Infrastructural Development and Its Effect on Economic Growth in Nigeria

Sheu Nurudeen Adebayo
Department of Economics
School of Arts and Social Sciences
Federal College of Education (Special), Oyo
E-mail: moyinpeluini@gmail.com

ABSTRACT

This paper investigates the impact of infrastructure on economic growth in Nigeria. Vector Error Correction Model (VECM) was deployed. Co-integration test was conducted to establish the number of co-integrating vectors using Johansen's methodology which have two test statistics which are the trace test statistic and the maximum Eigen-value test statistic. The research covered 47 years (1970 to 2017). The finding shows that infrastructural investment has a significant impact on output of the economy and that there is a long run relationship between infrastructure development and Nigerian economic growth. VECM have the expected negative sign, and is between the accepted region of less than unity. It also shows a low speed of adjustment towards equilibrium. The paper recommended increased investment in infrastructure. Also, the financing options for closing Nigeria's infrastructure gaps should focus on broadening the sources of finance and a better allocation of public resources. Consequently, the government should intensify the utilization of the public-private-partnership (PPP) framework.

Keywords: Infrastructure, VECM, economic growth, Nigeria

1. INTRODUCTION

A number of theoretical works that discuss the linkages between infrastructure and economic growth have been accentuated in endogenous Growth theories. Aschauer (1989) pioneered the econometric analysis on the impact of investment in public infrastructure, with productivity and GDP growth for the United States economy between 1949 to 1985. He discovered that the rate of return on private capital is positively influenced by public capital, and leads to private accumulation. There is a strong positive relationship between output per unit of capital input, the ratio of the public capital stock to the private capital input, and the private labour-capital ratio. Ashauer (1989) found that public infrastructure capital has elasticity of output.

Canning and Petroni (2004) investigate the long run impact of infrastructure provision on per capita income in a panel of countries over the period 1950 to 1992 and provide evidence that in majority of cases infrastructure stimulate long run growth effects. Udjo EO, Simelane S, Booysen D (2000) also identify infrastructure as having both direct and indirect impact on the growth of an economy. Infrastructure is said to add to economic growth and development by raising efficiency and providing facilities which enhance the quality of life. Infrastructure as defined by Akinyosoye (2010) is the "unpaid factor of production" which tends to raise productivity of other factors while serving as intermediate inputs to production. The services engendered as a result of an adequate infrastructure base will translate to an increase in aggregate output. Canning and Fay (1993) also found that the developing infrastructure which compared favourably

with those of developed countries. Nigeria is experiencing a stunted growth due to sluggish infrastructure development. Resources channelled to the provision of infrastructure services were largely inadequate and sub-optimal. According to National Bureau of Statistics (NBS) over the last decade, Nigeria's infrastructure spending contributed a 1.9% (approximately $4 billion) per annum to GDP. The recommendation of the Asian Development Bank in the KPMG report is that in order for a developing country to sustain growth and development, not less than 6% of GDP should be invested on infrastructure.

From the foregoing, infrastructure can be said to be more than just being a factor of production, but rather a veritable condition for increased rate of economic growth. From the endogenous growth models, infrastructure leads economic growth while the Wagner's law regards the increase in GDP as a main drive for public infrastructural investment. Some of the literature in fact report negative or non-significant growth impact of public investment. Since there is no consensus in the theoretical literature as to the direction of causality, this paper therefore seeks to investigate the impact of infrastructure on economic growth in Nigeria.

The paper will be divided into 5 sections as follows, section 1 will be introduction, and section 2 covers literature review, while section3 dwells on research methodology, section 4 is devoted to policy and its implication and section 5 concludes the work.

2. LITERATURE REVIEW

Literatures that have investigated the relationship that exist between infrastructure development and Economic growth abound. However, the results emanating from these studies have been inconclusive. Some studies suggests that infrastructure development impacts positively on economic growth while others have opined that a negative relationship exist between both variable.

