



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL  
OF ADVANCED RESEARCH

## RESEARCH ARTICLE

## THE ROLE OF INFRASTRUCTURE IN ECONOMIC TRANSFORMATION IN NIGERIA

Chikeziem F. Okorontah and Joseph C. Odionye

### Manuscript Info      Abstract

#### Manuscript History:

Received: 25 July 2014  
Final Accepted: 26 August 2014  
Published Online: September 2014

#### Key words:

Infrastructure, Economic Transformation, Ordinary Least Square.

#### \*Corresponding Author

**Chikeziem Okorontah F**

The study investigated the role of infrastructure in economic transformation in Nigeria using annual data for the period of 1980 to 2011. Ordinary Least Square (OLS) technique was employed. Expenditures on education, health and transportation and communication sector were used as proxy for infrastructure. The ADF test suggests that the series are random work processes in their level form. The empirical findings suggest evidence of long run equilibrium relationship between infrastructure and economic transformation in Nigeria. It further shows that infrastructure plays both positive and significant role in transforming the Nigerian economy. This findings support the finding of Ogunnowo and Oderimde (2012). The paper recommended that adequate funding of infrastructure in key sectors of the economy should be provided. Also, Nigerian government should ensure transparency and good governance to ensure proper utilization of the funds provided.

*Copy Right, IJAR, 2014.. All rights reserved*

### Introduction

According to the 8<sup>th</sup> Edition of advanced learner's dictionary, infrastructure is the basic system and service that is necessary for a country or an organization to run smoothly. Infrastructures are basic essential services that should be put in place to enable development to occur. The provision of infrastructure is necessary, but it is the provision and prudent management of the infrastructure that transform the economy.

Socio-economic development can be facilitated and accelerated by the presence of physical, social and economic infrastructure. If these facilities and services are not in place, development will be very difficult and infant can be like to very scarce commodity that can only be secured at a very high price and cost (familoni 2013).

Transformation connotes change, the act of transforming or state of being transformed. This perception of transformation draws strength from the stem "transform" which means to give a different form to; change the character of or alter the nature of something (Nwolise, 2012). Economic transformation is associated with a fundamental change in the structure of the economy and its drivers of growth and development. It necessarily involves: a reallocation of resources from less productive to more productive sectors and activities, an increase in the relative contribution of manufacturing to GDP; a declining share of agricultural employment to total employment; a shift in economic activity from rural to urban areas; the rise of a modern industrial and service economy; a demographic transition from high rates of births and deaths to low rate of birth and deaths (associated with better health standards in developed and urban areas); and a rise in urbanization (UN 2013).

It should be noted that economic transformation and human development are inextricable linked. It is from this term "Economic transformation" that this work differs from many others. Many authors have dealt with the effect of infrastructure on growth and or development. We have tried to investigate how infrastructure not only lead to growth but more so its ability to transform the economy.

This work is timely, as Nigeria plans to be among the top 20 economies of the world by 2020, it seems necessary to estimate the role infrastructure has to play in achieving the nation's economic transformation agenda, i.e. transforming the nation from small, weak, undiversified, unsustainable and low competitive economy to a large, strong, diversified, sustainable and competitive economy that effectively harnesses the talents and energies of its people and responsibly exploits its natural endowments to guarantee a high standard of living and quality of life to its citizens.

The purpose of this paper is to analyze the role infrastructure plays in transforming a nation.

## 2.0 Literature Review

That infrastructure matters to growth is now relatively well recognized and widely understood among practitioners and policy makers. There is, indeed, a plethora of anecdotal and more technical evidence that better quantity and quality of infrastructure can directly raise the productivity of human and physical capital and hence lead to economic growth (Antonio & Gregoire 2012)

Though, as cited by Rosina and Enrigue (2003); Holtz – Eakin (1994) and Garcia – Mila et al (1996) criticize the initial findings on positive infrastructure effects in the US case on econometric grounds. Also Cridfield and Panggabean (1985) using neoclassical growth model observe that public capital has a weak effect on growth in per capita product of US metropolitan economies.

