INFRASTRUCTURAL DEVELOPMENT AND VALUE ADDITION IN AGRICULTURAL OUTPUT IN NIGERIA

Ude Damian Kalu

Department of Economics, Michael Okpara University of Agriculture, Umudike, Nigeria

ABSTRACT

This work examined the impact of infrastructural development on value addition in agricultural output in Nigeria from 1981 to 2016, using secondary annual time series data. The methodology is centred on the neoclassical growth theory. The production function estimation tailed the Cobb-Douglas model stated as Hicks-neutral high-tech evolution (infrastructural development), on assumption that technological progress is both capital and labour augmenting. The value addition of the agricultural output model follows Solow Residual (SR) but with factor weights estimated econometrically. Results show that infrastructure has a significant effect on agricultural output value addition. Results also suggest that government capital expenditure on agriculture has a positive significant effect on agricultural output while value added tax has a negative effect on agricultural output value addition. The causality result shows that there is a unidirectional causality from value addition in agricultural output to infrastructural development in Nigeria. This work, consequently, indorses that satisfactory and appropriate care of prevailing infrastructure needs to be sustained while ratifying appropriate guidelines which will engineer effective execution and accomplishment of novel infrastructural ventures in Nigeria in order to enhance agrarian subdivision growth, decrease degeneration of farmstead yield and promote the prospect of diversification of the Nigerian economy.

Keywords: Infrastructure, agriculture, value addition, output.

JEL classification: H54, Q10, Q14, Q16, Q18, R41, R42

1. Introduction

The relevance of infrastructure as a key to the growth and advancement of countries in the world can never be overstressed. Infrastructure, as put by Tunde and Adeniyi (2012), advances the processes of industrialization, commerce, employment, and real estate industry through enhanced availability to end users. Basically, transportation infrastructure eases the movement of goods and services in rural settlements, which in turn enhances the sources of income of the countryside agriculturists (Ajiboye and Afolayan, 2009). As a precedence, it could be deduced that infrastructure is a sine qua non for the economic development of every economy in the world. With reference to the advanced economies, it is argued that efficient use of infrastructure spurred industrialization and development, as exemplified by China (Felloni, Wahl, Wandschneider, and Gilbert, 2001). Olubumehin (2012) has equally argued that the attainment of economic growth and development through overall aggregate output of developing countries is hinged on infrastructure. Interestingly, owing to the large quantity, and unpreserved and cheap nature of farm outputs, road infrastructure becomes pertinent to convey the products from the farm to the point of sale at the lowest cost and in the shortest possible time. As a result, there appears a sweeping statement from advanced to less developed countries that outlay in infrastructure, particularly on thoroughfare infrastructure which is the commonest means of connecting the rural areas to the urban centres, would compensate for the expensive transport fare on commercializing farm produce, dampening the unemployment rate, alleviating poverty and boosting sustainable development in agriculture (Ogunleye, Ajibola, Enilolobo, and Shogunle, 2018).

It is argued that dearth of infrastructure is among the foremost challenges to the development of agricultural value chain in Nigeria, consequently, this has formed an impediment in the chain of agronomists and users of their produce. Moreover, it has abridged marketplace prospects and motivations for participating in farmhouse production. Thus, improving the infrastructural base would constitute an important factor in attractiveness and value addition in the agricultural sub-sector.

It is also argued that agriculture is the mainstay of the Nigerian economy. It is a sure bet for the eradication of hunger and a guaranteed food haven. Interestingly, agriculture is the major employer in Nigeria. The agricultural sub-sector absorbs around 70 per cent of the working population in Nigeria and eventually contributes more to the economic performance and advancement of the Nigerian economy. Nevertheless, inasmuch as agriculture is critical to economic performance in the country, huge investments in essential infrastructure are required to trigger yield and efficiency as well as engagement chances for the working population, especially the youth.

Further, since the commencement of electricity production, the country has developed various power stations, including gas-fired, oil-fired, hydro-electric and coal-fired stations, depending on the energy sources (water, oil, coal and gas) available in the country. Nigeria is endowed with natural resources for power generation but this sector is still plagued with problems. The Nigerian power sub-sector is characterized by epileptic supply, improper pricing of power, energy theft, and non-settlement of tariffs (Nwabude, 2008). Although concerted efforts are being made to address these issues, the situation is not expected to change in the immediate future.

Some studies have argued that essential infrastructure like power supply, transportation infrastructure (rail, roads, ports), water resources, and internet telecommunication services are lacking in the agricultural sector. As an example, it has been shown that inadequate transportation infrastructure contributes up to 35 per cent of the cost of transferring farm yields to the marketplace. As a result, the needed investment from private and foreign investors are retarded. In view of this saddening data, Ogunleye et al. (2018) opined that transportation infrastructure would be key to improving value addition in the agricultural sector of the Nigerian economy.

In addition to the conflicting results, existing literature (Kassali, Ayanwale, Idowu, & William, 2012; Williamson, 2004; Tunde & Adeniyi, 2012), in relation to the impact of infrastructure on agriculture in Nigeria, captured some rural areas and others captured some states lacking in wider scope of the Nigerian economy in its entirety. As a matter of fact, infrastructural expenditure as used by the studies does not capture the exact state of infrastructure that bridges the gap between the rural and urban centres. Also, whether causality is unidirectional or bidirectional is yet to be addressed in empirical literature. Against this background, this study set out to investigate the role of infrastructural development on value addition in agricultural output in the Nigerian economy as well as establish whether the direction of causality is unidirectional or bidirectional in nature. The outcome, it is envisaged, would be useful to policy makers, investors and agriculturists and would facilitate policy making in the area of infrastructural improvement in the country.

2. Review of Relevant Literature

2.1 Conceptual framework

For the purpose of achieving the objectives of this study, the modified conceptual framework of Lakshmanan (2007) is adopted in the interest of attaining this study's stated aims as it captures both the dependent and explanatory variables of the study.

2.1.1 *Lakshamanan Conceptual Framework*

The modified framework of Lakshmanan (2007) has been adopted as the straightforward framework for this study, which tries to establish the impact of infrastructural development on agricultural value addition in Nigeria. This framework was modified to address the relationship between infrastructural development and value addition in the agricultural sector of the Nigerian economy. The framework is shown in figure 1, which offers the method and procedures fundamental to the broader gain of infrastructural development on agricultural value addition. This is a typical present-day framework (Williamson, 2004; O'Brien, 1983), of which the study termed 'forward linkages' of infrastructural development. It is argued that the reduced costs and improved availability of agricultural value addition products are caused by the rate of change of cost in infrastructural development, consumers' ease of movement and demand for agricultural value addition products. In the process of attaining these outcomes, employment is created, output increases and income is improved in the near future. In the long-run, aggregate economic growth would be achieved when the advancement impacts obtained from the methods and procedures of infrastructural development trigger a chain of webs of aggregate economic activities.

The operators in the transport industry have benefited a lot owing to the reduced charges which have improved convenience as a result of infrastructural development and quality service delivery. With improvement in quality product delivery in every nook and cranny of the country, and every sector of the economy, there would be a paradigm shift in the line of events from rural to urban areas. This development would trigger increased productivity, general commerce and specialty on the part of farmers. Generally, chances of engaging in international trade would be boosted and consequently, a network of economic activities would crop up which would spur more offshore commerce.