Aschauer (1989) when he established that slower growth recorded in the public capital accumulation in United States during 1970s and 1980s were largely from the spillover effect of stunted growth recorded in the private sector productivity. Aschauer (1989) further noted that private output elasticity with respect to public capital stood at 42%. Some other studies have relatively investigated the cause of the decline in the United States output and productivity growth. There were empirical regularities in the findings of these studies that the services provided through public capital are more important in the process of raising production efficiency (Lynde and Richmond,1993; Munnell,1990 and Garcia-Mila &Guire,1992). In another study, Aschauer (1993) observed further that infrastructure provision through public investment should be well taken as factor of production just as labour and private capital in the private sector production process. In order to raise productivity growth, countries must boost the existing stock of capital accumulation and at the same time investment abundantly on research and development.

Pereira and De Frutos (1999) examined the empirical relationship between public capital and private variables, which include employment level, private investment and economy's output in the US using new vector autoregressive (VAR) framework. The outcome of the empirical study revealed that a one-dollar increase in public capital will surge long term production by 65 cents. There exists a positive relationship between employment and private, and public capital. Pereira (2000) used annual time series data between 1956-1997 to confirm the relationship between private sector performance and public investment in US using VAR methodology. He affirmed that all kinds of public investment are growth compatible.

The productive of all public investment include sewage and water supply system, transit systems and airfields, electric and gas facilities. Other social infrastructures that produce low rate of return but are very important factors of growth include public buildings, hospital and education. Likewise, Bose and Haque (2005), findings suggest a unidirectional causation running from economic growth to capital formation in the form of public investment in transport and communication. However, the outcome of the study of Easterly and Levine (2001) concludes that capital accumulation does not contribute to faster economic growth. Bakare (2011) using data spanning from 1979 – 2009 found the presence of a significant relationship between capital formation and economic growth in Nigeria. The study also concludes that savings is paramount to the attainment of economic growth in Nigeria. Also, Dash, Sahoo and Nataraj (2010), using data spanning between 1975 to 2007 opines that infrastructural development in China has contributed significantly to economic growth.

Again, in China, a research by Dash and Sahoo (2010), using Two-Stage Least Squares (TSLS) and Dynamic Ordinary Least Squares (DOLS) techniques on data spanning between 1970-2006 finds that both physical and social infrastructure have a significant positive effect on economic growth in the country. From the discussion so far, it can be noted that most studies are of the view that infrastructure development in the form of GFCF is an important determinant of economic growth. However, for a country to be able to effectively achieve and sustain its economic growth, such country must have a ratio of GFCF to GDP of at least 27 percent (Bakare 2011, Hernandez-Cata 2000). However, Nigeria since the mid-1980s till 2013 has experienced a GFCF-GDP ratio of less than 20 percent; this could be a reason for the country's meager economic performance.

Nedozi et.al (2014) analyzed infrastructure development and economic growth in Nigeria using simultaneous analysis. Two models were specified and analyzed using the OLS method. Findings from the study show that infrastructure constitute a critical part of growth process in Nigeria. In line with this, Babatunde et.al (2012) attempted to investigate the impact of infrastructure on economic growth in Nigeria using a multivariate model of simultaneous equation during 1970 to 2010. The study utilized three-stage least squares technique to capture the transmission channels through which infrastructure impacted on growth. The study submitted that infrastructure investment directly impacted on the overall output and indirectly stimulates growth of other sectors.

3. METHODOLGY AND MODEL SPECIFICATIONS

3.1 Methodology

This study employed econometrics methodology in examining the relationship between infrastructural development. The VEC model was used to establish the long run relationship among the variables (road as a proxy for transportation, communication as a proxy non- transportation stock, degree of openness as a measure of the degree of openness in the country and education measured by secondary school enrolment ratio as a proxy for the quality of human capital). Stationary test was conducted using both the Philips-Perrson (PP) test (Challis and Kitney, 1991; Granger and Newbold, 1974; Bowerman and O'connell, 1979; Dickey and Fuller, 1979; Gujara Brooks, 2008). Co-integration test was conducted to establish the number of co-integrating vectors using Johansen's methodology which have two test statistics which are the trace test statistic and the maximum Eigen-value test statistic (Johansen, 1988). Co-integration rank was used to show the number of co-integrating vectors in VECM where two linearly independent combinations of non-stationary variables will be stationary and captured by a rank of two.

