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Research Article
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The Dynamics of Infrastructure and Economic Growth in Nigeria

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Abstract

This paper presents the dynamic linkages between infrastructure and economic growth in Nigeria. Economic development in Nigeria can be facilitated and accelerated by the presence of infrastructure. If these facilities and services are not in place, development will be very difficult and in fact can be likened to a very scarce commodity that can only be secured at a very high price and cost. In this study, two models are specified, and after applying the substitution method (reduce form equation), the two models collapsed to one which enabled the researcher to use OLS to run the regression. From the result, it is clear that infrastructure is an integral part of Nigeria economic growth. Underminding it (infrastructure) is underminding the growth and development of Nigerian economy. The study has shown that infrastructure is an intermediate goods and service for the real sector and a finished goods and service for consumers. So, if the real sector which is the engine of growth is to propel Nigerian growth and development, infrastructure should be given qualitative and adequate attention.

Keywords: Commodity; Economic growth; Infrastructure; Nigeria; VECM

Introduction

There is a popular Chinese saying "to get rich, first build a road." The Chinese proverb had it right – without infrastructure, economic development cannot happen. Infrastructure[1] is a heterogeneous term, comprising of physical structures of several kinds employed by numerous industries as inputs to the production of goods and services. This description includes "economic infrastructure" (such as network utilities) and "social infrastructure" (such as hospitals and schools). The former involves digital communications, water, energy, and transport. They represent the vital ingredients for the success of a modern economy and the focus of this paper. Conceptually, infrastructure may affect aggregate output in two key ways: (i) Directly, considering the sector contribution to GDP formation and as an additional input in the production process of other sectors[2]; and (ii) Indirectly, raising total factor productivity by reducing transaction and other costs therefore permitting a more efficient use of conventional productive inputs. Infrastructure can be considered as a complementary factor for economic growth.

How big is the contribution of infrastructure to aggregate economic performance? The answer is critical for various policy decisions – for instance, to gauge the growth effects of fiscal interventions in the form of public investment changes, or to assess if public infrastructure investments can be self-financing. The empirical literature is far from unanimous[3], but a majority of studies report a significant positive effect of infrastructure on output, productivity, or long-term growth rates. Infrastructure investment is complementary to other investment in the sense that insufficient infrastructure investment constrains other investment, while excessive infrastructure investment has no added value. To the extent that suboptimal infrastructure investment constrains other investment, it constrains growth.

[1]Infrastructure has been understood to include many different things, and a universally accepted definition has remained elusive. One well-known attempt reads (Gramlich 1994): "The definition that makes the most sense from an economics standpoint consists of large capital intensive natural monopolies such as highways, other transport facilities, water and sewer lines, and communications" (in Wagenvoort et al. 2010).

[2]For example, the total direct contribution of the energy sector to the UK economy in 2011 (measured by contribution to GDP) was £20.6bn, an increase from 2007 of 16 per cent (Energy UK, 2012).

[3]E.g. Gramlich (1994)

Empirical estimates of the magnitude of infrastructure's contribution display considerable variation across studies[4]. Overall, however, the most recent literature tends to find smaller (and more plausible) effects than those reported in the earlier studies, likely as a result – at least in part – of improved methodological approaches[5] that also allow better estimates of the causal relationship [1,2]. This empirical correlation is the subject of considerable heterogeneity depending on the countries and time periods under study, possibly indicating asset-quality issues, complementarities with other production factors, non-linearity due to the network character of infrastructure[6], and larger policy and institutional factors that still need to be better understood[7].

The potential connection between economic development and transport infrastructure investment in Nigeria has been at the forefront of academic debates over decades. A number of empirical studies suggest

[4]See Romp and Haan (2007) for a review of the relevant empirical literature.

[5]The empirical literature on the contribution of infrastructure to aggregate output is subject to major caveats, such as the fact of ignoring the non-stationarity of aggregate output and infrastructure capital, potential simultaneity between infrastructure and income level and potential heterogeneity across countries (Calderon et al, 2011; Esfahani and Ramirez, 2004)

[6]This problem mainly arise using a Cobb-Douglas production function since under this functional form the elasticity of substitution amongst factors is constrained to be one. The key argument with infrastructure is complementarity. Given that the assumptions underlying a Cobb-Douglas production function don't account for it, the infrastructure's impact on growth could be underestimated.

[7]Egert et al. 2009 sought to identify the wider economic benefits of transport infrastructure investments using a panel growth regressions framework for 1960–2005. The results suggested massive variation across the OECD both in signs and magnitudes and the authors conclude that the impacts are country-specific and depend inter alia on the pre-existing level of provision. In the UK case, both road and rail infrastructure investments were found to have significant indirect productivity impacts. This finding is consistent with recent evidence of quite strong agglomeration effects on productivity in the UK (Graham 2007, Crafts 2009).

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that government expenditures on public infrastructure, including transportation, can potentially increase productivity or reduce cost of production and, hence, increase economic growth [1,3,4]. Udjo 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 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 also found that the developing countries demonstrated a high rate of return on transport infrastructure which compared favourably with those of developed countries. Alternatively, others find no significant effect or even a negative impact on national productivity [5,6].