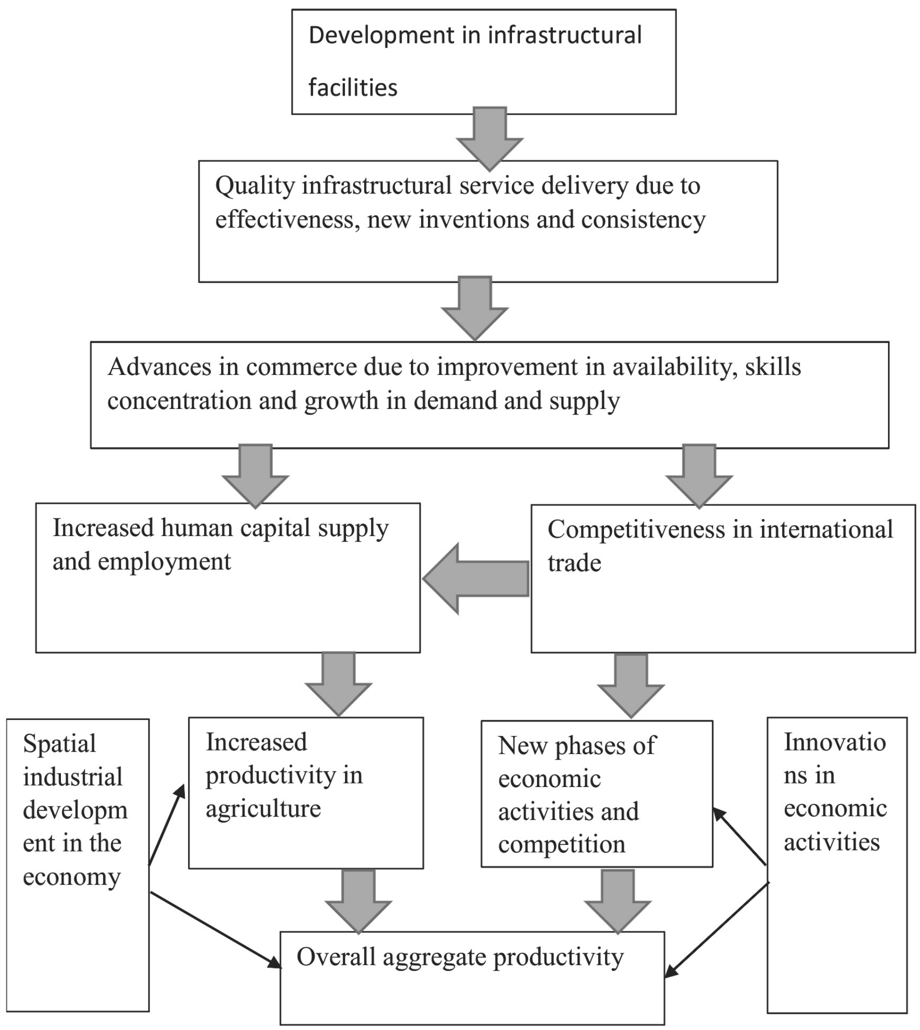

Figure 1. Infrastructure and Agricultural Value Addition.

As shown in figure 1, efficiency and effectiveness would be achieved when increased supplies are made to offset the static cost of production as a result of improved international trade which would initially increase the aggregate productivity level. Another side to this is that sustained importation of similar goods would drastically put a burden on the domestic prices of goods. In addition, when the pressure on domestic prices is attained, the issue of single-firm dominant charges would be a thing of the past and competency would be enhanced. Subsequently, employment would be generated and increased use of other productive factors would be enhanced through the reduction of transportation charges and improved supply. This would generate an entirely new phase of economic activities, especially in the productive factors market due to increased supply and reduced output charges.

Figure 1 shows the framework capturing infrastructural development and value addition in agricultural output in Nigeria. There are two boxes showing the instrument to navigate the economy. The lower left box shows altitudinal industrial development in the economy while the lower right box shows innovation in economic activities. Infrastructural development, which generated the two instruments, improves performance in economic activities, endogenizes growth and improves aggregate output in the agricultural sector. Also, infrastructure development could enhance internal economic activities through skills dissemination.

2.2 Theoretical literature review

Development economists have established several growth representations and growth philosophies including historical models and theories on economic growth. The growth representations and growth philosophies established are: Lewis Theory of Development, Classical Growth Theory, Rostow Growth Model, Harrod-Domar Growth Theory, New Growth Theory and the Neoclassical Growth Theory. This study adopts the Neoclassical Growth Theory as its principal theory.

2.2.1 *The Neoclassical Growth Theory*

The sequence of calculations that demonstrated the connection among investment properties, total work time, assets and total productivity, which is the idea of economic growth as augmented piles of investment goods, was organized as the Solow-Swan Growth Model. In line with this opinion, the effect of high-tech transformation turns out to be critical, to the extent that investment build-up was less vital. The very initial effort to compute long-term growth methodologically was established during the 1950s by Robert Solow and Trevor Swan. The important assumptions upheld by the model were that: employment would continue to increase, there would be continued diminishing returns to capital and that economies would employ their income and other resources judiciously. The neoclassical growth model formed three critical forecasts from the preceding three grounds of the Solow and Swan growth model. In the first place, it is argued that less-developed economies have inadequate per capita income, since each level of capital investment builds a higher return per capita than in developed economies. Secondly, increments in capital resources generate economic growth since productivity per person would be enhanced with more capital outlay. Then thirdly, countries ultimately get to the level where capital increment would not add to economic growth due to diminishing returns to capital. This is referred to as the **steady state**.

However, the theory asserts that new technological inventions could be employed by economies to overshoot the steady state in order to continue growing. Also, the percentages of productivity should be equivalent to the savings percentages, nonetheless, in the long-term, productivity per person would be contingent on savings percentages. This theory equally opined that the procedure in which economies would constantly keep increasing in aggregate productivity notwithstanding the decreasing returns to scale is called exogenous growth and which signifies the formation of novel technology and innovation which permits manufacturing with less amounts of capital and income. Technological innovation advances the level of capital resource increase in the steady state in which economies devote resources and continue to increase productivity. However, it is argued that available data could not validate the forecasts of the theory. Moreover, the neoclassical growth theory has been criticized on the ground that it does not take cognizance of the variations in the rate of return of various total investments across different economies.

2.2.2 *Stylized Facts and Growth in the Agricultural Sector*

Stylized facts and growth in the agricultural sector reveal that overall growth in the sector was 4.1% in 1998 and comparatively stationary at 3% in 2003 and 5.64% in 2010. The reason for the growth was that various administrations within the period under review had intensified efforts and transformed devotion via numerous transformation agenda which also reinvigorated private sector participation in commercial ongoings. However, this may not be attributed to success of various government policies in the long term. Many entrepreneurs in the agricultural sector were stationed to make good use of the targeted government policies. Undoubtedly, since 2004, the telecommunications sector has been the sector with the highest growth rate. Second to the telecommunication sector is the agricultural sector.

