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Infrastructural Development and Economic Growth in Nigeria

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Abstract
This study examines the relationships between infrastructural development and economic growth in Nigeria using annual time series data spanning from 1981 - 2017. Research variables like Gross Domestic Product (GDP), Agriculture and Natural Resources (ANR), Roads Maintenance and Construction (RMC), Energy Supply (ENS) and Transport and Communication System (TCS) were used for the study. Philips-Perron unit root test (PP), Vector Autoregressive (VAR) estimation technique and Wald Bounds test were employed. The results of the study confirmed that there is positive correlation between infrastructural development and economic growth in the short-run in Nigeria. Based on the research findings, the study recommends that fiscal macroeconomic instruments should be employed to increase government expenditure on infrastructural development in order to achieve the economic developmental goal of the country.
Keywords – Infrastructural Development, Economic Growth, Vector Autoregressive, Wald Bounds, Philips-Perron.
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1 INTRODUCTION

In under-developed countries, infrastructural development has been an issue of concern to economic growth in every phase, despite the essentiality of infrastructures to life and humanity. Infrastructures like electricity, roads, water, telecommunication and irrigation are fundamental needs which cannot be undermined in creating enabling environments for achieving growth and development if they are well placed (Fidelis, Obasanmi and Ighata, 2014). Infrastructural facilities must be embacked upon in a country to complement her inputs for traditional factors of production such as capital, labour and entrepreneur. They have to be facilitated to enhance returns on investment by reducing the cost of production and to improve on its transition efficiency. The availability of infrastructural facilities as well as the efficiency of such facilities to an extent can determine the success of all other production endeavours (Organization for Economic Co-operation and Development [OECD], 2006).

According to Familoni (2011), infrastructural development cannot be feasible without putting infrastructures in place. In fact, demand for infrastructural development in Nigeria is very high and the resources needed for meeting this project are limited. According to Kathmandu Final Workshop Report (2009), it was discovered that the analyses of the linkages between infrastructure and economic growth are very complex. Not only does infrastructure affect production and consumption directly, but also creates many direct and indirect externalities. It involves large flows of expenditure, thereby creating additional employment, income, international trade and quality of life. Putting appropriate infrastructure in place reduces the level of crimes and attaining higher productivity and growth of the region that embraces it.

Roller and Waverman (2009), opined that economic growth necessitates increase in per-capita infrastructural facilities. Unfortunately, the aforementioned infrastructures are not adequately available in the less developed nations to effect such growth. Even when such infrastructures are in place, they are not effective economic mechanisms in enhancing Gross Domestic Product (GDP) in less developed countries because of the poor condition of the existing infrastructures.

According to Raji and Yunus (2014), there has been a falling condition of overall infrastructures in Nigeria despite the annual financial allocation committed to this sector by the federal government as a result of poor maintenance of the facilities, hence a week factor of growth enhancement. On the role of infrastructure in economic development, Yoshino and Nakahigashi (2000) identified that through an improved services provided by infrastructure investment stock, indirect production costs of the private sector will be reduced and their productivity will increase, raises production level. Comparing the identified positions of Raji and Yunus (2014) and Yoshino and Nakahigashi (2000) in literature, it is highly necessary to search into the current and actual significant role of infrastructural development on the economic growth in Nigeria.

More importantly, the issue of spurious regression that characterized some earlier studies like Ratner (1983), Aschauer (1989) and Munnell (1992) on the relationship between infrastructural development and economic growth due to the neglect of the time series properties is a serious methodological matter to be addressed. To bridge this identify gap, it is necessary to verify the unit root property of the series in this study to avoid spurious or

nonsense regression (Gujarati and Dawn, 2009).

These needs have generated some researchable questions such as: Are there existing trend relationships between infrastructural expenditure and economic growth in Nigeria? Is there any significant relationship between government expenditures on infrastructure and economic growth in Nigerian economy? It is the aim of this study to provide solutions to the identified questions by analyzing the descriptive view of the research variables and examining the inter-relationship between government expenditure on infrastructural development and economic growth in the country.