The current level of infrastructure deficit in Nigeria has been identified by Sanusi as the major constraint towards achieving the nation's vision of becoming one of the 20 largest economies in 2020. He further proffered that about 70 percent of the 193,000 kilometres of roads in the country is in poor condition; that enterprise surveys show that the power outages the nation experiences amount to over 320 lost days a year, with over 60 percent of the population lacking access to electricity with over $13 billion spent annually to fuel generators and that Nigeria, which once had one of the most extensive railway systems in Africa, could now barely boast of a functional route either for passengers or freight.

According to National Bureau of Statistics (NBS) over the last decade, Nigeria's infrastructure spending contributed a 1.9 percent (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 percent of GDP should be invested on infrastructure. Sanusi, reports that Nigeria is currently investing about 7 percent of GDP on infrastructure, which is above the average for Sub-Saharan Africa. He however expressed the need to increase this figure to at least 12 percent of the GDP. Following from the above, 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. Notwithstanding the diverse perspectives regarding transport infrastructure investment, the recent global economic recession has encouraged some policy makers to utilize this fiscal policy tool to promote economic recovery, reinforcing the debate about the economic impact of infrastructure investment. The aim of this research is to revisit the long-term impact of transport infrastructure on Nigeria economic growth. Most importantly, the analysis provides policy makers updated and more accurate information for more efficient allocation of scarce budget resources to infrastructure investments.

The remainder of this article is organized as follows: literature review about the relationships between economic growth and infrastructure is provided in the next session, the third part deals with road infrastructure and economic growth by looking at some empirical evidences followed by an explanation of the analytical methods. A description of the data and empirical analysis are then presented in part four. Part five emphasizes on policy implications and conclusions.

Literature Review

Conceptual framework

The conceptual framework of the theoretical linkage between infrastructural investment and economic growth is presented in Figure 1. The channel of infrastructural transmission to economic growth is manifested only through the economic growth indicators (GDP, industrial production, employment, price stability, education, technology, openness, knowledge, innovation). The nature of transmission is determined by the role of infrastructure capital in the production function i.e. whether it is a direct or intermediate input. As a direct input, it can either be guided by market forces, in which case it is or provided by the government as a public good. Where infrastructure capital is an intermediate input in the production process, the indirect transmission channel through which infrastructure affects growth is determined by three factors. These are productivity of physical capital which is in turn determined by reduction in adjustment costs and maintenance of existing infrastructure also derived from the facilitation of reallocation of capital. The second variable is higher labour productivity obtained from improved human capacity development. The transmission impact through human development can be realized through improving health better nutrition, education, better Roads, access to electricity, telecommuting, etc. The third factor is the externalities which transmit key technological innovations to other sectors leading to involve lower costs, and spill-over effects on other firms and therefore, on the economy as a whole.

Transport and economic development-key connections

Figure 2 indicates the broad relationships between transport interventions, funding, wellbeing and economic development. These relationships highlight a recurring theme in the literature, that transport investments can have multiple overlapping economic effects. They are reflected in government transport policies and in project evaluation methods, in Nigeria and many other countries. As a contributor to economic development, transport infrastructure by its very nature has important spatial impacts, for example on intra-regional and inter-regional transport time and costs, and thus potentially on the location of households and businesses. Transport services are produced and consumed jointly with transport infrastructure, a major component of the fixed capital of the transport sector.

A distinguishing feature of the transport sector is that its function is primarily as an input into many other activities. Firms transport products to distribution centres and retail outlets; businesses send their employees to meet with customers, suppliers, regulators and co-workers; people travel to work and for leisure pursuits. However, the demand for transport cannot be treated solely as a derived demand. Improved access is a necessary (but not sufficient) precondition for increased productivity, and improvements in transport systems may themselves promote growth. There are various ways in which transport can affect economic growth, for example through reorganisation and rationalisation of production, distribution and land use: and reducing labour costs by expanding catchment areas. The link between transport and the economy depends crucially on whether firms are primarily consumers (users) of transport services, or whether firms use transport to change their production processes (or some combination of these roles).

Summary of the literature review

The literature is not conclusive on the effect of infrastructure on economic growth. There are studies that establish little or no