In terms of the aggregate economic activity growth since 2013, the agricultural sector contribution to the GDP has been staggering between 40% and 41%. The crop sub-sector was the sub-sector with the highest contribution to the GDP between 2013 and 2017. From 2013 to 2015, the sub-sector growth averaged 36% while it averaged 37% in cumulative style between 2016 and 2017. In addition, the fishing sub-sector has contributed about 1.37% within the period under review while the livestock sub-sector contribution has remained relatively stagnant at about 2.6%. The sector with the largest contribution to non-oil aggregate economic activity growth rate has been the agricultural sector. Although there was a decline in the rate of growth of the agricultural sector in 2013 and 2014 at 6.6% and 6.5% respectively, the growth rate increased in 2015 to 7% but again declined in 2018 to 5.6%. After an initial fall from 6.64% in 2003 to 6.50% in 2004, the growth rate appreciated per annum from 2005 (7.06%) but still fell to 5.64% in 2010. The positive growth rate was anticipated to have a positive impact on per capita income levels as well as general wellbeing but unemployment and prices of food worsened during the period under consideration.

In recent times, total government budget has increased but the allocation to the agricultural sector has declined within the same period. The agricultural sector share of the budget has continued to be abysmal at 1.3% and only just increased to 7% in 2017. Capital expenditure for the agricultural sector has not fared any better though with gradual increases in recent times. By implication, it is assumed that the greater portion of the agricultural sector budget is taken away by recurrent expenditure.

Despite the budgetary allocation to the development of infrastructural facilities in the agricultural sector, the state of agricultural infrastructure has remained deprived. However, there has been some energy geared towards liberal advancement of irrigation infrastructure in some segments of the country. Data suggest that total capital budget allocated to the agricultural sector improved astronomically from 8.5 billion naira in 2013 to136.3 billion naira in 2017. This is an indication that agricultural sector development in Nigeria is hinged on public spending.

Accordingly, the total budgets of various state governments showed an increase in agricultural sector spending from ₦18.1b in 2013 to ₦30.8b in 2017. Moreover, an identical tendency is witnessed in agricultural capital expenditure. However, the overdependence of the Nigerian economy on crude oil windfalls probably explains the minute contribution of state governments to agricultural sector development in Nigeria. This could also be the reason why state governments have not yet tapped into the enormous income avenue in the agricultural sector.

2.3 Empirical studies

Many empirical research works (local and foreign) have examined agricultural sector productivity and value addition determinants in the sector. Few of the studies are: Nkonya et al. (2010), Oni, Nkonya, Pender, Phillips, and Kato (2009), Diao, Nwafor and Alpuerto (2009), and Nkamleu (2007). Most of the research works were undertaken in several countries to ascertain the elementary drivers of growth rate in agricultural sector productivity.

As an instance, the study by Nkamleu (2007) covers 30 years and applied a wide-ranging context to establish the growth of the agricultural sector in different economies, and investigated the sources and determinants of agricultural growth, covering the last three decades. The study found that accumulation of factors inputs was a significant determinant of agricultural productivity while total factor productivity had insignificant effect on the growth of the agricultural sector across different countries. Also, studies by O'Connell and Ndulu (2000) and Downes (2001) revealed that progress in technological development, development in human capital and inventions are major determinants in the growth process of any economy.

Again, Ighodaro (2009) investigated the impact of infrastructural development on economic performance in Nigeria. The study applied the Granger causality test and Vector Error Correction Model (VECM) and found that there was no causality (unidirectional or bidirectional) between transportation infrastructure and economic performance in Nigeria. The study also found that transportation infrastructural development is a significant factor affecting economic performance in Nigeria. Similarly, Ajiboye, (2009) investigated the relationship between transportation infrastructure and economic performance in Nigeria through farm produce distribution and food security. The result of the study suggests that poor distribution of agricultural products, food insecurity and by extension insignificant economic performance are caused by insufficient and unavailability of transportation infrastructure and excessive transportation charges.

2.3.1 *Information and Telecommunications Infrastructure*

Policy makers and academics have regularly highlighted the importance of infrastructural development to economic performance. The World Bank (2012) observed that information and communication technology (ICT) is a quicker way to obtain and spread information. Information and communication technology (ICT) is the interaction of events by electrical channels which stimulates the development, broadcast and dispersal of data (Rodriguez and Wilson, 2000). However, Roller and Waverman (2001) contend that the dispersal of messages among companies is inadequate when telecommunication is not developed. In terms of information and communication technology and economic growth, Dewan and Kraemer (2000) in their cross-country analysis found that ICT has a positive significant impact on economic performance. Other studies with different methodologies and different data sets have similar findings that telecommunication infrastructural asset is a significant factor affecting economic performance (Daveri, 2001; Madden, Savage & Simpson, 1998; Sridhar and Sridhar, 2007; Zahra et al., 2008).

2.3.2 *Transport Infrastructure and Agricultural Value Addition*

There are conflicting studies on empirical literature transportation infrastructural development and value addition in the agricultural sector. For instance, some studies (Ighodaro, 2009; Lokesha, and Mahesha, 2016) established that transportation infrastructural development is a major factor affecting agricultural value addition. However, Ulimwengu, Funes, Heady, and You (2009) found that transportation infrastructural development has insignificant impact on agricultural value addition.

In a different study to determine the extent to which agricultural productivity is affected by road transportation infrastructure in Nigeria, Inoni and Omotor (2009) found that countryside road transport infrastructural development has a substantial impact on agricultural productivity in Nigeria.

3. Methodology and Data

3.1 Theoretical perception and analytical framework

This study adopts the neoclassical theoretical framework. The neoclassical growth model formed three critical forecasts from the Solow and Swan growth model. In the first place, it is argued that less developed economies have inadequate per capita income since each level of capital investment builds a higher return per capita than in developed economies. Secondly, increments in capital resources generate economic growth since productivity per person would be enhanced with more capital outlay. Then thirdly, countries ultimately get to the level where capital increment would not add to economic growth due to diminishing returns to capital. Oni, Nkonya, Pender, Phillips, and Kato (2009) established agricultural growth rate determinants in Nigeria, however, agricultural value addition may not be affected by decreases in input factors as witnessed in the United States during the 1980s.

Analytically, the growth accounting or index number approach, non-parametric approach, and econometric approach are the three different techniques available in the literature.

The growth accounting technique (GAT) models aggregate economic activities integrated mechanism related with factor input improvement. The factor inputs in this technique include land, labour and capital, and other control variables. Furthermore, index of total factor productivity (TFP) is computed by a comprehensive record of all the input and output data. However, the inability of this technique to establish the relationship between the quantity of physical resource development and productivity constitutes a major drawback (Zepeda, 2001).

Analogous to the growth accounting technique is the non-parametric approach. However, the linear programming estimation technique is applied. The non-parametric approach is often used as a substitute to the growth accounting technique. It can also be applied to detect the mixture of input and output. It is sometimes cited as an alternative to GAT and can be used to identify an input-output combination that explains productivity border-lines using either macro-level data or micro-level data. The major shortcoming of this approach is its inability to ascertain the factors affecting the premise of productivity scientifically (Zepeda, 2001).