2 LITERATURE REVIEW

2.1 Theoretical Literature

Theory of Infrastructure-led Development

The Theory of Infrastructure-led Development was developed by Agenor (2010). The theory proposes a long-term economic development based on public infrastructure which was referred to as the main engine of growth. The theory stipulates that government investment in agriculture and public infrastructures will enhance productivity of both commodities.

That is: GDP = f (AINP, PINF) …….. (1)

Where; GDP, AINP & PINF are Gross Domestic Product, Agricultural Input and Public Infrastructure respectively.

The theory suggests that a large shift toward spending on infrastructure will generate desirable effects only if the degree of efficiency of public investment is sufficiently high. The theory confirmed that when the levels of infrastructure are low, producers may have no choice but to adapt to inefficient technology leading to poor and low productivities. So, in the absence of a reliable power grid in Nigeria for example, firms may not be able to switch to more advanced machines and sophisticated equipment even though it would be profitable to do so. With no roads to transport commodities between rural and urban areas easily, the adoption of new production techniques in agriculture may not be feasible either. But as long as adequate infrastructure provision is certain, producers may find it easier to adopt a modern technology leading to social and economic benefits for growth in output.

2.2 Conceptual and Empirical Literatures

According to Kallie (2016), economic growth is the increase in the goods and services produced in a country over a long period of time. It is measured as the percentage increase in real Gross Domestic Product (GDP). Infrastructure is the basic facilities, services and installations needed for the economic operations of a society. The demand for infrastructural development is very high but resources used in provision of infrastructure are limited. Infrastructural development in democratic governance involves identifying the right project, carrying out feasibility and viability studies and carrying out physical development of the project (Oyedele, 2012).

For an economic growth to take off, infrastructural development must correlate with employment generation to enhance industrialization across the land. Infrastructures in certain remote areas can serve as an incentive to attract certain levels of industrial activities which pari-parse can facilitate investment in less-developed areas. It was confirmed in literature therefore that infrastructural provision is fundamental for successful rural transformation and agricultural development (Fidelis et al. 2014).

There have been several studies that have investigated the impact and role of infrastructural development on economic growth and development. However, the results emanating from these studies have been inconclusive in that some studies suggest that infrastructural development impacts positively on economic growth while others have opined the existence of their negative influence and relationship.

Dash, Sahoo and Nataraj (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 infrastructures have a significant positive effect on economic growth in China.

Uwagboe (2011) estimated a Cobb-Douglas production function for 47 developing countries and 19 developed countries. The study found out that transportation infrastructure was an effective factor of production which cannot be overemphasized in engineering economic growth and development. Anwar, Davies and Sampath (1996) explained the causality between economic growth and government expenditures for 88 countries over the period of 1960-1992, using unit root, Pairwise causality and co-integration techniques. They found uni-directional causality for 23 countries that infrastructural government expenditure causes economic growth and bi-directional causality for 8 countries.

Canning and Bennathan (2000), by using co-integration methods estimated rate of returns to road infrastructure of 41 countries for four decades. They found out that the highest rate of return to roads infrastructure occurs in countries with shortage infrastructures.

Srinvivasu and Srinivasa (2013) emphasized that infrastructural development is one of the major factors contributing to overall economic growth and development. They opined that if direct investment is made on infrastructures, it will create production, stimulate economic activities, reduce transaction costs, improve competitiveness and finally provide employment opportunities.

According to Kathmandu final workshop report (2009), it was ascertained that infrastructures can have significant impacts on output, income, employment, international trade and quality of life. So, infrastructural development is indispensable in the circle of unemployment leading to economic growth and development where it is embraced.

United Nations (2015), observed that investments in infrastructure (transport, irrigation, energy and information and communication technology) are crucial to achieve sustainable development and empowering communities in many countries. She recognized that growth in productivity and incomes, and improvements in health and education outcomes require investment in infrastructure.