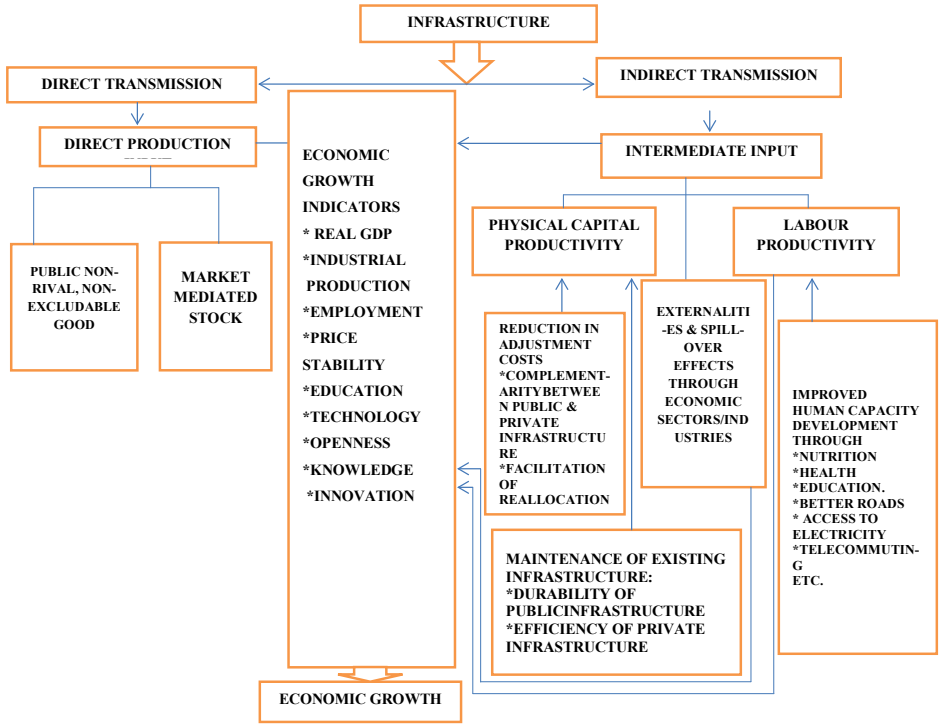

Figure 1: The oretical flow of the transmission channels through which infrastructural investment affect economic growth.

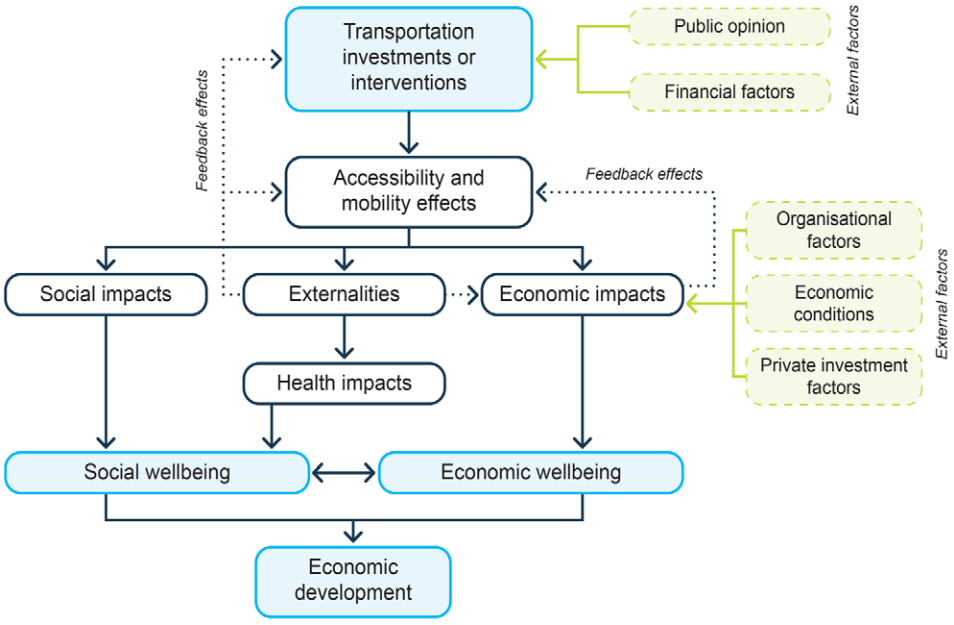

Figure 2: Transport and economic development-key connections.

significantly positive relationship between infrastructure and economic growth [5,7]. Perkins et al.'s study was the first of a series of studies attempting to address these particular challenges [8]. This study used the PSS ARDL technique to focus specifically on the question of causality, while taking into account the time trends in the data. They find that the direction of forcing varied across different infrastructure measures: (a) Aggregate public sector investment and public sector fixed capita stock drive GDP; (b) Roads (total road length, paved road length, number of passenger vehicles) drive GDP; (c) GDP drives ports' freight handling levels and airports' passenger levels; (d) The direction of forcing is ambiguous for measures of railway, power generation and telecommunication infrastructure. The data directly address the issue of causality and explicitly consider both direct and indirect channels of effect. They find that aggregate infrastructure investment and

infrastructure stock drive GDP, as do measures of road infrastructure. Telecommunication, port and airport infrastructure and some railway infrastructure, however, are driven by GDP. The direction of the relationship is ambiguous for electricity generation and some other railway infrastructure. These results are broadly consistent with those obtained by Perkins et al. and so are not presented in a separate table [8]. In calculating the magnitude of the relationship between output and infrastructure, they adopt a multivariate co-integration model that examines the long-term interaction between several variables, allowing for the possibility of ambiguous causal relationships. In this model they include GDP, fixed capital stock, public sector fixed capital stock (a financial measure of infrastructure), total road length and electricity generation capacity. They find that there is a relationship between infrastructure stock and GDP but that this relationship is indirect, with rising infrastructure stock encouraging investment in fixed capital and thereby boosting GDP. The elasticity of GDP with respect to fixed capital stock is 0.06 and that of fixed capital stock with respect to infrastructure is 1.37. This means that a one percent increase in infrastructure increases fixed capital stock by 1.37%, while a one percent increase in fixed capital stock increase GDP by 0.06%. Furthermore, electricity generation directly effects GDP with an elasticity of 0.2 (that is, a one per cent increase in electricity generation capacity directly increases GDP by 0.2%). Some of these results, however, are not robust to the replacement of total road length by other infrastructure measures.

They also introduced a control for property rights to test for the role of institutions in the infrastructure-growth relationship. With this control included, the indirect relationship via fixed capital stock is maintained and a significant direct positive relationship is also found, with elasticity between 0.4 and 0.5. A paper by Kularatne looks at both economic and social infrastructure [9]. He also uses both the PSS ARDL approach to test the direction of causality and a VECM model to examine the relationship between his two measures of infrastructure, private investment and Gross Value Added (GVA). By including the private investment variable, he allowed for the possibility that the infrastructure-growth relationship is direct or indirect, via private investment.