However, the error correction term in the VEC model must be negative, significant and less than one to explain short term oscillation between the independent variables and the dependent variable resulting to a steady long-run relationship between the variables. However, this study was conducted using data from 1981 to 2014. The data was collected from Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS) and World Development Index (WDI).

3.2 Model Specification

As a premise, the link between infrastructure and economic growth reviewed above as well as the work of Pooloo (2009) are suffice to establish a model that captures the relationship among the variables for the study, hence:

$$GDP = f(PRIINV, ROAD, COM, DOO \text{ and } EDU) \quad \ldots\ldots(1)$$

Where GDP represents the economy's output, PRIINV represents the private capital as captured by the proportion of private investment to GDP showing the extent of private investment as well as foreign direct investment in Nigeria. ROAD is a proxy for transportation stock, while COM is a proxy for non-transportation stock. However, the length of paved road per square kilometer and telephone lines per 1,000 inhabitants are used to quantify ROAD and COM respectively. DOO represent the total of exports and imports divided by GDP which is simply tagged as degree of openness as a measure of the degree of openness in the country. Lastly, EDU represents education measured by secondary school enrolment ratio as a proxy for the quality of human capital. Hence, equation (1), in its econometrics forms transforms into:

$$GDP_t = \alpha + \beta_1 PRIINV_t + \beta_2 ROAD_t + \beta 3 COM_t + \beta_4 DOO_t + \beta_5 EDU_t + \mu \quad \ldots\ldots(2)$$

where
α is the constant,
$\beta_1 - \beta_5$ represent the coefficients of the explanatory variables,
while μ is the error term.

The apriori expectation posed that, all the independent variables produce a positive relationship with the dependent variable. Therefore, β_1, β_2, $\beta 3$, $\beta 4$ & $\beta 5 > 0$.

4. ESTIMATION AND INTERPRETATION OF RESULT

4.1 Result of unit root test

From Table 1, the ADF and PP unit root test revealed that all the variables considered were not stationary at level; as the critical values were greater than the calculated values produced by ADF and PP test. Therefore, the null hypothesis of no unit root for the variables cannot be rejected. Hence, we proceeded by taking the first difference of the variables and after the tests were conducted on the differenced variables. The critical value at 1% is less than the calculated value leading to rejection of the null hypothesis of unit root and acceptance of alternative hypothesis of no unit root problem. It can then be concluded that, the variables were all stationary at first difference and were integrated of order one I(0). To identify the long-run relationship among the variables included in the model, co-integration test was employed.

Table: 1: Unit root test

	Level	First Difference		Level	First Diffrence	
Variables	**ADF**	**PP**		**ADF**	**PP**	
LGDP	-2.611	-2.421	Non-stationary	-3.935*	-3.884*	Stationary
LPRIINV	-1.903	-1.548	Non-stationary	-8.833*	-8.673*	Stationary
LROAD	-1.434	-1.456	Non-stationary	-5.061*	-5.059*	Stationary
LCOM	-2.134	-2.581	Non-stationary	-5.540*	-5.924*	Stationary
LDOO	-2.386	-2.201	Non-stationary	-4.922*	-5.035*	Stationary
EDU	-0.572	-0.926	Non-stationary	-3.873490*	-4.848*	Stationary
	-3.662	-	-	-3.654	-	-
Critical value	-2.960	-	-	-2.957	-	-
	-2.619	-	-	-2.617	-	-

Source: Authors' computation from E-views output (Note: *denote significance at 1% level).

4.2 Co-integration Test

The result of trace test and maximum-eigen test both show existence of five cointegrating variables in the system of equation which is a pointer to the fact that, there exists a long-run relationship among the variables under consideration. From Table 2, both the maximum eigen value and the trace statistics are higher than the critical value at 5% level of significant, indicating that the variables are all cointegrated at 5% level of significant. Having satisfied the aforementioned two conditions, the model formulation conditions for estimating the model formulation using VEC Model is invoked.