Another alternative technique is the econometric approach. The econometric approach has been used by the Solow residual traditional model to estimate world productivity function in relation to agricultural value addition. This approach caters for the lapses in the other two approaches and makes provision for the authentication of the estimated outcomes. This approach has two shortcomings. Firstly, more vigorous data is needed for estimation than the other alternative approaches. Secondly, it requires a high numerical value of data set to allow its application. However, this approach is most suitable irrespective of its criticism because the noted shortcomings can be controlled. The data set for this study is about 35 years, to surmount the data challenge, and the data would be detrended to ensure stationarity

3.2 Model specification

Taking inference from the empirical findings and theories, which have been derived from the theoretical expositions of traditional Solow residual growth model, the Neo-classical growth theory and Cobb-Douglas production, and thus ensuring that agriculture is fundamental to the model, an equation has been stated to examine agricultural sector growth in the Nigerian context. The study adopted the Okezie, Nwosu and Njoku (2016) model as specified below:

$$VAO = f\,(INFR,\ VAT,\ GACE) \qquad (1)$$

Thus, linearizing equation (1) econometrically, we obtain:

$$VAO = b_0 + b_1 INFR + b_2 VAT + b_3 GACE + m_t \qquad (2)$$

3.3 Definition and measurement of variables

VAO – Value-addition of agricultural output

INFR – Infrastructure

VAT – Value added tax of agricultural output

GACE – Government agricultural capital expenditure

β, is intercept,

β_1 to β_3 are the parametric coefficients of the explanatory variables to be estimated where μ is the white noise term at time *t*.

Equation (2) is the long-term regression model to obtain the long-term relationship between the dependent and the explanatory variables.

VOA is a vector for CPV (crop production value-addition), LSV (livestock value-addition), FRV (forestry value-addition), and FSV (fishing value-addition). Further, INFR is a vector for TINF (transport infrastructure), ICINF (information and communication infrastructure), and UINF (utilities infrastructure).

TINF is further decomposed into RTR (road transport infrastructure), RATP (rail transport infrastructure), WTR (water transport infrastructure), ATR (air transport infrastructure), TRS (transport services infrastructure), and PCS (post and courier services infrastructure). UINF is also decomposed into EUINF (electricity utility infrastructure), and WUINF (water utility infrastructure). The value additions of these variables as defined are measured as changes of each variable. All the variables are in millions of naira.

From the foregoing, equation (2) could be stated as:

$$CPV = b_0 + b_1 INFR + b_2 VAT + b_3 GACE + m_t \tag{2.1}$$

$$LSV = b_0 + b_1 INFR + b_2 VAT + b_3 GACE + m_t \tag{2.2}$$

$$FRV = b_0 + b_1 INFR + b_2 VAT + b_3 GACE + m_t \tag{2.3}$$

$$FSV = b_0 + b_1 INFR + b_2 VAT + b_3 GACE + m_t \tag{2.4}$$

Incorporating the first line infrastructural components in equation 2.1 to 2.4 the study obtains:

$$CPV = b_0 + b_1 TINF + b_2 ICINF + b_3 UINF + b_4 VAT + b_5 GACE + m_{t1} \tag{2.1.1}$$

$$LSV = b_0 + b_1 TINF + b_2 ICINF + b_3 UINF + b_4 VAT + b_5 GACE + m_{t2} \tag{2.2.1}$$

$$FRV = b_0 + b_1 TINF + b_2 ICINF + b_3 UINF + b_4 VAT + b_5 GACE + m_{t3} \tag{2.3.1}$$

$$FSV = b_0 + b_1TINF + b_2ICINF + b_3UINF + b_4VAT + b_5GACE + m_{t4} \quad (2.4.1)$$

Unit roots are routine tests on time series data to ascertain if individual series are stationary which aid the application of the appropriate estimation technique. As a matter of academic exercise, the most fitting stationarity test is challenging. The Augmented Dickey-Fuller (ADF) (1981) and the Philips-Perron unit root tests have been suggested in extant literature. If they reinforce each other, then we can have confidence in the results. However, Elliott-Rothenberg-Stock (ERS) point-optimal unit root test has been shown to be very robust. Therefore, to test for series stationarity, the ERS test would be conducted. The unit root tests would be conducted at level and at first difference for the intercept, and the intercept and trend term.

To obtain the rate of change of the value of agricultural output with respect to the parametric coefficient, the model of 2.1.1 to 2.4.1 is rewritten as:

$$InCPV = b_0 + b_1 1nTINF + b_2InICINF + b_3InUINF + b_4InVAT + b_5InGACE + \mathrm{m}_{t1} \quad (2.1.2)$$

$$InLSV = b_0 + b_1InTINF + b_2InICINF + b_3InUINF + b_4InVAT + b_5InGACE + m_t \quad (2.2.2)$$

$$InFRV = b_0 + b_1InTINF + b_2InICINF + b_3InUINF + b_4InVAT + b_5InGACE + m_{t3} \quad (2.3.2)$$

$$InFSV = b_0 + b_1InTINF + b_2InICINF + b_3InUINF + b_4InVAT + b_5InGACE + m_{t4} \quad (2.4.2)$$

The presence of unit root and co-integration is the necessary and sufficient condition for an error correction mechanism. Suffice it to reiterate that co-integration provides the theoretical underpinning for the error-correction model. Specifying equation (2) in the spirit of the error-correction model, we have:

$$\Delta logVAO_t = \Delta log\, \alpha + \sum_{i=1}^{n} \beta_1 \Delta\, logINFR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta\, logVAT_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta\, logGACE_{t-i} + \delta ECT_{t-i} + \epsilon_t \quad (3)$$

$ECM_{t\ -1}$ = the error correction term (ECT t-1) of the short-run equation (equation 3),

t = represents the stochastic error term.

The study would now partially differentiate with respect to the log of each variable to ascertain the elasticity of VAO and the *a priori* sign expectation of equation (2);

$$\frac{\partial logVAO}{\partial logCED_t} = \left(\frac{\partial logVAO}{\partial logCED_t}\right)\left(\frac{CED}{VAO_t}\right) = \beta_1 < 0 \tag{4}$$

$$\frac{\partial logVAO}{\partial logVAT_t} = \left(\frac{\partial logVAO}{\partial logVAT_t}\right)\left(\frac{VAT}{VAO_t}\right) = \beta_2 < 0 \tag{5}$$

$$\frac{\partial logVAO}{\partial logGACE_t} = \left(\frac{\partial logVAO}{\partial logGACE_t}\right)\left(\frac{GACE}{VAO_t}\right) = \beta_3 > 0 \tag{6}$$

$$\frac{\partial logVAO}{\partial logECT_{t-1}} = \left(\frac{\partial logVAO}{\partial logECT_{t-1}}\right)\left(\frac{ECT}{VAO_t}\right) = \delta < 0 \tag{7}$$

The issue of causality relationship as proposed by Granger (1963) is useful in analysing how a time series can be used to forecast another. Thus, a variable X_t is said to Granger-cause another series Y_t, if given the past of Y_t, past values of X_t can help forecast Y_t. Thus, the model for the second objective involves the following pair of regressions:

$$VAO_t = \sum_{i=1}^{n} \alpha_i\, INFR_{t-i} + \sum_{j=1}^{n} \beta j\, VAO_{t-j} + \mu_{it} \tag{8}$$

where: α_i, β, φ, β*j*, λ_i, δ*j* = parametric coefficients; other variables are as defined earlier.

The data used in this study are annual secondary data from 1981 to 2016. The data were sourced from the Central Bank of Nigeria Statistical Bulletin (2017). For all the variables, their natural logarithmic values would be used.

4. Results and Discussion

The results of the empirical estimates are discussed below.