Using physical measures of economic and social infrastructure (constructed from road and class-room data, respectively), he finds that social infrastructure directly drives economic infrastructure, private investment and GVA. Ambiguous causal relationships exist between economic infrastructure on the one hand and both private investment and GVA on the other hand. Using the VECM model, he finds that GVA responds to social infrastructure spending with an elasticity of 0.06, while the private investment rate responds to economic infrastructure spending with an elasticity of 0.02. (GVA in turn responds to private investment with an elasticity of 2.5.) While he finds a positive infrastructure growth relationship, he also tested explicitly for the possibility that this relationship may be nonlinear: that infrastructure spending initially enhances growth but then stunts growth beyond some sufficiently high level. He finds that the relationship is positive for both economic and social infrastructure for all values of infrastructure investment recorded in South Africa in the last thirty years. This finding is of substantial importance when interpreting the other South African empirical studies, as it suggests that their results are not compromised by the fact that they do not take into account the possibility of a nonlinear relationship between infrastructure and growth.

Snieska and Simkunaite observed that it is the characteristic of each country that determines the set of infrastructure components and the aspect of impact on social and economic development economic growth [10]. The empirical test also proved that the direction of relationship differs in Lithuania and Latvia which are attributed to the same level development and these results contradict the findings in scientific literature. There is also the body of works that have found some limited positive impact of infrastructure on growth [1,11-14]. In Nigeria, Akinlabi et al. examine the impact of investment in public infrastructures on poverty alleviation and consequently economic development [15]. Using Cointegration and Granger causality test for the period 1981 to 2006, they found public infrastructure Granger cause GDP, but fiscal deficit does not Granger cause GDP. Ijaiya and Akanbi found long term linkages between infrastructure and economic growth [16]. The link between infrastructure and growth in African countries (South Africa, Nigeria, Uganda and others) has also been shown to be positive by Foster in the Africa Infrastructure Country Diagnostic report [17].

Some other early studies on the relationship public infrastructure e.g. Aschauer have suffered from simultaneity bias and spurious correlation [1]. Fedderke and Bogetic examine the impact of infrastructure investments in South Africa. They observed that past studies have shown the effect of public infrastructure investment on economic growth to be ambiguous. They contend that this result is due to not controlling the endogeneity of infrastructure investment. When they control the endogeneity of infrastructure investment, their findings is that infrastructure investment has a positive effect on economic growth and development. There is the need to determine the inter-sectoral linkage impact of infrastructure on the economy. This is underscored by the fact that infrastructure, apart from serving as a direct input, can also be an intermediate input in the production process. Thus, activities of the real sector of the economy are influenced by infrastructural investment and consequently their contributions to economic growth [18,19].

Using the data from 48 contiguous states, Munnell and Cook reported a lower output elasticity of public capital of 0.15 [3]. The use of less aggregated state or county data by others also yielded smaller positive effects of transport infrastructure on economic growth [4,20]. In addition, a number of case studies for particular states or counties suggested positive impacts of highway and street infrastructure development on local or regional economic activity [21,22]. Other researchers measured the "broader" economic effects of transport infrastructure by considering the spillover (indirect) effects on neighboring geographic areas, attempting to enhance the precision of the effects of infrastructure [23,24]. Besides, others confirmed the positive effects of transport infrastructure on activities in the private sector [25,26].

Conversely, a few studies found no effect (or mixed effects) of infrastructure capital on economic growth. For instance, Tatom found no effect of public capital on productivity growth after making adjustments for a spurious regression problem [27]. Similarly, Garcia-Mila et al. generated a state-level production function with three forms of public capital-highways, water and sewage systems, and all other public capital-as inputs, and found no evidence of their effect on productivity [5]. Another group of studies considered the spillover effects of transport infrastructure and reported that the development of transport infrastructure in one location may simply relocate economic activity from that location to others, yielding no (or negative) impact on regional economic output [7,28,29]. Moreover, some argued that, because the modern transport system already exist in the nation, additional infrastructure investment has little impact on economic

output, and the impact, if any, varies across regions [6,30].

In addition to the mixed effects of transport infrastructure on economic growth found in previous empirical studies, the direction of the causal relationship remains unclear. Kessides suggests that simultaneity makes research concerning the impact of transport infrastructure on economic growth tenuous, because economic growth can lead to development of the transport system [31]. Extending the related literature, Fisher discussed the potential importance of accounting for the possible reverse impact of economic growth on public capital development [32]. The ambiguity about the causal relationship between transport infrastructure and economic growth suggests the need for further research on the economic benefits of investment in transport infrastructure [33].

Theoretically, ignoring these sectoral multiplier effects, when in fact they exist, may lead to biased and inefficient results. In the absence of a consensus in the theoretical literature as to the significance and indeed direction of causality; as earlier stated, this paper seeks to investigate the impact of infrastructure on economic growth in Nigeria. The next discussion thus focuses on road infrastructure and economic growth by looking at some empirical evidences and the methodology and model specification.