However Estache and Wren-Lewis (2009), suggest that large supranational energy or transport projects can have very significant payoffs at all stages of development. Investment in these sectors can thus make significant impact in terms of connecting markets. They also noted that:-

- The poorer a country, the more infrastructure matters on average.
- The weaker the institutions (i.e. more corruption, fewer skills,...), the lower the payoff.
- The more competitive the environment, the higher the payoff.
- The more balanced the residual regulation, the higher the payoffs.

## 2.1 Conceptual Issues

In general, infrastructure is defined as electricity, gas, telecoms, transport and water supply, sanitation and sewerage. However, because data on the physical stocks of these sectors, or their valuation, tends to be scarce, authors have often relied on stocks of public capital or specific subsectors as provision for infrastructure (Antonio and Gregoire 2012).

Sillen (1994) pointed out that, although a consensus is lacking, most empirical studies concentrate on high ways, water systems, sewer systems and public buildings as the major components of infrastructure. Andrew (1994) as recorded in Jenet and Michael (1995) made a distinction between point infrastructure and network infrastructure. Point infrastructure consists of the underlying core amenities within a particular community that support the basic processes of the social-economic system within the community, such as water system, local roads, and public buildings. And network infrastructure consists of systems designed to facilitate linkage between economic units across space, such as highways, railroads and canals. According to Naoyuki and Masaki (2000) infrastructure is the capital stock that provides public goods and services. It produces various effects, including those on production activities and quality of life for the household, which thus permeate the entire society.

Economic transformation is associated with a fundamental change in the structure of the economy involving among other things, reallocation of resources from less productive to more productive sectors and activities so as to drive the economy to growth and development. This economic fundamental change many argue depends much on the rate of infrastructure development.

## 2.2 How important is infrastructure in Economic development?

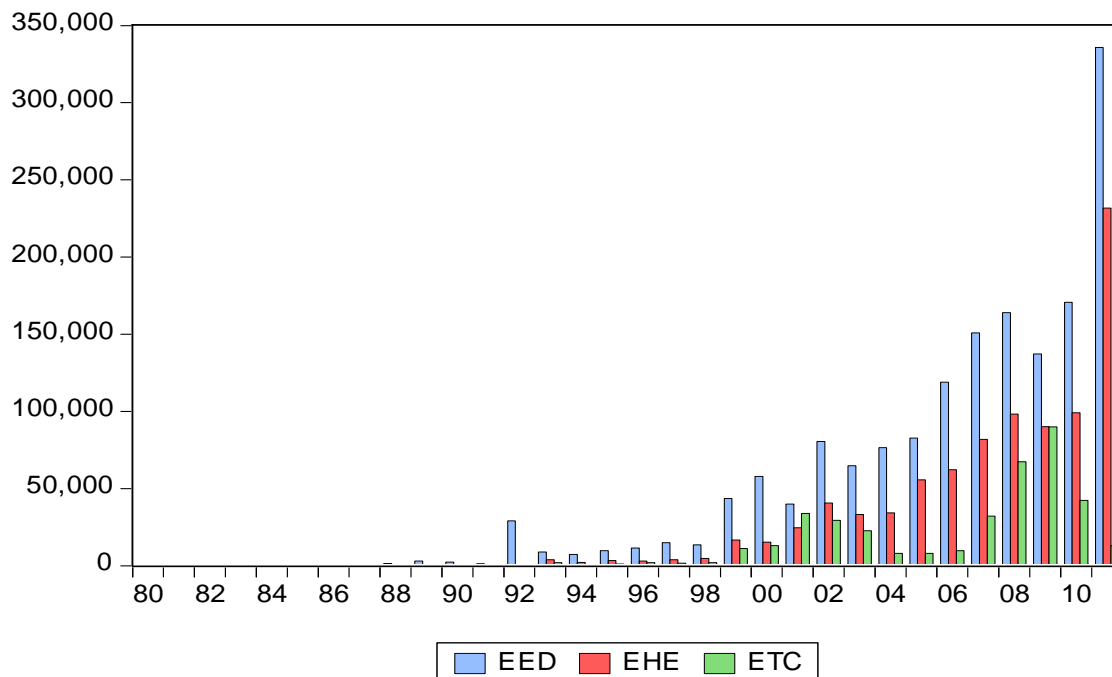
Considering the importance of infrastructure in economic transformation, the minister of works, ARC Mike Onolemamem declared that the country is in the process of developing a national integrated infrastructure master plan (2014-2043). According to him the move results from the fact that infrastructure stock in Nigeria today is far from being adequate which becomes even more evident when compared to countries such as Brazil, Turkey, India and South Africa (Leke 2013). Infrastructure development has made these countries rise above Nigeria in terms of