Table 1. Relationship between agricultural value addition and infrastructure in Nigeria before unit root test was conducted

Dependent Variable: VAO

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2928.169	287.6633	10.17916	0
INFR	1.106578	0.40486	2.733238	0.0101
VAT	0.017414	1.108563	0.015709	0.9876
GACE	3.905653	1.007417	3.8769	0.001
R-squared	0.949032			

The results in table 1 suggest that infrastructure and government capital spending on agriculture have positive and significant effect on agricultural value addition in Nigeria.

Table 2. Relationship between agricultural value addition and infrastructure variables in Nigeria before unit root test was conducted

Dependent Variable: VAO

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	957.6206	690.735	1.386379	0.1758
TINF	10.28218	4.175596	2.462445	0.0198
ICINF	0.139211	0.451974	0.308006	0.7602
UINF	18.55471	6.723185	2.75981	0.0098
VAT	-0.724993	1.136527	-0.637902	0.5284
GACE	1.184531	0.902292	1.312803	0.1992
R-squared				

However, when infrastructure was disaggregated, the study found that only transport infrastructure and utility infrastructure had significant impact on value addition of agricultural output in Nigeria.

4.1 Pre-estimation test

Table 3. Elliott-Rothenberg-Stock (ERS) Point-Optimal Unit Root Test

D(VAO) Elliott-Rothenberg-Stock test statistic		5.095396
Test critical values:	1% level	4.22
	5% level	5.02
	10% level	6.77
D(TINF) Elliott-Rothenberg-Stock test statistic		6.827287
Test critical values:	1% level	4.22
	5% level	5.72
	10% level	6.77
D(ICINF) Elliott-Rothenberg-Stock test statistic		13.11593
Test critical values:	1% level	4.22
	5% level	5.72
	10% level	6.77
D(UINF) Elliott-Rothenberg-Stock test statistic		6.563755
Test critical values:	1% level	4.22
	5% level	5.72
	10% level	6.77
D(VAT) Elliott-Rothenberg-Stock test statistic		5.777161
Test critical values:	1% level	4.22
	5% level	5.72
	10% level	6.77
D(GACE) Elliott-Rothenberg-Stock test statistic		6.090052
Test critical values:	1% level	4.22
	5% level	5.72
	10% level	6.77

The unit root results in table 3 suggest that all the variables attain stationarity after first difference. The results also show that all the variables possess significant intercept and trend while the software auto-selected lag 3 for all the variables. This is interesting because it would enable the study to check for cointegration.

Table 4. Relationship between agricultural value addition and infrastructure in Nigeria

Dependent Variable: D(LOG(VAO))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.055118	0.015817	3.484861	0.0015
D(LOG(INFR))	0.474113	0.113263	4.185948	0
D(LOG(VAT))	-0.084327	0.040886	-2.062497	0.0476
D(LOG(GACE))	0.089629	0.044052	2.034618	0.0484

The results shown in table 4 suggest that infrastructure and government capital expenditure on agriculture have positive significant impact on value addition of agricultural output to the tune of 47% and 9% respectively. This may not be unconnected with the increased budgetary allocation and spending on agricultural sector over the past decade. The result also suggests that value added tax has a negative significant effect on agricultural output value addition in Nigeria. These results conformed to a priori expectation and are in line with the findings by Ogunleye et al. (2018). This result is more robust than the earlier result obtained before the unit root test was conducted.

Table 5. Impact of infrastructure on agricultural value addition in Nigeria

Dependent Variable: D(LOG(VAO))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.059582	0.016149	3.689406	0.0009
D(LOG(TINF))	0.324071	0.133479	2.427883	0.0216
D(LOG(ICINF))	0.039537	0.132326	0.298784	0.7672
D(LOG(UINF))	0.155417	0.069322	2.241958	0.0233
D(LOG(VAT))	-0.077751	0.041332	-1.881129	0.07
D(LOG(GACE))	0.107565	0.042928	2.505707	0.0013

The results in table 5 suggest that after disaggregating infrastructure, two out of three infrastructure variables have significant effect on agricultural value addition. Specifically, transport infrastructure and utility (electricity and water) infrastructure have significant impact on agricultural value addition to the tune of 32% and 16% respectively. However, information and communication infrastructure have insignificant effect on agricultural value addition in Nigeria. This conforms to the finding by Olubumehin (2012). These results imply that the impact of aggregate infrastructure on agricultural value addition in Nigeria as earlier indicated was due to transport infrastructure and utility (electricity and water) infrastructure only.

Table 6. Impact of infrastructure on crop production value addition in Nigeria

Dependent Variable: D(LOG(CPV))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.066096	0.018728	3.529218	0.0014
D(LOG(TINF))	0.392385	0.154794	2.534879	0.0169
D(LOG(ICINF))	0.084556	0.153457	0.551008	0.5858
D(LOG(UINF))	0.246261	0.080392	3.063253	0.0094
D(LOG(VAT))	-0.088649	0.047932	-1.849469	0.0746
D(LOG(GACE))	0.102205	0.049783	2.05301	0.0481

The results in table 6 show that transport infrastructure and utility infrastructure as well as government agricultural capital expenditure have significant positive impact on crop production value addition. An increase in these variables by 1% for instance would increase crop production value addition by 39%, 25% and 10% respectively.

Table 7. Impact of infrastructure on livestock production value addition in Nigeria

Dependent Variable: D(LOG(LSV))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029339	0.005966	4.917885	0
D(LOG(TINF))	0.240539	0.049309	4.878197	0
D(LOG(ICINF))	0.09244	0.048883	1.891028	0.0686
D(LOG(UINF))	0.131262	0.025608	5.12582	0
D(LOG(VAT))	-0.003265	0.015269	-0.213834	0.8322
D(LOG(GACE))	0.01572	0.015858	0.991253	0.3298

The results in table 7 show that an increase in transport infrastructure and utility infrastructure by 1% would increase livestock production value addition by 24% and 13% respectively. However, information and communication infrastructure remain insignificant factors affecting livestock production value addition in Nigeria.

Table 8. Impact of infrastructure on forestry value addition in Nigeria

Dependent Variable: D(LOG(FRV))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.01597	0.013805	1.156889	0.2568
D(LOG(TINF))	0.374859	0.114099	3.285384	0.001
D(LOG(ICINF))	0.125957	0.113113	1.113546	0.2746
D(LOG(UINF))	0.035849	0.059257	0.604981	0.5499
D(LOG(VAT))	0.214349	0.035331	6.066882	0
D(LOG(GACE))	0.018325	0.036695	0.499396	0.6213

The results in table 8 suggest that transport infrastructure and value added tax have positive significant impact on forestry value addition. This is an interesting outcome. This implies that as more tax is levied on timber for instance, it would deter people from cutting down more trees thereby preserving the nation's forest. Again, since wood provides form utility when transformed into furniture, more tax on the finished work would add to agricultural output and by extension economic growth.