Road Infrastructure and Economic Growth: Some Empirical Evidences

To access the contribution of road infrastructure to economic growth, a number of studies specified an aggregate production function that included transportation infrastructures among the explanatory variables. Antle in Uwagboe, for example estimated a Cobb-Douglas production function for 47 developing countries and 19 developed countries [34]. Infrastructure was specified as gross national output from transportation and communication industries per square kilometer of land area. Antle found that transportation infrastructure was an effective factor of production. Canning and Bennathan, using cointegration methods, estimated the rate of returns to paved roads for a period of 41 countries over the past four decades [35]. Canning found out that the highest rate of return to roads infrastructure occurs in countries with infrastructures shortages. Canning and Bennathan also analyzed whether physical capital, labour and other infrastructure variables are complement or substitute to road is highly correlated with physical and human capital. He however found that the margined return to roads decline rapidly if the length of paved roads increased in Isolation from other inputs [35]. A study carried out by Fan et al. on the impact of road investment a promoting production growth in China consistently showed the importance of road investments in promoting production growth in China [36].

From Table 1, it is clear that the contribution of road transport to GDP has not being encouraging in spite of government effort at revamping road development. The table shows that as at 1981, the total contribution of road transportations to GDP was 2,328.7 representing 4.89% of the total GDP. This fell to 1,860.9 in 1983 representing 3.50% of the total GDP leading to -2.3 growth rate of road transportation. This, however, increased to 46687.5 in 1995 representing 2.42% of the total GDP leading to 156.5 growth rate of road transportation. In the year 2000, the growth rate of the sector was 19.5%, this rate was not sustained, the rate fell to 5.1% in 2005, rose a little to 6.9% in 2010 and rose again in 2013 to 7.85%. This indicates an improvement in the sector.

Table 2 reveals that out of the total GDP of 47,619.7 in 1981, rail transport and pipeline transportation contributed 110.6 representing 0.23% of the total GDP. In 1994 and 1995, rail transport contributed 2.9 and 2.4 respectively leading to a negative growth rate of 95.1 and 17.2. However in 2008, rail and pipeline transportation contributed 11.8 to GDP leading to a growth rate of 22.9%. The year 2008 witnessed the highest growth in the sector. Since then, the sector witnessed a sharp fall to 5.7% in 2009. The sector maintained stead rates in 2011 and 2012 which are 5.9% respectively. In 2013, the sector managed a marginal growth rate to 6.47%.

Year	Total GDP (NM)	Contribution of road transport	Growth rate of road transport
1981	47,619.7	2,328.7	-
1982	49,089.3	1,905.1	18.2
1983	53,107.4	1,860.9	2.3
1984	59,622.5	2,089.8	12.3
1985	67,908.6	3,030.5	45.0
1986	69,147.0	3,171.1	4.6
1987	105,222.8	3,430.0	8.2
1988	139,035.3	3,710.0	8.2
1989	216,797.5	4,019.6	8.3
1990	267,550.0	4,886.6	21.6
1991	312,139.7	5,293.8	8.3
1992	532,613.8	8,050.8	52.1
1993	683,869.8	13,548.2	68.3
1994	899,863.2	29,826.6	120.2
1995	1,933,211.6	46,687.5	156.5
1996	2,702,719.1	66,621.7	29.8
1997	2,801,972.6	69,876.1	15.3
1998	2,708,430.9	90,067.6	28.9
1999	3,194,015.0	106,212.1	17.9
2000	4,582,127.3	116,336.7	19.5
2001	4,725,086.0	129,967.8	11.7
2002	6,912,381.3	160,679.9	23.6
2003	8,487,031.6	205,936.7	28.2
2004	11,411,066.9	344,913.0	67.5
2005	14,572,239.1	362,605.3	5.1
2006	18,564,594.7	416,240.3	14.8
2007	20,657,317.7	444,990.0	6.9
2008	23,842,170.7	472,495.3	6.1
2009	718,977.33	17534.51	6.8
2010	776,332.21	18727.95	6.9
2011	834,000.83	20017.89	6.9
2012	888,893.00	21394.38	5.85
2013	9,29,1515.40	23073.84	7.85

Source: Various issues of CBN Statistical bulletin and other periodicals

Table 1: The contribution of road transportation to gross domestic product 1981-2013.

Telecommunications infrastructure and economic growth: some empirical evidences

Despite the obvious policy relevance of telecommunication infrastructure, there are far few studies that accentuated on the specific impact of telecommunications on economic growth. Using data for over 15 developed and 45 developing nations from 1960 to 1973, Hardy regressed Gross Domestic product per capital on lagged telephone per capita and the number of lagged radios. He concluded that telephone per capita do have a significant impact on GDP,

Year	Total GDP (NM)	Contribution of road transport	Growth rate of road transport
1981	47,619.7	110.6	-
1982	49,089.3	128.3	16.0
1983	53,107.4	110.5	-13.9
1984	59.622.5	109.3	-1.1
1985	67,908.6	131.5	20.3
1986	69,147.0	138.3	5.2
1987	105,222.8	93.7	-32.3
1988	139,035.3	79.8	-14.8
1989	216,797.5	58.7	-26.4
1990	267,550.0	50.9	-13.3
1991	312,139.7	59.3	16.5
1992	532,613.8	42.7	-28.0
1993	683,869.8	58.7	37.5
1994	899,863.2	2.9	-95.1
1995	1,933,211.6	2.4	-17.2
1996	2,702,719.1	2.9	20.8
1997	2,801,972.6	3.7	27.5
1998	2,708,430.9	3.9	5.4
1999	3,194,015.0	4.2	7.7
2000	4,725,086.0	4.5	7.1
2001	4,725,086.0	4.9	8.9
2002	6,912,381.3	5.4	10.2
2003	8,487,031.6	5.9	9.3
2004	11,411,066.9	6.4	8.5
2005	14,572,239.1	6.9	7.8
2006	18,564,594.7	7.5	8.7
2007	20,657,317.7	9.6	2.8
2008	23,842,170.7	11.8	22.9
2009	718,977.33	2.12	5.7
2010	776,332.21	2.24	5.8
2011	834,000.83	2.37	5.9
2012	888,893.00	2.51	5.9
2013	9,29,1515.40	2.67	6.47

