# Investment in Telecommunication Infrastructure And Economic Growth in Nigeria (1992-2007)

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### Abstract

The study appraised the effects of investments in telecommunication infrastructure on economic growth of Nigeria measured by gross domestic product using a comprehensive national level data set in Nigeria for a sample period of 16 years (1992-2007). Data on economic variables such as gross domestic product, government expenditure were obtained from the Statistical Bulletin published by Central Bank of Nigeria. Data on telecommunication infrastructure investment such as telephone mainlines (both fixed line and mobile), total capital expenditure, telecom sector revenue and telecom sector employment were sourced from the publication of the International Telecommunication Union, the Nigeria Communication Commission and as well as World Bank Development Indicator Database. The data were analyzed through the pooled ordinary least squared (OLS) regression methods. The causal relationship between the likely interdependence of telecommunication and economic variables were tested using the time series data. The results showed that telecommunication infrastructure measured by teledensity and telecommunication employment is both statistically significant and positively correlated with economic growth. The study concluded that the stock of telecommunication infrastructure plays a role in determining growth and productivity in Nigeria and that there is the need to create a conducive and competitive climate for the growth of the telecommunication industry, encourage more investment in the sector through private participation, stable and transparent telecommunication policies so that the capital required for building telecommunication infrastructure can be met.

## 1. Introduction

The potential role that may be played by information and communication technologies in promoting economic growth, especially in low-income countries is attracting considerable attention worldwide. There is a long tradition of economic research on the impact of investment in telecommunication infrastructure on economic growth in developed economies. Studies carried out by Scott J(,2001), Roller, Lars H, (2001), Lamont, J (2001) etc, have successfully measured the growth dividend of investment in telecommunication infrastructure in developed economies. Telecommunication sector across the globe has been identified as one with generic effect on almost all other sectors of the economy. Its function in any economy is described as a strategic one aimed at promoting economic growth and as one that has the linkages with other sectors.

For instance, in an emerging global economy, its ability to provide a competitive network for exchanging information has significant implications for productivity and economic growth because, today's global economy demands a modern and efficient information infrastructure to support growth. Most of the developed economies such as U.S, having realized Japan e.t.c this. had deregulated their telecommunication sectors to allow more investment and the results, for improved them were not iust telecommunication capabilities but also; increased foreign investment, boom in private development ,more employment sector opportunities and better education and training facilities (Strette 1999)

Motivated by the result from developed economies and the quest for economic growth, many developing countries began to reform their telecommunication sector in the late 80s and early 90s.In line with this development, Nigeria government like many other developing countries is not left out in the race for rapid development. Emphasis is placed on the deregulation the need for of telecommunication sector and investment in telecommunication infrastructure in order to realize the expected economic and social growth rate of the country. The realization by Nigerian government that investment in telecom infrastructure is a necessarv foundation for economic growth has further spurred the need for deregulation and privatization of the sector. It was also realized that massive investment is required to address the low teledensity and poor service typical of the telecommunication market. The deregulation of telecommunication services in Nigeria began in 1992 with the promulgation of Nigerian Communication Commission (NCC) which licensed private participation in the provision of telecommunication services in Nigeria, thus ending the state-owned NITEL's monopoly of the sector and ushering in competition. Such government policy was expected to enhance efficiency and lead to more infrastructure investment in the sector and improve productivity in other sectors of the economy.

Today in Nigeria, there have been large infrastructure investments resulting from deregulation between 1992-2007, which have

enabled million of people to communicate and transact better. Deregulation attracted new operators from within and outside the country. The new operators have injected competition and provided a new employment opportunity and many indigenous companies such as Global Com, Odua Communication etc have emerged. This growth is expected to have equally profound impact on the job and employment market, enhance efficiency in other productive sectors and increase national output. Though so far, no proper assessment has been made to the volume and impact of new job creation and extent of growth in national output due to the growth in the Nigerian telecommunication sector. The general assumption has been that all have been high and far-reaching. This study therefore examined the effects of investment in Telecommunication infrastructure on economic performance measured by GDP using a comprehensive national level data set from Nigeria. It presents empirical testing based on the data collected and for the purpose of investigating if there is a significant link between telecommunication investment and economic growth. How do investments in telecommunication infrastructure undertaken by both private and public institutions impact the economic performance in Nigeria, is basically the question addressed by this study and specifically, this study focuses on one aspect of ICT-Telephone.

The structure of the paper is organized as follows. Section 2 provides a brief summary of empirical issues on relationships between investment in telecommunication infrastructure and economic growth. Section 3 gives the methodology adopted in the work. Section 4 provides the discussion of results. The last section contains the concluding remarks.

