of autocorrelation in the economic growth models both in the long and short run equilibrium for Nigeria from 1980 – 2010.

Policy Implication of the Findings

The empirical analysis shows that capital stock, labour force employed, investment in telecommunication and electricity supply are important to economic growth in Nigeria. Thus, in order to achieve steady economic growth in Nigeria, these measures must be appropriately implemented.

1. There should be a strict policy in place to aggressively promote investment in fixed assets that facilitate increase in aggregate output and stimulates aggregate demand in order foster economic growth. And, government needs to create enabling environment for capital investment.

2. The active population (labour force) should be fully empowered, engaged and employed so that there would not be idle human resources. Thus, emphasis should be laid more on quality skills acquisition and this will improve the marginal productivity of labour.

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3. Promotion of investment policy targeted at telecommunication infrastructures so as to reduce digital divide rate in Nigeria. The telecommunication sub sector should serve as medium through which digital provide could be attained. And, digital provide will lead to high teledensity and efficiency that integrate productivity in aggregate output.

4. There should be a constant power supply since it is largely required for production. This will minimize the cost of production and maximize profit and output.

5.0 CONCLUSION

This study discovered that real investment in telecommunication and other specified factors (capital stock, labour force employed and electricity supply) exert pressure on economic growth in Nigeria. The real investment in telecommunication is negatively correlated with economic growth in Nigeria. This is caused by the negative growth of real investment in telecommunication in Nigeria, prior to liberialisation of the telecommunications industry. But, the liberalization integrate the telecommunications industry in which at least competition and market forces are allowed to operate and determine economic activities in the industry. And, competition and market forces in the telecommunication sector foster real growth in investment in telecommunication. Thus, liberalisitions of the telecommunication sector have created technological improvement and economic growth leap frog in Nigeria. Liberalisation of the telecommunication sub sector have promoted information innovation in the information and communication technology (ICT) sector in Nigeria and this have great impact on production and economic improvement.

Therefore, real investment in telecommunication is theoretically and empirically significant to economic growth in Nigeria. The telecommunication sub sector bridge the gap between the digital divide and digital provide in Nigeria because it is the most used ICT gadget in Nigeria.

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