Source: Various issues of CBN Statistical bulletin and other periodicals

Table 2: Contribution of rail transport and pipeline to real gross domestic product in Nigeria 1981-2013.

whereas the spread of radio does not. However, when the regression was attempted for developed and developing economies separately, no significant effects occurred [37]. Calderon and Serven employed the causality and reverse causality analysis to confirm the existence of feedback process in which economic activities and growth stimulates demand for telecommunication services [2]. As the economy grows, more telecommunication facilities are needed to conduct the increased business transactions in Calderon and Serven investigated this relationship at the state and sub state levels of United States [2]. This study confirm at both the state and country's level using data from the state of Pennsylvania, USA, that telecommunication investment affects economic activities and that economic activities can also affects telecommunication investment. Roller and Waverman on their part estimated the impact of telecommunication infrastructures on economic growth from 21 OECD countries over the past 20 years using simultaneous approach [38]. After accounting for simultaneity and country specific fixed effect, Roller and Waverman found that the impact between telecommunication infrastructure and aggregated output was much reduced and statistically insignificant [38].

Table 3 reveals that the contribution of the communication industry to GDP has actually not been encouraging until times. For example in 1981, communication contributed 159.9 to total GDP of 47,619.7 representing 0.33% of the total GDP. However in 2001, communication contributed 6,891.2 to total GDP of 4,725086.0 representing 0.12% of the total GDP and growth rate of 583.0% which indeed was amazing. This sector witnessed the highest growth rate in 2006 with increase to 318.9% from 82.9% in 2005. In 2008, the sector witnesses to shape fall in growth rate, but this was reversed in 2011 from 7.5% in 2008 to 31.8%, and in 2013, it dropped marginally to 24.75%.

Methodology and Data

Model specification

In the empirical analysis of the relationship between infrastructural development and economic growth using a simultaneous analysis; the researcher specified two models, one which is the Cobb-Douglas production function,

$Q=f(K^{\alpha}, L^{1-\alpha})$ and the other which is on infrastructure. After applying the simultaneous equation, the two models composed to

Year	Total GDP (NM)	Contribution of road transport	Growth rate of road transport
1981	47,619.7	157.9	-
1982	49,089.3	179.7	11.9
1983	53,107.4	145.5	-19.0
1984	59.622.5	151.1	-3.8
1985	67,908.6	186.0	23.1
1986	69,147.0	191.8	3.1
1987	105,222.8	201.7	5.2
1988	139,035.3	215.7	6.9
1989	216,797.5	219.5	1.8
1990	267,550.0	247.9	12.9
1991	312,139.7	252.3	1.8
1992	532,613.8	323.3	28.1
1993	683,869.8	446.2	38.0
1994	899,863.2	452.2	1.3
1995	1,933,211.6	525.7	16.3
1996	2,702,719.1	605.7	15.2
1997	2,801,972.6	684.5	13.0
1998	2,708,430.9	743.3	8.6
1999	3,194,015.0	814.0	9.5
2000	4,725,086.0	1,009.1	24.0
2001	4,725,086.0	6,891.2	583.0
2002	6,912,381.3	9,891.2	42.5
2003	8,487,031.6	13.206.7	34.5
2004	11,411,066.9	21,609.5	63.6
2005	14,572,239.1	39,513.2	82.9
2006	18,564,594.7	65,524.1	318.9
2007	20,657,317.7	234,551.0	47.1
2008	23,842,170.7	261,868.8	7.5
2009	718,977.33	26,298.88	34.4
2010	776,332.21	35,339.34	34.6
2011	834,000.83	47,561.70	31.8
2012	888,893.00	62,697.40	31.8
2013	9,29,1515.40	78,215.01	24.75

Source: Various issues of CBN Statistical bulletin and other periodicals

Table 3: The contribution of the communication industry to real GDP in Nigeria 1981-2013.

Variable	Values	1% Critical value	5% Critical value	10% Critical value	Order of integration
EXR	-1.671363	-3.7076	-2.9798	-2.6290	1(1)
GDP	-0.356657	-3.7076	-2.9798	-2.6290	1(1)
INFL	-2.499352	-3.7204	-2.9850	-2.6318	1(1)
INFRA	-0.261163	-3.7076	-2.9798	-2.6290	1(2)
L	-2.463575	-3.7076	-2.9798	-2.6290	1(1)

Source: Researchers' Computation using E-views 3.1

Table 4: ADF unit root test result.

one (below for details): From the original Cobb- Douglas production function

$$Q=f(K^{\alpha}, L^{1-\alpha}) \quad (1)$$

$$K^{\alpha}=g(infra, infl, exr, Q \quad (2)$$

From equation 1

$$Q=\beta_o + \beta_1 K^{\alpha} + \beta_2 L^{1-\alpha} + u_t \quad (3)$$

From equation 2

$$K^{\alpha} = \delta_0 + \delta_1 infl + \delta_2 exr + \delta_3 Q + \delta_4 infra + e_t \quad (4)$$