development or economic transformation. In a conference tagged “Building the infrastructure for Nigeria’s vision 20:2020 held in the United States of America, the minister said (in his keynote address) “This conference underscores the importance the administration of president GoodluckEbele Jonathan attaches to the development of infrastructure in Nigeria in pursuit of the nation’s economic wellbeing. The minister also maintains that inadequate infrastructure continues to militate against the realization of the lofty objectives of the transformation agenda of the federal government of Nigeria and the nation’s vision 20:2020.

William (2010) has emphasized on the important role of such infrastructure as transportation, electricity and internet services. According to him these infrastructures have transformative efforts and are usually system wide and they generally do one of three things:-

- Make it easier to move goods and people
- Make it easier to move information vital to commence
- Radically reduce the cost of doing business or alternatively greatly increase the capacity to do business.

Below is a chart showing the trend of Government expenditure on some key sectors (Education, Health and Transport/Communication) of the Nigerian economy.



Source: Data from CBN Statistical Bulletin, 2011.

A cursory look at the bar chart above, it is observed that not until 1999, government expenditure on these sectors of the economy were infinitesimal. But between 1999 and 2011 there was an upward swing in government expenditure on these sectors. This period corresponds to the period of democracy in the country.

### 2.3 Infrastructure and Its Role in Economic Transformation

There are several ways in which infrastructure promote economic development and transform the economy. As Janet and Michael (1995) pointed out, infrastructure enters the production function of firms as an unpaid input and arguments the productivity of other inputs. A firm that must transport its good with truck transport will find its drivers and trucks more productive if there is a well – built highway system in the country. Also infrastructure is an amenity that serves as a magnet in the location decision of firms and household. Sewer and water system are particularly important factors for industry location decisions. A food processing plant will not consider locating in a community unless there is a sewage system sufficient to handle the capacity of its plant.

Stove (1987) notes that infrastructure makes the construction of housing possible and thus increase the value of urban land.

The importance of access to electricity to human development has been documented in a number of case studies and cross-country econometric studies across regions. Among these studies, those focusing on developing countries all find a positive impact of energy infrastructure on output/growth.

Garsous (2012) suggest that investing in the energy sector may be the safest bet to achieve a high social rate of return. This is because energy is indeed an input into any of the other infrastructure subsectors. It plays a role of a leading factor and also sustains the diversification of the economy that brings about economic transformation. Using a descriptive analysis Antonio and Gregorie (2012) shade light on the important role energy; water/sanitation; Telecommunication and transport play in economic development. David and Peter (2004) investigated the long run consequences of infrastructure provision on per capita income in a panel of countries over the period 1950-1992 (using such infrastructure as telephones, electricity generation capacity and paved roads), their result provided a clear evidence that in the vast majority of cases infrastructure does induce long run growth effects.

Indeed, the justification for higher government expenditure on education (education infrastructure) is often based on its economic and moral impact (see Psacharopoulo 1985, Barro, 1996a, Squire 1993). Measures of educational attainment reflect the knowledge and skills of the population or human capital development. Education has also been found to play a crucial role in the adoption of new agriculture technologies. In addition education is seen as a means to improve health and reduce fertility/mortality (Foster and Rosenzwing, 1996, Schultz, 1999).

All these are evidence that organized and prudent management of education infrastructure play important role for economic transformation to take place.

#### **2.4 Rational for economic transformation in Nigeria**

Nigeria has experienced economic growth since its independence in 1960. Unfortunately, this growth has not reasonably made impact in the life of the citizens. No doubt, social indicators have improved as evidenced by significant achievements in primary, secondary and tertiary enrollments, gender parity in education, decreasing maternal and infant mortality rates and less violent democratic transitions since 1999.

However, careful assessment of the Nigerian economy reveals the following characteristics:

- Low productivity in the agriculture subsector
- An economy driven by natural resources and or primary commodities.
- An embryonic manufacturing sector, limiting the potential employment gains from the processing of primary commodities.
- Limited applications of modern technologies
- Underdeveloped social protection programs which heightens the vulnerability of the aged, the disabled as well as the unemployed and underemployed labour force.