#### 2. Literature review

#### 2.1. Empirical evidence

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 there have been few economic growth. corresponding studies from developing countries especially those in Africa whose are vulnerable to disruption economies with inadequacy associated gross 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, Bee and (1967) studied the relationship Gilling 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 (Li. Wei and Colin Lixin Xu 2004).

There are a large number of recent empirical studies on this topic and the interest in 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; Yilmag, Haynes, mand Dinc, 2001; Yilmaz and Bink, 2002). 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 economic relationship between positive growth and telecom infrastructure investment. A study of Yilmaz, et al (2001) indicated that accumulation of telecommunication the

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, Leonard, M Meschi and M Fuss (2005), combats poverty (Calderon and Serven, 2004) and promotes expansion in economic activities (World Bank, 1991). A wide range of studies indicated have that expanded telecommunication investment is essential but not the only determinant of economic growth. Dholakia and Harlem (1994) showed the relationship between investment in telephone infrastructure and economic growth bv 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 education. as 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 infrastructure transportation produce approximately the same productivity effect of other capital investment, the productivity telephone infrastructure effect of is surprisingly higher in comparison. According Canning (1999), this suggests to 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 (1991) concludes that expansion of telephone infrastructure provides "substantial growth – and investment- enhancing activity and thus facilitates economic development. Norton's explanation for his findings 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 the empirical and evidence on the relationship 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 crosscountry 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 wealthv countries may not be directly relevant to those 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. Methodology

## 3.1 Data and data sources

To carry out this empirical analysis, the study employed secondary data. Annual data that characterizes the aggregate economy and telecommunication sector were sourced from International Telecommunication Union (ITU), World Bank Development Indicator Database, Central Bank of Nigeria (CBN) statistical bulletin and Nigeria Communication Commission (NCC) publications. The data set

was tailored to the need of the empirical framework and it contained information on economic variable such as gross domestic product (GDP). Several key indicators for measuring impact of telecommunication on economic growth have been identified in literature such as; telecom sector revenue, telecom sector employment, telecom sector contribution to GDP, telecom sector export, telecom sector R&D expenditure, telecom sector investment as a percentage of GDP, overall telecom investment in the economy as a whole, e.t.c. But the paucity of data in this sector in Africa countries particularly, Nigeria, poses a serious problem for the adoption of many of the indicators though, this problem has been partially solved in the last18 years, when international organizations such as World Bank and ITU have been able to collect and provide researchers with accurate and systematized data.

The sample period (1992-2007) is determined by the availability of short-time series data on the variable that are required for this analysis. The analysis is confined to the sample period in order to avoid the complication might that arise from inconsistency and non-availability of data prior to 1992. It was obvious that before 1992 that size of telecommunication infrastructure in Nigeria was very small and as a result, its effect on Nigeria's whole economy would be marginal. Also 1992 marked the beginning of a new era in telecommunication policy in Nigeria with the reform and establishment of NCC and it was from the late 1990s that the telecommunications sector began the rapid expansion.

The data gathered consisted of data on general economic variables and country characteristicsdomestic product. gross population, development expenditure, Wages rate and literacy. Also gathered, were data on a number of characteristics of telecommunication development- teledensity, the number of telephone per 100 inhabitants including both fixed line and mobile, number expenditure of network. total on telecommunication and total

telecommunication sector employment and telecommunication sector revenue.

Given the short period of data availability, an approximation of initial capital value (with respect to telecommunication) as a fraction of GDP caused several statistical problems of collinearity (Leonard, 2005). To avoid this, the study introduced proxy for telecommunication infrastructure investment.. A proxy used in recent studies such as Canning (1998) and Canning & Bennathan (1999), is physical infrastructure such as the number of telephone line. Considering the peculiar nature of data in Nigeria, this study therefore used telephone mainlines (both fixed line and Moibile), total capital expenditure, telecommunication sector revenue and telecommunication employment to sector capture telecommunication infrastructure investment. These proxies were found to be significant in a number of international studies (Easterly and Rebelo, 1993, Canning, Fay, and Perotti, 1994, Canning, 1999; and Roller and Waverman, 2001)

The work estimates the demand for telecommunication services (Telrev). telecommunication employment (Telemp), gross total telecommunication investment (telinv) and the change in telecommunication penetration. The estimation was done along with the macro economic data (GDP) using data over 1992-2007 period. The period used was based solely on the availability of data for a consecutive line of years and the study does not differentiate between public and private investment since it is the total amount that is crucial in this work. OLS Multiple regression method was used to estimate the system Furthermore, the study identified equation. certain variables that are of specific relevance to economic growth in the content of Nigerian economy. Summary statistics of the data and the list of the variables used in the models and their description are given in table 1 and 2 below