Using the reduced form equation under the simultaneous equation method, the researcher substitute equation (4) into equation (3), the researcher has

$$Q = \beta_o + \beta_1 (\delta_0 + \delta_1 infl + \delta_2 exr + \delta_3 Q + \delta_4 infra + e_t) + \beta_2 L^{1-\alpha} + u_t \quad (5)$$

$$Q = \beta_o + \beta_1\delta_0 + \beta_1\phi_1 exr + \beta_1\phi_2 infl + \beta_1\delta_3 Q + \beta_1\delta_4 infra + \beta_1 e_t + \beta_2 L^{1-\alpha} + u_t \quad (6)$$

Collection of like terms

$$Q - \beta_1\delta_3 Q = \beta_o + \beta_1\delta_0 + \beta_1\delta_1 exr + \beta_1\delta_2 infl + \beta_1\delta_4 infra + \beta_1 e_t + \beta_2 L^{1-\alpha} + u_t \quad (7)$$

$$Q(1-\beta_1\delta_3) = \beta_o + \beta_1\delta_0 + \beta_1\delta_1 exr + \beta_1\delta_2 infl + \beta_1\delta_4 infra + \beta_2 L^{1-\alpha} + \beta_1 e_t + u_t \quad (8)$$

Dividing by $(1-\beta_1\delta_3)$ the researcher has

$$Q = \Omega_0 + \Omega_1 exr + \Omega_2 infl + \Omega_3 infra + \Omega_4 L^{1-\alpha} + v_t \quad (9)$$

Where:

$$(\beta_o + \beta_1\delta_0)/(1-\beta_1\delta_3) = \Omega_0$$

$$\beta_1/(1-\beta_1\delta_3) = \&^{l}_{1}$$

$$\beta_2/(1-\beta_1\delta_3) = \&^{l}_{2}$$

$$\beta_3\delta_1/(1-\beta_1\delta_3) = \&^{l}_{3}$$

$$\beta_3\delta_2/(1-\beta_1\delta_3) = \&^{l}_{4}$$

$$(\beta_3 e_t + u_t)/(1-\beta_3\delta_3) = v_t$$

In order to remove the exponential in equation (9), the researcher log the equation,

$$LogQ = \Omega_0 + \Omega_1 logexr + \Omega_2 loginfl + \Omega_3 loginfra + \Omega_4 (l-á) logL + v_t \quad (10)$$

Therefore the model of infrastructure and growth is

$$LogQ = \phi_0 + \phi_1 logexr + \phi_1 loginfl + \phi_1 loginfra + \phi_4 logL + v_t \quad (11)$$

where:

Q = GDP (Gross domestic product)

exr = exchange rate

L = labour force

Variable	Co-efficient	t-stat
C	0.602152	0.238085
LogL	0.956655	0.494467
LogINFRA	0.787663	6.856789
LogINFL	0.111694	3.462135
LogEXR	0.165190	1.735265
AR (15)	0.492507	2.838969

R-squared=0.99

R-bar–squared=98

F-stat=86.23

DW stat=1.99

Table 5: Result of the regression analysis regression result showing beta co-efficient and t-statistic.

Infla = Inflation rate

Infra = Contribution of infrastructure

v_t = Error term

$\phi_i >$, where I = 3 and 4

$\phi_j <$ where j = 1 and 2

Empirical results

The researcher used time series data obtained from various sources like CBN statistical bulletin, journals, internet etc. Because of spurious nature of data series data, the researcher used unit root test to check for the stationarity of each variable under consideration in this study.

Analysis for ADF unit root test

The results of Table 4 on the ADF unit root tests indicate that the variables (both explained and explanatory) are not stationary at 1(0) levels but are stationary at 1(1) first difference except infra (infrastructure) which is stationary at 1(2), that is, second order difference. The stationarity of the variables are at 1 percent, 5 percent and 10 percent levels. By summary, the results of the ADF tests suggest that all the variables of interest have a unit root (that is, the null hypotheses of all the relevant variables having unit root could not be rejected).This means that in order to eliminate possibility of spurious regression results and enormous inferences, the first differences of the relevant variables in the estimation process was used.

From the result on Table 5 the R^2 estimation shows that there is goodness of fits of the model. With the percent of 99, it indicates that the explanatory variables (L, exr, infra and infl) explain very well of the explained variable (GDP). This is endorsed by the R-bar-square of 98%. This means that the explanatory variables (L, exr, infra and infl) have good account of the dependent variable (GDP).The f-test statistic value of 86.23 indicates that at least one the explanatory variables is statistically significant or that the explanatory variables are jointly

statistical significant in the determination of the relationship between infrastructure development and economic growth of Nigeria.

For the t-statistic which is use to measure the individual statistic of the independent and using the rule of thumb which specifies that any t-value which is not up to two (2) is considered not statistically significant. From the result of Table 5, it is clear that only infra and infl (infrastructure and inflation) are individually significant in this study as in Table 2 while other (exr, and), are not individually significant. The result of the t-statistic is not single as it is in line with the study of Udegbunam, Fan S, Roller and Waverman and Fedderke and Luiz [36,38-40]. In the three estimations in these studies mentioned, infrastructure was divided in components. In these studies, all the coefficients have negative coefficients which are contrary to economic theory. As for the co-efficient of the explanatory variables (exr, L.infl and infra), it is observed that outside these variables, the economic growth (GDP) will operate at approximately 0.602 rate. This means that an increase of one unit in the autonomous will generate a positive increase in the GDP by 0.602 units.