Table 9. Impact of infrastructure on fishing value addition in Nigeria

Dependent Variable: D(LOG(FSV)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007302	0.037315	0.195688	0.8462
D(LOG(TINF))	0.429758	0.208422	2.061961	0.0431
D(LOG(ICINF))	0.569932	0.105758	5.38902	0
D(LOG(UINF))	0.393195	0.160177	2.354753	0.005
D(LOG(VAT))	-0.039135	0.095503	-0.409782	0.685
D(LOG(GACE))	0.15217	0.099191	1.534113	0.1358

The results presented in the table above show that if transport, information and communication, and utility infrastructures increase by 1%, fishing value addition would increase by 43%, 57% and 39% respectively. This conforms to a priori expectations and gives credence to the findings by Tunde and Adeniyi (2012). Furthermore, when transport infrastructure was further disaggregated into D(LOG(RTR)) (road transport infrastructure), D(LOG(RATP)) (rail transport infrastructure) D(LOG(WTR)) (water transport infrastructure), D(LOG(ATR)) (air transport infrastructure), D(LOG(TRS)) (transport services infrastructure) and D(LOG(PCS)) (post and courier services infrastructure), the study found that all the means of transport infrastructure except post and courier service infrastructure have positive significant impact on agricultural value added in Nigeria. Also, when utility infrastructure was decomposed into D(LOG(EULINF)) (electricity utility infrastructure), and D(LOG(WUTINF)) (water utility infrastructure), the study found that both variables have positive significant impact on agricultural value added in Nigeria.

Table 10. Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.953458	217.2445	95.75366	0
At most 1 *	0.713545	112.9528	69.81889	0
At most 2 *	0.664043	70.44681	47.85613	0.0001
At most 3 *	0.480157	33.36052	29.79707	0.0186
At most 4	0.278725	11.11678	15.49471	0.2044
At most 5	0.000228	0.007769	3.841466	0.9293

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.953458	104.2918	40.07757	0
At most 1 *	0.713545	42.50595	33.87687	0.0037
At most 2 *	0.664043	37.08629	27.58434	0.0022
At most 3 *	0.480157	22.24374	21.13162	0.0348
At most 4	0.278725	11.10901	14.2646	0.1488
At most 5	0.000228	0.007769	3.841466	0.9293

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Johansen cointegration test follows the trace statistic. The results suggest four cointigrating equations by the significance of the trace statistics. Thus, the study concludes the there is a long-run relationship between infrastructure, value added tax, government agricultural capital expenditure and value addition of agricultural output.

Table 11. Error Correction Mechanism

Dependent Variable: D(LOG(VAO))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.539874	0.204416	-2.641055	0.0068

The result of the ECM suggests that there is a short-run disequilibrium in the model. This shows that the speed of adjustment is about 54%, which implies that the short-run disequilibrium would be corrected in the next period to the tune of 54%.

Table 12. Causality Test Result

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
INFR does not Granger Cause VAO	34	0.59637	0.5574
VAO does not Granger Cause INFR		15.1049	0.00003

Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
INFR does not Granger Cause VAO	32	0.17585	0.9486
VAO does not Granger Cause INFR		13.9573	0

Lags: 6

Null Hypothesis:	Obs	F-Statistic	Prob.
INFR does not Granger Cause VAO	30	0.21672	0.9662
VAO does not Granger Cause INFR		12.4199	0.00002

Lags: 8

Null Hypothesis:	Obs	F-Statistic	Prob.
INFR does not Granger Cause VAO	28	0.17743	0.9894
VAO does not Granger Cause INFR		12.0825	0.0002

The results shown in table 12 suggest that there is a unidirectional causality from value addition in agriculture to infrastructural development in Nigeria. This outcome was obtained both at lag 2, 4, 6 and 8. This implies that agricultural value addition causes growth in infrastructural development in Nigeria.

Table 13. Summary of supply and demand drivers of growth in agricultural sector

Agricultural Value Added Determinants	% share of factor	Total Factor Productivity (TFP) Determinants	% share of factor	Lag Period of TFP determinants
Machinery and Agro chemicals	0.25	Government expenditure on agricultural infrastructure	0.05	(3 years) Long run
Labour	0.45	International Price of Agricultural commodities	0.46	(3 years) Long run
Fertilizer use efficiency	0.62	Per capita income	0.49	(2 years) Long run
Land	0.23	Nominal exchange rate	0.38	(2 years) Long run
Technology (efficiency parameter)	0.91	Investment rate in agriculture	0.2118	(8 years) Long run
Rainfall	2.02	Access to credit	0.33	Short run
Irrigated land % of crop land	1.74	Human capital	1.16	(6 years) Long run
Total share of capital:		Trade policy in agriculture	-0.08	Short run
a.(excl. irrigation)	0.87			
b. (Incl. irrigation)	2.53			
Capital-Labour gap (measure of unbalance growth):		Environmental damage	-0.22	(3 years) Long run
(excl. irrigation)	0.42			
(incl. Irrigation)	1.97			
Total factor elasticity:		Agricultural output variability	0.02	(2 years) Long run
(excl. irrigation)	4.48	(measure of uncertainty)		
(incl. Irrigation)	6.34			
		Long run error correction	-0.89	
		Constant term	-0.11	

Table 13 shows the comprehensive evidence of the connection between the respective factors of production and the two major determinants set of economic performance. The breach among capital input and labour input and the sign of the measure of actions is an indication that there is excess application of labour as also shown in table 13. The relevance of irrigation in the agricultural sector is reflected in the estimation. The table also shows that irrigation is a very important determinant of agricultural productivity in Nigeria. Incidentally, it is glaring that irrigation would be the uppermost significant factor affecting agricultural productivity if the impediments are eliminated and only the significant determinants are ranked.

The average growth rate of agricultural value added and TFP are presented in figure 2. The chart suggests that the productivity of total factor was least at about one percent between 1998 and 2000, but recorded its highest value at about 25 percent between 1974 and 1976. However, the value addition in the agricultural sector was highest at 42.5 percent between 1992 and 1994 but recorded its least value of about 7.5 percent between 1998 and 2000. Furthermore, the average real growth rate of agricultural value addition was least between 1971 and 1973 at about −2 percent and peaked at about 18 percent between 2001 and 2003.

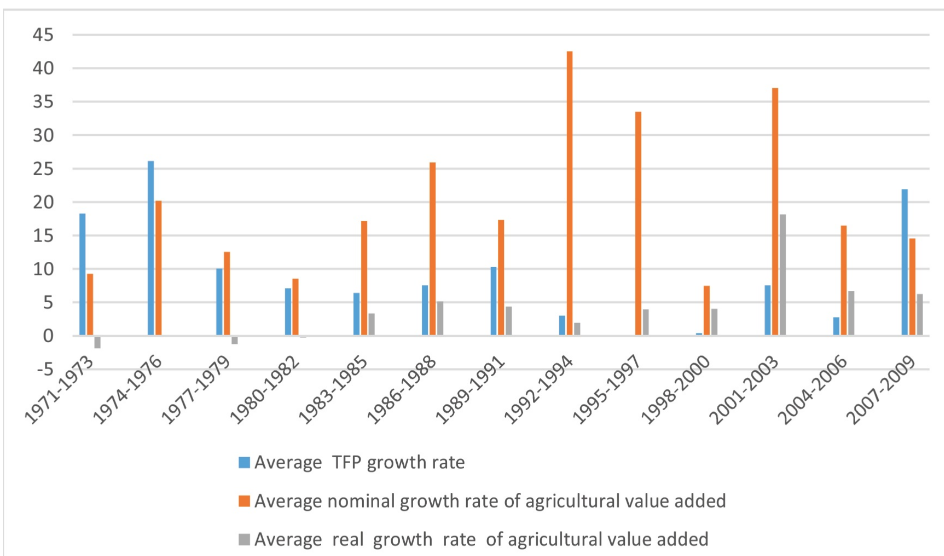

Figure 2. Average growth rate of agricultural value added and TFP.