In effect Nigeria is among the countries with greater proportion of poor people or high poverty rate. It therefore needs to transform its economy to create wealth, reduce poverty, minimize inequalities, strengthen productive capacities, enhance social conditions and achieve sustainable development.

Also the opportunity to transform the nation is visible now than ever before. With more than a decade of peaceful political environment, the nation can improve its macroeconomic management and attract both local and foreign investors for economic transformation. Windfall gains from the commodity export boom (mainly oil) can be reinvested in developing the industrial sector. Lastly as UN (2013) pointed out (in discussing about Africa) the shift in the global economic balance of power to the south (i.e., Brazil, India and China) coupled with the readiness of such countries to invest in Africa's economic sectors, provide additional opportunities for the continent in support of its transformation agenda.

#### **3.0 Definition of Model Variables and Methodology**

Annual series data sourced from Central Bank of Nigeria statistical bulletin (2011) were used for this analysis. The study covered the period 1980 to 2011. Following the nature of this study, Ordinary Least Square (OLS) technique was used to determine the impact of infrastructure on the transformation of the Nigerian economy. The functional form is stated as:

$GDP = f(EED, EHE, ETC) \dots$  (1) where GDP = gross domestic product used as proxy for economic transformation, EED = expenditure on education, EHE = expenditure on health ETC = expenditure on transportation

and communication. These variables are used as proxy for infrastructures. In order to estimate equation 1, we specify it in econometric form as:  $GDP_t = \eta_0 + \eta_1 EED_t + \eta_2 EHE_t + \eta_3 ETC_t + \mu \dots(2)$

where  $\eta_0$  = intercept,  $\eta_i$  (where  $i = 1, 2, 3$ ) = parameters to be estimated, and  $\mu$  = iid stochastic error term.

To fully explore the data generating process, we first examined the time series properties of model variables using the Augmented Dickey- Fuller test.

The ADF test regression equations with constant are:

$$\Delta Y_T = \alpha_0 + \alpha_1 Y_{T-1} + \sum_{j=1}^k a_j \Delta Y_{T-1} + \varepsilon_T \dots (3)$$

where  $\Delta$  is the first difference operator,  $\varepsilon_T$  is random error term that is iid,  $k$  = no of lagged differences  $Y$  = the variable. The unit root test is then carried out under the null hypothesis  $\alpha = 0$  against the alternative hypothesis of  $\alpha$

$< 0$ . Once a value for the test statistics  $ADF_\tau = \frac{\hat{\alpha}}{SE(\alpha)} \dots \dots \dots (4)$  is computed we shall compare it with the

relevant critical value for the Dickey-Fuller Test. If the test statistic is greater (in absolute value) than the critical value at 5% level of significance, then the null hypothesis of  $\alpha = 0$  is rejected and no unit root is present. If the variables are non-stationary at level form and integrated of the same order, this implies evidence of co-integration in the model. We therefore used the Engle-Granger cointegration procedure to test for cointegration in the model. Thus, the model in equation 5 is therefore used to determine both short and long run impact of infrastructure on the Nigerian economy.

$$\Delta GDP_t = \eta_0 + \lambda ec_m + \eta_1 \Delta EED_t + \eta_2 \Delta EHE_t + \eta_3 \Delta ETC_t + \mu \dots (5)$$

Where  $\Delta$  = difference operator

$\lambda$  = the long run multiplier

ECM = the error correction term.

**4.0 Data Analysis and Discussions.**

**Unit Roots Test Result**

Most time series data tend to contain infinite variances that are not mean- reverting and lie on the unit circle. It is, however, observed that equations estimated from such series are usually resulting in spurious regression that makes little or no economic sense. Indeed, the loading of the endogenous variable is infinitesimal when in fact a long-run relationship exists between it and the economic fundamentals driving it; [See Granger and Newbold (1974), Engle and Granger (1987), Dickey and Fuller (1981), and Pindyck and Rubinfeld (1998)]. Thus each of the underlying variables was examined for unit root and co integration.