All the explanatory variables conform to apriori expectation except inflation which is in line with economic theory. For labour force (L), holding other explanatory variables constant, a unit increase in LF will decrease GDP by 0.96 units. Also, for exr, infl and infra, a unit increase in them will increase GDP by 0.79, 0.11 and 0.17 unit respectively. Finally, the result of the DWstatistic of 1.99 shows the absence of serial autocorrelation in the estimation. This makes the model/estimation to be acceptable.

Conclusion

In this study, two models are specified, and after applying the substitution method (reduce form equation), the two models collapsed to one which enabled the researcher to use OLS estimation approach to run the regression. From the result, it is clear that infrastructure is an integral part of Nigeria economic growth. Underminding it (infrastructure) is underminding the growth and development of Nigerian economy. The results suggest that the development of infrastructure capital creates multiple-year positive impacts on private capital formation and employment. Infrastructure is also vital to household and firms as the availability and quality of infrastructure result in different decisions to invest and may influence migration, business establishment location. Although, the result of the two estimations speak that infrastructural development has a positive linkage with economy growth but, the researcher believe this is in term of availability and quality of infrastructure in the economy. And also, the magnitude of the contribution leaves a lot to question. This questionable contribution or lack of quality infrastructural development has been seen in the relocation of some firms out of Nigeria to other neighbouring countries like Ghana etc.

The relocation of some firms out of Nigeria which is as a result of weak quality of our infrastructure base has not only affected the economy negatively in the short run but also in the long run which are manifesting in a lot of social/ youth restiveness like Niger Delta militancy, boko Haram in the North to mention but a few. Know fully that infrastructure services are used as final consumption item for households and intermediate consumption item for firms, any wrong action taken by government that negates the growth and development of infrastructure has both micro and macroeconomic affect the economy at large. The quality of infrastructure has direct effect on business productivity and growth, and different investments to infrastructure capital from inequality between regions and countries. The role of infrastructural development on economic is a vital issue for strategic and development country policy management for a country with weak quality of infrastructure base. Efficient infrastructure attracts centers of production and consumption, gives greater access to markets and education centers and that timely access to health care, facilitated by transport can prevent maternal deaths and lower infant mortality rates.

Policy implication

Infrastructure development is one of major elements of structural reforms in developing economy like Nigeria because of its expected large economic and social impact. As can be inferred from the studies by other researchers, infrastructure investments alone do not have a significant influence on economic growth. The institutional environment is a very important complement, allowing infrastructure investments to be translated into economic growth.

Based on this, the following are the policy implication of this study:

Several policy implications are suggested from the findings of our research. First, as concerns have arisen about the deteriorating infrastructure system and its effects on private sector productivity and the nation's economy, enhancing the nation's transport infrastructure may be crucial to stimulating the stagnant economy. Based on the findings of this study, investment in transport infrastructure will encourage private capital formation and assist in the formation of other public infrastructure, both of which in turn support economic growth. The resulting economic growth will then encourage an increased allocation of resources toward public transport capital formation, perpetuating a cycle of public investment, private investment and economic growth. The recently reauthorized surface transportation bill, MAP-21, proposed by the Obama Administration's with the intention to stimulate the United States economy through enhanced public transport infrastructure investment is one example of how Nigerian government can improve transport infrastructure system in Nigeria.

Second, the insignificant direct impact of transport infrastructure capital on economic output may imply that the Nigeria highways and streets are not well managed (e.g., issues of congestion and traffic safety) or maintained, hence, lowering the economic impact of investment in the nation's road systems. Talley indicated that spatial accessibility and transportation quality-of-service are important when evaluating the economic impact of transport infrastructure investment [41]. Moreover, the road system may not be efficiently utilized, limiting its contribution to the national economy. Thus, along with increasing the transport infrastructure capital stock, greater economic impact may result from policies that better manage and utilize the nation's road system.

Third, given current global economic stagnation and the domestic budget crisis, the results suggest that the Nigeria government efficiently allocate scarce budget resources toward crucial public infrastructure formation. Allocating resources to highway and street infrastructure can encourage the cycle of public investment, private investment, and economic growth, while investing in non transport public infrastructure can provide positive sustainable effects on economic output and exports. As suggested by Garrison and Souleyrette nearly two decades ago, policy makers should encourage innovations integrating transportation services with improvement in other sectors to enhance and sustain the value of transport infrastructure [42].

Four, the government should enhance the competition between and the efficiency in infrastructure industries, (especially electricity) and with it, the government can make an indirect contribution to

economic development. The railways sector should receive government blessing as exemplified by the Chinese and Indians governments. This is because since passengers and goods are carried by railways cheap and significant compared to other means of land transportation.

Future research is needed to explore the economic impacts of highway and street infrastructure by disaggregating it into several categories since not all categories would have the same impact on GDP (e.g., interstate highways versus county roads). The economic gains from spending on highway networks linking shipping ports or investment in the state highways with the highest likelihood for increasing local private capital investment can be analyzed, compared, and used to prioritize budget allocations. Also, additional measures of highway infrastructure management, such as government spending on Intelligent Transportation Systems and their operation, or on reducing the hours of congestion on highways, can be included to further evaluate the impact of transportation infrastructure on the national economy.

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