Dependent variables N	Minin	ıum Maxin	num Mea	n Std. Devi	ation
Year 1992 – 2007					
-Dependent variables					
GDP	16	267550.00	14553130	3973435.6	40622578.6415
-Telecom Variables					
NETEFFEC	16	403562.00	2465472.0	909595.00	570158.29296
TELINV	16	3.56E+08	8.97E+10	2.05E+10	25890245854
TELEMP	16	11350.00	22548.00	14603.438	2951.26294
TELREV	16	2.21E+09	3.69E+11	7.79E+10	1.0791E+11
TELDEN	16	30	9.47	1.7363	2.85607
- Other control variables					
DEVEXP	16	9055600.0	5.20E+08	1.70E+08	165844540.23
POPULTN	16	88992220	1.34E+08	1.10E+08	14320946.354
LITRA	16	38.00	62.00	48.4375	8.66386

Table 1: Descriptive Statistics of dependent and independent variables

Source: Based on computation of data from ITU (2004), CBN Statistical Bulletin (2007) NCC Publication (1992- 2007)

Variable	Definition	Source
Dependent variable GDP	Gross Domestic production at factor cost price	CBN statistical Bulletin ( 2007)
TelecomVariablesTeldenNeteffeccTelinvTelrevTelempOthereconomicvariablesPopDevexp.Litera	Teledensity Connection capacity of local exchange Total real investment in telecommunication Total telecomrevenue(fixedand mobile) Value added by telecom services Total telecom employment Population Development Expenditure Literacy rate	ITU, World Dev. Indicator NCC Publications ITU, World Dev. Indicator NCC Publications National population commission CBN statistical Bulletin Ministry of Education

Table 2: Description and source of Dependent and Explanatory Variables

## 3.2. Model Specification

The selection of variables was primarily guided by the results of the previous empirical studies and the availability of data. It was during the sample period that the telecommunication sector has witnessed a considerable inflow of investment and an appreciable level of consistency and stability in data. Given the small number of observation and 16 years time period, this study employs the pooled OLS regressions to estimate the equation after Hausman test suggested its appropriateness. The causal relationship between the likely interdependence of telecommunication and economic variables are tested using the times series data. A simplified model is used for this purpose. The regression model is:

 $gdp_{t-1} = \alpha + \beta_1 telinv_{t-1} + \beta_2 neteffec_{t-1} + \beta_3 telrev_{t-1} + \beta_4 telemp_{t-1} + \beta_5 telden_{t-1} + \beta_6 pop + B_7 devexp + \beta_8 litra + \mu$  -------(1)

Where, gdp is gross domestic product in Nigeria in year t, telden is teledensity, neteffec. effect. telinv is network is total telecommunication investment, telrev is telecommunication sector revenue, telemp is telecommunication sector employment,(teliny, neteffec, telinv, telrev, telemp and telden are set of variables used to capture the effect of telecommunication infrastructure investment) and, devexp (development expenditure) pop (population) litra (literacy rate) are the set of other variables that may affect GDP.

The underlying assumption was that reform of telecommunication sector leads to more competition and greater availability of telecommunication infrastructure investment which would have the following effects: (i) increase the number of people connected telephone (teledensity); (ii) increase the total number of telephone connection (network effect), (iii) increase in inflow of investment in telecommunication (total telecom expenditure) and (iv) increase in telecom sector employment thus, leading to higher economic growth measured by GDP. In this analysis, teledensity is measured as the number of telephone per 100 populations. The number of telephone connection provided is used to capture the network effect while total expenditure in telecommunication (both fixed and mobile lines) is used to capture infrastructure investment.

## 4. Empirical results

4.1. Empirical results and discussion The study examines whether there is a significant relationship between telecommunication investment and GDP in Nigeria. Due to the choice of GDP rather than GDP growth as the dependent variable, the problem with time trend occurred. GDP is likely to increase overtime following a general tread, thus it might be misleading to argue that an increase in GDP is caused by the explanatory variables if this is not taken into account. To control for the time tread factor, the study included as an explanatory variable, the variable't'. Also the telecommunication

variables were lagged for one year in the model. This was done because it was expected to be a lag between the investment and the actual expansion of the network, thus the effect on GDP was not instantaneous. However, other control variables (pop. devexp and litra) were not lagged since the effect of a change in these variables will be felt more instantly than changes in the other telecommunication variable in the models. The result is indicated in Table3.