The contribution of infrastructure to economic development in general and to industrialization in particular is enormous, since it provides the environment with productive activities to take place, encourages investment, allows wider movement of goods and people, facilitates information flows and helps to commercialize and diversify the economy all over (World Bank, 1994).

Infrastructural investment is an important driving force to achieve rapid and sustained economic growth. In the society where infrastructure is not made available, its primary sector will suffer a broad setback as it will be difficult to provide the basis for the expansion of local manufacturing industries (Human Development Report of India, 2011). While pioneer efforts in the field suggest a positive relationship between infrastructural development and economic growth and report robust positive coefficients (Ratner, 1983; Aschauer, 1989; Mitsui and Inoue, 1995), a sizable number of subsequent studies have reported less than attractive results, thus suggesting a weak link between infrastructural development and economic growth (Munnell, 1992; Gramlich, 1994; Romp and de Haan, 2007).

The infrastructural report of Nigeria just like any third world country is nothing to write home about. The housing situation is in a sad state both quantitatively and qualitatively (Agbola, 1998; Ajanlekoko, 2001; Nubi, 2000 and Onibokun, 2007). In Nigeria, most of the infrastructures are now decayed and they need repair, rehabilitation or replacement if life is to be made more conducive for the citizens.

Asiedu (2002) concluded base on certain analysis that countries with good infrastructural development will attract more investments which can transform the socio-economic phase of such countries, leading to economic growth and development.

In the modern world, there is no way economic growth and development can be realized without enhancing industrialization which needs to be boosted by functional infrastructures. Industrialization must be encouraged by the government by making available the needed infrastructures (uninterrupted electricity, good road network, water, irrigation and sound communication network) so that tangible economic growth and development can be recorded in Nigeria (Meire, 1976).

3 METHODOLOGY

3.1 Model Specification

By adopting Agenor (2010) model as in equation 1 above, this research model is as specified below:

GDP = f (ANR, RMC, ENS, TCS) …….. (2)

Where:

GDP = Gross Domestic Product.
ANR = Agriculture and natural resources.
RMC = Roads maintenance and construction.
ENS = Energy supply (proxy by electric power consumption).
TCS = Transport and communication system.

In an econometric form, the equation 2 becomes:

$GDP = \alpha_0 + \alpha_1 ANR + \alpha_2 RMC + \alpha_3 ENS + \alpha_4 TCS + u_t$ ---------- (3)

Where:

α_0 = Intercept term
$\alpha_1 - \alpha_4$ = Regression coefficients
u_t = Error term.

3.2 Apriori Expectation

The apriori expectation for the parameters in use are as follows:

$\frac{\partial GDP}{\partial ANR} > 0$, $\frac{\partial GDP}{\partial RMC} > 0$, $\frac{\partial GDP}{\partial ENS} > 0$, and $\frac{\partial GDP}{\partial TCS} > 0$.

The independent variables are all expected to have positive relationships with the dependent variable.

3.3 Estimation Techniques

The data collected on government expenditures on infrastructures (agriculture and natural resources, road maintenance and constructions, energy supply, and transport and communication system) will be analyzed by

using Vector Autoregressive (VAR) technique and Wald test analysis. Stationarity of the research variables was tested using Philips-Perron (PP) unit root test.

3.4 Sources of Data

Secondary data on infrastructures will be sourced from Central Bank of Nigeria (CBN) Statistical Bulletin and National Bureau of Statistics Bulletin (various issues) while economic growth is sourced from International Monetary Fund Annual Reports (IMF). The period of observations covered in this study is between 1981 and 2017.