Table 2: co-integration test

Unrestricted co-integrated rank test (Trace)

Hypothesized		**Trace**	**0.05**
No. of CE(s)	**Eigen value**	**Statistic**	**Critical value**
None*	0.878	110.81	91.664
At most 1	0.663	63.772	72.941
At most 2	0.547	43.275	62.788
At most 3	0.336	16.635	31.781
At most 4	0.142	4.430	13.955
At most 5	0.003	0.070	3.832

Trace test indicates 1 cointegrating equation(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration RankTest (Maximum Eugenvalue)

Hypothesized		Max-Eigen	0.05
No. of CE(s)	Eigenvalue	Statistic	Critical Value
None *	0.878	46.054	40.056
At most 1	0.663	24.950	30.888
At most 2	0.547	17.661	25.554
At most 3	0.336	12.110	23.112
At most 4	0.142	4.424	11.285
At most 5	0.003	0.070	3.832

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 0.05 level
*denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Authors' computation

4.2 Vector Error Correction Model

From table 3, the t-statistics indicates that the variables are co-integrated except LDOO whose t-value is -0.070 and this is asymptotically statistically insignificant. The result shows that there is a long-run relationship among the variables such that they tends to move in the same direction in the long-run. The next logical step within the framework adopted is to examine their short-run relationship, and identify the speed of adjustment that reconciles the long-run equilibrium and the short-run.

In Table 4, infrastructural facilities on road and communication have a positive relationship with GDP that is proxied for economic growth in the long-run, while private investment and education determined by school enrolment have negative relationship with GDP in the long run. It is evident that, all the explanatory were statistically significant in explaining the dependent variables and the elasticity of these variables in the long-run normalized vector as revealed in the result. The result of the private investment, degree of openness and education contradict the expected relationship in the long run.

The result from the empirical findings above shows that, the level of education in the country might not produce the level of growth expected in Nigeria. In the same vein, the result of the short-run analysis shows that, the VEC is statistically significant, have negative sign as expected and less than one. The implication of this is that, a low speed of adjustment towards equilibrium is possible in the case of disequilibrium in the short-run at the rate of 2%. This further shows that there exists a short-run relationship between the variables under study. The explanatory variables also confirm with the long-run relationship and the coefficient of determination shows that, 49% of the variation in GDP is explained by the independent variables and taking cognizance of the problem of degree of freedom, the adjusted coefficient of determination was at 38%.

Table 3: Results of the normalized long-run co-integration equation

LGDP	LPRINV	LROAD	LCOM	LDOO	EDU
1.000000	-0.157	0.132	0.431	-0.271	-0.077
-	(0.027)	(0.032)	(0.130)	(0.157)	(0.019)
-	[-5.816]	[-5.819]	[11.000]	[-1.780]	[-8.8630]

Standard errors in ( ) and t-statistics in [ ].

Table 4. Vector error correction model result.

LGDP	CointEq1	LPRIINV	LROAD	LCOM	LDOO	EDU
1.000000	-0.020	-0.020	0.023	0.071	-0.023	-0.002
-	(0.044)	(0.200)	(0.011)	(0.053)	(0.034)	(0.006)
-	[-2.462]	[-1.357]	[1.450]	[1.044]	[-0.482]	[-0.345]
R^2 = 0.49						
$\bar{R}^2$ = 0.38						

Standard errors in ( ) and t-statistics in [ ].

5. CONCLUSION

The paper has reviewed the impact of infrastructure on economic growth. The results of the paper are consistent with similar results of other countries. The study has ascertained that investments in infrastructure both directly and indirectly significantly affect economic growth in Nigeria. The results of the study further show that government should increase the funding of the development of infrastructure particularly in line with the lessons learnt from the Korean government which has invested in the postwar period on construction of roads, power stations, electricity and communication which created jobs, roused the economy, reduce the production costs indirectly and raise their productivity. The financing options for closing Nigeria's infrastructure gaps should focus on broadening the sources of finance and a better allocation of public resources In this wise, the government should intensify the utilisation of the public-private-partnership (PPP) framework as exemplified by the USD 385million Lekki-Epe toll road in Lagos and as obtained in Morocco where nearly two- thirds of electricity production is by private producers.

This paper has made a case for infrastructure investment in order to engender economic growth and development Future search needs to address in depth the exact dynamics of investment in infrastructure, identify threshold effects and collect information on quality and maintenance.

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