Figure 3 presents the trend of value addition of agricultural output and infrastructure variables. The figure suggests a positive trend between value addition of agricultural output and infrastructural variables. Notably, information and communication technology is trending almost at a parallel distance with agricultural output value addition.

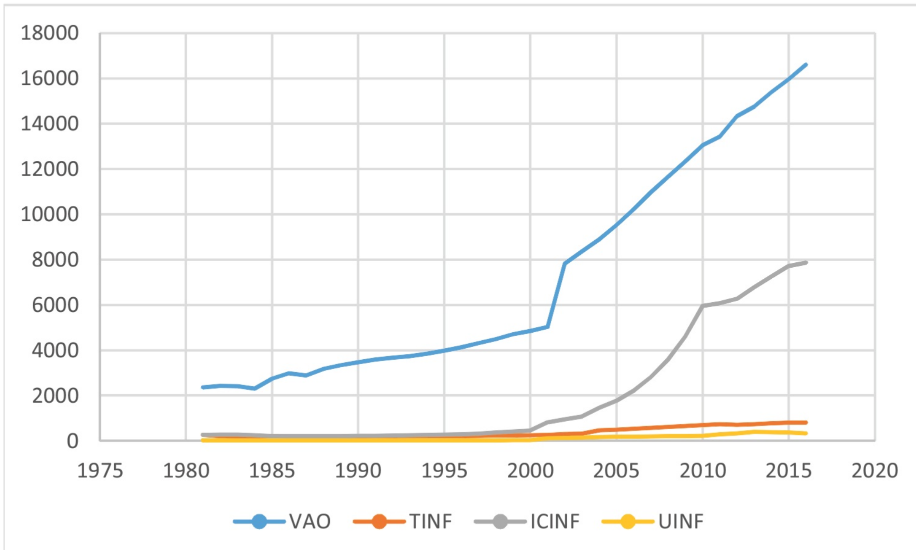

Figure 3. Trend of value addition of agricultural output and infrastructure variables.

Figure 4 shows a positive relationship between infrastructure and agricultural value added. An increase in infrastructure is followed by an increase in agricultural value addition as well.

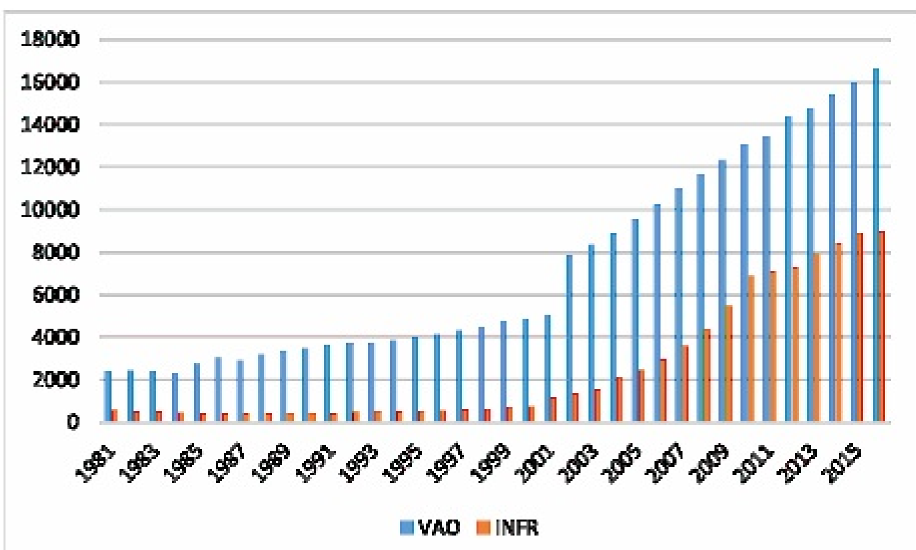

Figure 4. Infrastructure and agricultural value addition.

Figure 5 shows the average annual growth rate of agricultural value added and TFP. The average total factor productivity growth rate was 22%, while the average non-inflationary growth rate of value addition in the agricultural sector was 69%. However, the agricultural value addition real growth rate stood at 9%.

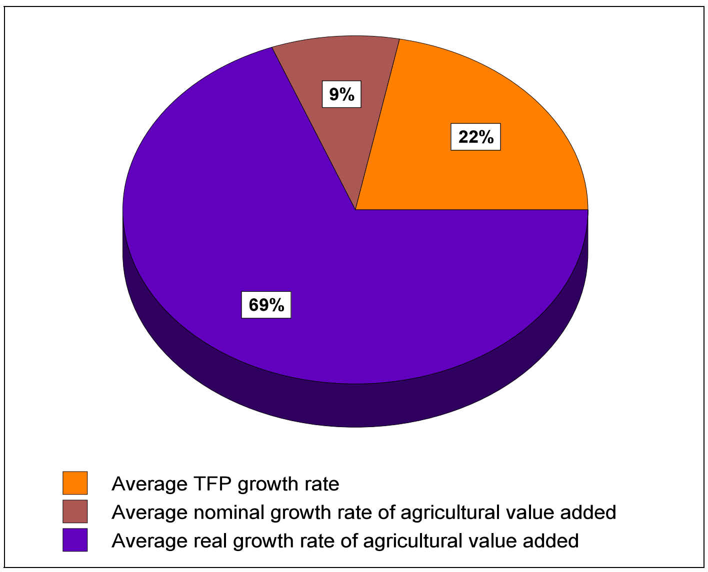

Figure 5. Average growth rate of agricultural value added and TFP

Source: Author's plot.

4. Conclusion and Policy Recommendations

The study examined the effect of infrastructure on agricultural sector output value addition with the intent to inform and influence agricultural value chain policies. The infrastructural factor was decomposed into transport infrastructure, information and communication infrastructure, and utilities infrastructure. The methodology centred on the neoclassical growth theory. The value addition of agricultural output model followed the Solow Residual (SR) but with factor weights estimated econometrically.

The results of the linearized function analysis confirmed existing evidence that the Nigerian agricultural sector is characterized by increasing return to scale, where infrastructural variables impact positively on agricultural output value addition. This finding underscores the huge potential to raise agricultural output value addition through increased use of state of the art infrastructure, rather than by mere expansion of cultivated land.

The findings of this study advocate the construction and reconstruction of hinterland roads which would connect the rural areas and the urban centres and by extension generate value addition in the agricultural sector. This would decrease the time taken to supply farm produce to buyers. Naturally, investors would come in to provide the needed transportation services as well as storage facilities to reduce wastage and ensure availability all year round.

The study concludes that road transport infrastructure has a statistically significant positive effect on agricultural output value addition in Nigeria. The trend of agricultural sector development has shown an upward movement over the years while infrastructural development has remained low.