4 RESULTS AND DISCUSSION OF FINDINGS

4.1 Descriptive Analysis of Data Set

Table 1: Descriptive Statistics Result

Variable	GDP	ANR	RMC	ENS	TCS
Mean	3.694118	12.98176	25.46000	68.68529	13.07000
Median	4.350000	2.475000	2.475000	67.20000	2.050000
Maximum	33.70000	65.40000	195.8600	82.90000	90.03000
Minimum	-13.10000	0.010000	0.090000	58.10000	0.030000
Std. Dev.	7.786233	18.01933	43.06748	6.623975	20.62942
Skewness	1.145162	1.449981	2.236419	0.508416	2.199604
Kurtosis	8.305635	4.201699	8.348444	2.348997	7.825666
Jarque-Bera	47.31007	13.95964	68.86718	2.065149	60.40678
Probability	0.000000	0.000930	0.000000	0.356089	0.000000
Sum	125.6000	441.3800	865.6400	2335.300	444.3800
Sum Sq. Dev.	2000.639	10714.98	61208.67	1447.943	14043.90
Observations	36	36	36	36	36

Source: Authors' computation (2018), using E-view 7.0

Table 1 shows the descriptive statistics result of the employed research variables including: Gross Domestic Product (GDP), Agriculture and Natural Resources (ANR), Roads Maintenance and Construction (RMC), Energy Supply (ENS) and Transport and Telecommunication System (TCS). The mean value of GDP, ANR, RMC, ENS and TCS are 3.694118, 12.98176, 25.46000, 68.68529 and 13.07000 while the standard deviation remains 7.786233, 18.01933, 43.06748, 6.623975 and 20.62942 respectively. From the analysis, it is only the Mean of ENS that is greater than the standard deviation among the variables.

From the observed table, while GDP has the least Mean value, ENS has the least standard deviation figure. The Jarque-Bera test has a null hypothesis of normality of distribution for only ENS since its p-value 35.6% is greater than 5% level of significance while the rest shows the hypothesis of non-normality.

4.2 Unit Root Test

This test verifies the stationarity of all the variables specified for estimation in this study.

Table 2: Philips-Perron Test Statistics

Variable	AT LEVEL			1ST DIFFERENCE			LEVEL OF INTEGRATION
	PP-Test	1% C.V	5% C.V	PP-Test	1% C.V	5% C.V	
GDP	-2.426167	-4.243644	-3.544284	-3.619812	-4.252879	-3.548490	I(1)
ANR	-5.424182	-4.243644	-3.544284	-	-	-	I(0)
RMC	-3.892999	-4.243644	-3.544284	-	-	-	I(0)
ENS	0.167529	-4.243644	-3.544284	-9.208201	-4.252879	-3.548490	I(1)
TCS	-2.329314	-4.243644	-3.544284	-7.647323	-4.252879	-3.548490	I(1)

Source: Authors' computation (2018), using E-view 7.0

Table 2 summarizes the results of the unit root tests for this study, using Philip-Perron (PP) method. Agriculture and Natural Resources (ANR) and Roads Maintenance and Construction (RMC) were stationary at their levels while Gross Domestic Product (GDP), Energy Supply (ENS) and Transport and Communication System (TCS) were made stationary at first (1st) difference. The result structure creates a necessary condition for Vector Autoregressive (VAR) approach to examine the short-run dynamism of the model.

4.3 Vector Autoregressive (VAR) Analysis

Table 3: Vector Autoregressive Estimates

Variable	GDP	ANR	RMC	ENS	TCS
GDP(-1)	1.2727	-10.9543	-39.3451	-5.8427	50.6493
ANR(-1)	-9.87E-05	-0.1791	0.2205	0.0323	0.2436
RMC(-1)	0.0001	0.0572	0.0221	-0.0186	0.0584
ENS(-1)	-0.0022	-0.7514	-0.9573	0.6513	-0.3497
TCS(-1)	0.0009	0.1379	-0.0598	-0.0199	0.7107
C	0.0749	-358.6319	-263.9547	-47.2271	-75.5109
R^2	0.9952	0.6259	0.7196	0.8839	0.7809
F-stat	477.7524	3.8482	5.9036	17.5069	8.1984

Source: Authors' computation (2018), using E-view 7.0

As shown in Table 3, F-values ranged between 3.8482 and 477.7524 while those of R^2 between 62.6% and 99.5%. The results show that there are significant variations among ANR, RMC, ENS, TCS and GDP in the short-run during the observation period.