Arising from the above discussion, we started the modeling by running the Augmented Dickey – Fuller (ADF) unit root test of stationarity on the levels of the variables at the first differences and the result displayed in Table 1

As shown in Table 1; all the variables examined except ETC were stationary (significant) at second differenced; that is, they were integrated of order one ( $I \sim (2)$ ). In effects, the order of integration as shown by the unit root clearly left us with the suspicion of evidence of co-integration from the variables. And for this reason, we conduct co-integration test as shown below.

**Results from Co-Integration Test**

Given the unit root properties of the variables, we proceed to implement the Engle-Granger co-integration procedure. All the variables except ETC have the same order ( $I \sim (2)$ ) of integration; we estimate their linear combination at their level form without the intercept term and obtain their residual which is then subjected to co integration test as shown in Table 2:

**Table 1: ADF Unit Root Test on the annual Series**

Variable	GDP	EED	EHE	ETC
$I \sim (d)$	2	2	2	0

Lag length	2	1	1	0
t – adf	-3.384252	-3.271955	-4.092607	-3.31052
Critical @ 5% & 1% values	-2.9750 -3.6959	-2.9205 -3.6852	-2.9705 -3.6852	-2.9661 -3.6661

NB D= number of differencing

**Table 2: Co-Integration Tests**

	t-ADF	Lag	5% Critical val	1% Critical val
Residual	-3.167001	0	-2.9621	-3.6661

From the table, since the residual t-ADF of -3.167001 at lag length 0 is greater than the 5% critical values of -2.9621, it means that the residual is stationary at level form and hence there is linear relationship among the variables. This implies that there is a robust long run equilibrium relationship between infrastructure and the transformation of the Nigerian economy. Consequently, we adopt the Error Correction Model which was specified in case, co-integration was established among the variables.

**Table 3: Multiple Regression Result.  
Dependable Variable: D(D(GDP))**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	113072.6	217440.5	0.520016	0.6076
D(D(EED))	34.116***	8.251858	4.134420	0.0004
D(D(EHE))	27.3386**	11.47076	2.383338	0.0251
ETC	3.019590	8.571285	0.352291	0.7276
F-Statistic	4.5831***			0.0065
ECM (-1)	-0.1912**	0.096506	-1.98123	0.0527
R <sup>2</sup> =0.523066	Adjusted R <sup>2</sup> =0.430757	Durbin Wat.= 2.32		

\*\*\*[\*\*] denotes significant of variable at 1% [5%] significance level respectively.

The estimated model can be shown as:

$$\text{GDP} = 113072.6 + 34.116 \text{ EED} + 27.339 \text{ EHE} + 3.02 \text{ ETC} \dots (6)$$

From the result in table 3 and in equation 6, the estimated model shows that the expenditure in education (EED) used as a proxy for infrastructure has positive impact on the Nigerian economy. This is in consistent with the 'a priori' expectation. Specifically, a one unit increase in expenditure in education will increase output by about 34.116 units. Interestingly, the t- statistic reveals that the variable is highly significant at 1% level of significance since the probability value is less than 0.01 (p- value < 0.01). This implies that expenditure in education has a positive and significant impact on economic growth in Nigeria.

Also, the expenditure in health (EHE) used as alternative proxy for infrastructure has positive impact on the Nigerian economy. This also is in line with the 'a priori' expectation. In the same vein the t- statistic reveals that the variable is significant at 5% level of significance since the probability value is less than 0.05 (p- value < 0.05).

Expenditure in transportation and communication (ETC) has a positive but insignificant impact on economic growth given the probability level of t- statistic (ie 0.72 > 0.05). The implication is that the infrastructure in this sector of the economy has not contributed so much in the growth of the economy.

The results show that the error correction term (ECM) for the estimated GDP equation is statistically significant and negative. Thus, it will rightly act to correct any deviations from long-run equilibrium. Specifically, if actual equilibrium value is too high, the ECM will reduce it, while if it is too low, the ECM will raise it. The

coefficient of -0.19 denotes that 19% of any past deviation will be corrected in the current period. Thus, it will take a long time for any disequilibrium in the economy resulted from infrastructural development to be corrected.

The coefficient of determination and its adjusted are 0.523 and 0.431 respectively implying that there exists goodness of fit in the model. This means that about 52.3% of the variation in growth of GDP is accounted for by variation in expenditure in these three sectors of the economy.

The overall regression is significant at 5% level of significance implying that the joint effects of all the included variables were significant.