Dependent var	iable: GDP				
Model	(1)	(2)	(3)	(4)	(5)
Telinv	0.054	0.044	-0.028		
	(0.743)	(0.719)	(-0.598)		
Net effect	0.164				-0.034
	(0.237)				(1.479)
Telden			0.605		
			(11.488) **		
Telemp	0.319	0.623		0.631	0.410
*	(1.032)	(3.341)**	k	(3.486) **	(1.479)
Telrev	, , , , , , , , , , , , , , , , , , ,	-0.470		-0.481	, , , , , , , , , , , , , , , , , , ,
		(-1.283)		(1.350)	
Devexp	0.156	0.192	0.110	0.146	0.115
-	(1.015)	(1.377)	(1.068)	(1.210)	(0.822)
Pop	0.560	1.024	0.572	1.056	0.745
*	(0.915)	(1.377)	(3.183) **	(3.099)	** (1.363)
Litra	-0.052	-0.640	- 0.212	- 0.019	-0.011
	(-0181)	(-0.244)	(-1.118)	(-0.078)	(-0.041)
Constant	1.089	(-30416)	(-1.089)	2.269	(-1.710)
R-squared	0.967	0.973	0.820	0.974	0.969
F-value	70.	062 84.1	147 13.731	10.766	88.357

Table 3 OLS Results of Effect of Investment in TelecommunicationInfrastructure on GDP

*Robust t – statistics in parentheses \*\*Significant at 5%* 

Source: Based on computation of data from ITU (2004), CBN Statistical Bulletin (2007) NCC Publication (1992-2007)

Table 3 presents the OLS estimate of the effects of investment in telecommunication infrastructure on GDP. Model (1) includes total real telecommunication investment, network effect and telecom employment as measures of telecommunication investment, model (2)includes total real telecommunication investment. telecom employment and telecom revenue as measure of telecommunication investment, model (3)

includes total real telecommunication investment and teledensity as measure of telecommunication investment, model (4) includes telecom employment and telecom revenue and model (5) includes network effect and telecom employment. A first glance at this result shows there are indications that most variables have the expected positive signs. R -Square is high in each model, showing that the models explain the variation in GDP. From the regression results, F- values in the models suggest the appropriateness of the regression and also, indicate the acceptance of the regression result and that the models are overall a good fit to the data.

However, the coefficients between GDP and telecommunication variable in model 1 and 5 though, showing positive relationship, were statistically insignificant at 5 percent level of significance. The close correlation between teledensity and GDP as indicated by numerous correlation studies which have been conducted (Roller and Waver man, (2001, Norton e.t.c.) have been upheld by this analysis (model 3). The coefficient estimate for teldensity is positive and at the same time highly significant, which provides support for the basic argument that increased access to communication services has a positive impact on GDP.GDP is estimated to increase by 61 percent if the lagged teledensity increase by 1 percent.

The coefficient between GDP, and telecommunication employment, were found to be respectively 0.623, and 0.631. in model 2 and 4 (all statistically significant). Although their correlations were not as high as those found by Roller and Waverman (2001) given their statistical significance. The employment effects that come to the telecommunication sector is very significant and if strong enough could provide an economic boost for the country, thus resulting to positive impact on GDP. Surprisingly, the beta coefficient of telinv is positive showing that one percent increase in lagged telinv is estimated to cause GDP to increase by 5 percent and 4 percent in model 1 and 2 respectively but on the other hand, it is statistically insignificant at 5 percent significant level according to the t-value. The explanation for the insignificance is that telecommunication sector before liberalization and in the early stage of liberalization, received almost the same amount of investment every year and when these amounts are regressed against GDP which varies overtime, the result though showed positive sign of correlation, suggested that the slow process of liberalization in Nigeria created obstacles for private firm.

#### 5. Concluding remarks

This study has used national level data to analyze empirically the effect of investment in telecommunication infrastructure on economic growth. The assumption for the empirical work was that the contribution of investment in telecommunication infrastructure in Nigeria is positive and this was tested by looking at the relationship between telecommunication variables and measures of economic growth. The results of this work provided evidence to the earlier work support that telecommunication investments have positive effects on economic performances. Though most studies had focused exclusively on developed countries and the few in developing countries focused on cross-country studies but interestingly, the conclusion drawn from these wealthy countries using cross-countries data are directly relevant and similar to Nigeria case.

The close correlation between telecommunication and economic growth as indicated by numerous correlation studies which have been conducted has been upheld in The results confirmed this work. the hypothesis that telecommunication investment drives growth. The primary assumption was that telecommunication investments are necessary but not sufficient condition for economic growth. Many factors other than telephone investment were critical to growth, but the lack of this investment hinders growth no matter what resources are dedicated in other areas of the economy. Thus, there is need to create a conducive competitive climate for the growth of the industry in order to allow more private investment.

Also, considering the relevance of the telecommunication industry to economic growth and development, policy makers should ensure that telecommunication policies are transparent and stable. Policies and regulations should be made to promote a conducive and competitive climate for foreign investment so that the capital required for building telecom infrastructure can be met. The result of this study showed that there is an employment effect that originates from

investment in telecom sector. Thus, empirical result of this study has implication for how Nigeria economy can increase its penetration

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