The result confirmed that 100 units increase in the lag value of RMC enhances 0.01 unit increase in economic growth and 100 units investment on TCS(-1) results to 0.09 unit increase in the economic growth in the short run. In the same vein, the coefficient values of ANR (-1) and RMC (-1) are 0.2205 and 0.0221 respectively showing the positive effects of the variables on road maintenance and construction (RMC) infrastructure. It is also confirmed that a 1% increase in ANR (-1) will improve electricity supply by 3.23% in the short run.

4.4 Wald Test Result Analysis

Wald test was carried out to further examine the existing inter-relationship between government expenditure on infrastructural development and output growth in Nigeria. Decision rule for accepting or rejecting null hypothesis under a Wald test is based on the tabulated critical lower and upper bounds values supplied by Pesaran, Shin and Smith (2001). The table is presented as follows:

Table 4: Critical Lower and Upper Bounds Values

	5%		1%	
	Lower	Upper	Lower	Upper
Restricted intercept without trend	1.98	3.04	2.41	3.61
Unrestricted intercept without trend	2.06	3.24	2.54	3.86

Source: Pesaran *et. al.* (2001), Table CI (iii) Case II

The decision rule is that if the computed f-statistic falls below the lower bound value, the null hypothesis (no co-integration) cannot be rejected and vice versa. If the computed result falls between the lower and upper bounds, the test is inconclusive. The Wald test result is presented in Table 5 below:

Table 5: Wald Bounds Test of Presence of Co-integration

Test Statistic	Value	Probability	Decision
F-statistic	1.536061	0.2142	No co-integration
Chi-square	15.36061	0.1195	No co-integration
Null hypothesis: C(3)=C(4)=C(5)=C(6)=C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=0			
Null hypothesis summary:			
Normalized Restriction (=0)		Value	Standard Error
C=(6) – C(12)		1.090553	0.636532
C=(7) – C(12)		-0.158630	0.153199
C=(8) – C(12)		-0.424630	0.279274
C=(9) – C(12)		0.303518	0.497713
C=(10) – C(12)		0.528800	0.491695
C=(11) – C(12)		-0.105790	0.344379

Source: Authors' computation (2018), using E-view 7.0

The Wald test chi-square value is 15.36061. The value indicates a significant short run relationship between the lag values of the variables in the research model. It indicates that a unit increase in infrastructural facility will add values to economic performance in Nigeria in the short run. On the co-integration analysis, Tables 4 and 5 confirmed that the calculated f-statistic of 1.536061 was lower than the lower bound critical value of 1.98 at 5% error level. Based on the report, that is, the Cal (1.54) < Tab (1.98) at 5% level, we conclude that there is no evidence of long-run relationships between GDP (economic growth) and infrastructural facilities in Nigeria during the period under consideration. The null hypothesis of no co-integration is therefore accepted at 5% level of significance.

The result of the Wald test corroborates the outcome of the Vector Autoregressive (VAR) estimates that infrastructural facilities actually induced economic growth in the country in the short run period.

5 CONCLUSION AND POLICY RECOMMENDATIONS

The study discovers the effects of infrastructural development on economic growth in Nigeria. For a short run analysis, Vector Autoregressive (VAR) analysis was carried out. The results of the estimation confirmed that government's investment on some infrastructural facilities like telecommunication system (TCS) and roads maintenance and construction (RMC) lead to economic growth in the short run in Nigeria. The report is in line with the positions of United Nations (2015) and Dash, Sahoo Nataraj (2010) who opined that infrastructural development is an engine of economic growth.

Based on the above findings and conclusion, the study recommends as follows:

1. Government should put appropriate fiscal policy in place in order to increase annual public expenditure on infrastructural development for attaining her economic growth objective in the country.
2. Government should formulate infrastructural maintenance policy in order to avoid waste and damages of the existing infrastructures in the country.
3. Government should invite the private sector into the co-ownership commercialization structure of infrastructural development in Nigeria in the view of enhancing efficiency, reducing government financial challenges and achieving economic growth objective.

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