The Durbin Watson statistic of 2.32 shows evidence of no first order serial autocorrelation in the model given that it is approximately 2.

### 5.0 Conclusions and Recommendations

This paper has investigated the role of infrastructure (using government expenditure in education, health and transport and communication as its proxy) in transforming the Nigerian economy between the period 1980 and 2011. The estimated results point that infrastructure has both positive and significant impact on economic growth in Nigeria. This result corroborates the findings of Ogunnowo and Oderimde (2012) who found that adequate provision of reliable rural infrastructure plays crucial roles in raising the quality of life, transformation of rural communities, economic growth and empowerment for the rural population. The paper recommended that adequate funding of infrastructure in key sectors of the economy should be provided. Also, Nigerian government should ensure transparency and good governance to ensure proper utilization of the funds provided.

### REFERENCES

- Antonio, E. and Gregoire, G. (2012) "The impact of infrastructure on growth in developing country" IFC Economics Notes, Note 1.
- Barro, R.J. (1996) "Determinants of economic growth. A cross-country empirical study". NBER working paper No. 5968. National Bureau of Economic Research, Cambridge, MA.
- David, C. and Peter, P. (2004) "The effect of infrastructure on long Run Economic growth"; Baker institute and department of Economic Rice University, 610 main St. Houston
- Dickey D.W and Fuller, W.A (1981), Distribution of the Estimator for Autoregressive Time Series with a Unit Root, Journal of the American Statistical Association.
- Engle R.F and W.J. Granger (1987) cointegration and error correction; Representation estimation and testing.
- Estache, A and Wren-Lewis, L. (2009) "Towards a theory of Regulation for Developing countries: following Jean Jacques laffont's lead", journal of Economic literature, 47:3.
- Familoni, L.A. (2013) "The role of Economic and social infrastructure in Economic Development". A Global view, academic.edu, share research.
- Foster, A. and Rosenzweig, M. 1996) "Technical change and human capital returns and investment: evidence from the green revolution. *American Economic Review* 86 (4).
- Garsous, G. (2012) "How productive is infrastructure? A quantitative survey" ECARES working paper, University libre de Bruxelles.
- Gillen, D. (1994) "Transportation Infrastructure and economic development," paper presented at a conference on the Role of infrastructure in Economic Development, Chicago, Illinois (September 24, 1994)
- Granger C and Newbold (1974), Spurious Regression in Econometrics, *Journal of Econometrics* 2.
- Janet, M.R. and Michael, T. H. (1995) "Infrastructure and local Economic Development". *Regional Science perspective*, vol. 25 No. 1 1995.
- Leke, A (2013) "Nigeria's infrastructure Master plan, underway; vanguard Monday September 30, 2013.

- Naoyuki, Y. and Masaki, N. (2001) "The role of infrastructure in Economic Development (Preliminary version), center for excellence (COE) Ministry of Education Kerio University.
- Nwolise, O.B.C. (2012), "National Security and National Transformation" paper presented at the conference of the Institute of Economists of Nigeria, University of Ibadan conference centre July 7, 2012.
- Oxford Advanced Learner's Dictionary (2010) International Student's Edition, 8<sup>th</sup> Edition.
- Pacharoponlous, G. and Patrinos, H.A. (2002). Returns to investment in Education: A further update World Bank policy research paper No. 2881 World Bank, Washinton D.C.
- Pindyck R.S and D.L Rubinfeld (1990); Econometrics Model and Econometric forecast, 4<sup>th</sup>ed McGraw Hill, New York
- Rosina, M. and Enrique, L. (2003) "The impact of infrastructure on Regional Economic growth: some results on its spillover effect", grupd'Analisiquantilatave Regional (AQA Research group) universal de Barcelona; preliminary version June 2003.
- Schultz, T.P. (1999), "Health and schooling investment in Africa". Journal of Economic perspection 113.
- Squire, L. (1993) "fighting poverty", American Economic Review 832.
- UN (2013) "Economic Transformation for Africa's Development" UN Economic Commission for Africa; Macroeconomic policy division, C-10 meeting April 2013, Washington D.C.
- William, F. (2010) "The search for infrastructure Driven transformations leaders forums, Michigan, Georgia Caligormia, Texas USA.