Based on the above-mentioned results, the study recommends the following policies:

- The Nigerian government and policymakers should ensure that infrastructural development is stepped up, especially transport infrastructure, by increasing the budgetary allocation to access road construction and rehabilitation. It is also important to guarantee that corruption is reduced to the barest minimum when infrastructural construction projects are being awarded and provide adequate supervision such that the contracts awarded would not be abandoned later thereby disrupting the agricultural sector value-chain development.
- The Nigerian government and policymakers should also ensure adequate maintenance of the existing infrastructure as this will further reduce the cost of transportation of goods and services, thereby increasing the value addition of output of the agricultural sector and boosting economic growth in Nigeria.
- Government capital expenditure on agriculture should be increased substantially to boost infrastructural development in the sector which would further enhance the agricultural value chain.
- Value added tax should be administered with caution since it has been ascertained that it has a negative effect on agricultural output value addition.

References

Ajiboye, A.O. (2009). The Effects of Transportation System on Food Marketing and Security in Nigeria. Transport Management Technology, School of Entrepreneurship and Management Technology, Federal University of Technology, Minna, Nigeria, pp. 1-14.

Ajiboye A.O., and Afolayan, O. (2009) The impact of transportation on agricultural production in a developing country: A case of kola nut production in Nigeria. *International Journal of Agricultural Economics and Rural Development*, 49-57.

Central Bank of Nigeria. (2017). Statistical Bulletin Retrieved from www.cenbank.org/OUT/2018/PUBLICATIONS/STATISTICS/2019/html

Daveri, F. (2001). Information Technology and Growth in Europe. University of Parma and IGIER, Mimeo, May.

Dewan, S., and Kraemer, K.L. (2000). Information technology and productivity: Preliminary evidence from country-level data. *Management Science*, 46 (4), 548-562.

Diao, X., Nwafor, M., and Alpuerto, V. (2009). Options for agricultural growth for poverty reduction in Nigeria. Background Paper No. NSSP 002. Abuja: International Food Policy Research Institute (IFPRI).

Downes, A. S. (2001). Economic growth in a small developing country: The case of Barbados. GDN/LACEA Project on economic growth in Latin America and the Caribbean. Global Development Network.

Felloni, F., Wahl, T., Wandschneider, P., and Gilbert, J. (2001). Infrastructure and Agricultural Production: Cross-Country Evidence and Implications for China. *TWP-2001-103*: pp. 1-23.

Ighodaro, A. (2009). Transport infrastructure and economic growth in Nigeria. *Journal of Research in National Development*, 7(2), pp.1-12.

Inoni, O., and Omotor, E. (2009). Effects of road infrastructure on agricultural output and income of rural households in Delta State, Nigeria. *Agricultural Tropicalet Subtropical,* 42(2), 90-97.

Kassali, R., Ayanwale, A., Idowu, E., and William, S. (2012). Effect of rural transportation system on agricultural productivity in Oyo State, Nigeria. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 113(1): pp.13–19.

Lakshmanan, T. R. (2007). The Wider Economic Benefits of Transportation: An Overview. *Discussion Paper No. 2007-8*: pp.1-15.

Lokesha, M.N. and Mahesha, M. (2016). Impact of road infrastructure on agricultural development and rural road infrastructure development programmes in India. *International Journal of Humanities and Social Science Invention*, 5(6), pp. 1-7.

Madden, G., Savage, S., & Simpson. M. (1998). Regional information access: The use of telecentres to meet universal services obligations. *Telematics and Informatics*, 14 (3), 273-288.

Nkamleu, G. B. (2007). Productivity growth, technical progress and efficiency change in African agriculture. *Development*, (237).

Nkonya, E., Pender, J., Kato, E., Oni, O., Phillips, D., and Ehui, S. (2010). *Options for Enhancing Agricultural Productivity in Nigeria.* NSSP 11. Abuja: International Food Policy Research Institute (IFPRI).

Nwabude, E.S. (2008). Sustaining the Nigerian electricity sub-sector: Challenges and prospects. *Nigerian Journal of Energy and Environmental Economics*, 1(1), 38-51.

O'Brien, P. (1983). Transport and economic development in Europe, 1789-1914. In: O'Brien P. *Railways and Economic Growth of Western Europe*. London: Macmillan Press, pp.1-27

O'Connell, S.A., and Ndulu, B.J. (2000). Africa's growth experience: A focus on sources of growth. *AERC/Havard Conference on Africa Economic Growth,* Cambridge, MA, March 26-27.

Ogunleye, O., Ajibola, A., Enilolobo, O., and Shogunle, O. (2018), Influence of road transport infrastructure on agricultural sector development in Nigeria. *Logistics & Sustainable Transport*, 9(1).

Okezie, A., Ihugba, Nwosu C., and Njoku, A.C. (2016). Government expenditure on agriculture and agricultural output in Nigeria (1975-2010). *Journal of Economics and International Finance*, 5(5).

Olubumehin, O. O. (2012). The Nigerian motor transport since the 1920s in Nigeria. *Research in Humanities and Social Sciences*, 2(12).

Oni, O., Nkonya, E., Pender, J., Phillips, D., and Kato, E. (2009). *Trends and Drivers of Agricultural Productivity in Nigeria*, NSSP Report 1. Abuja, International Food Policy Research Institute (IFPRI).

Rodriguez F., & Wilson, E. (2000). Are Poor Countries Losing the Information Revolution?, *Information Development Working Paper*, Washington DC: World Bank.

Roller, L., & Waverman, L. (2001). Telecommunication infrastructure and economic development: A simultaneous approach. *American Economic Review*, 91(4), 909-923.

Solow, R. (1987). Growth Theory and After. Nobel Prize Lecture available at http://nobelprize.org/nobel_prizes/economics/laureates/1987/solow-lecture.html.

Sridhar, K.S., & Sridhar V. (2007). Telecommunications infrastructure and economic growth: Evidence from developing countries. *Applied Econometrics and International Development*, 7 (2), 37-61.

Tunde, A. and Adeniyi, E. (2012). Impact of road transport on agricultural development: A Nigerian example. *Ethiopian Journal of Environmental Studies and Management*, 5(3), 17.

Ulimwengu, J., Funes, J., Heady, L., and You, L. (2009). The Impact of Transport Infrastructure on Agricultural Production and Poverty Reduction in the Democratic Republic of Congo. *IFPRI Discussion Paper* 00944: pp.1-52.

Williamson, J.G. (2004). *Late Nineteenth-Century American Development: A general equilibrium history*. London: Cambridge University Press.

World Bank Database. (2012). Available at: data worldbank.org/data-catalogue/world development indicators WDI.

Zahra, K., Azim, P., & Mahmood, A. (2008). Telecommunication infrastructure development and economic growth: A panel data approach. *The Pakistan Development Review*, 47 (4), 711-726.

Zepeda, L. (2001). Agricultural investment and productivity in developing countries. *FAO Economic and Social Development Paper 148*. Food and Agriculture Organization of the United Nations.

Data and Source

VAO	CPV	LSV	FRV	FSV	TINF	RTR	RATP	WTR	ATR	TRS	PCS	ICINF	UINF	EULINF	WUTINF	GACE	VAT	INFR
2,364.37	1,854.76	341.41	77.90	90.30	264.51	222.11	9.46	5.74	18.66	4.48	4.06	263.41	18.39	6.16	12.23	6.57	4.73	346.32
2,425.96	1,897.08	361.12	73.91	93.86	211.89	168.11	10.16	4.66	21.24	4.52	3.20	281.24	17.17	6.82	10.35	6.42	3.62	310.30
2,409.08	1,842.70	393.13	75.28	97.96	178.32	132.24	9.21	7.21	22.53	4.25	2.89	278.79	22.26	6.56	15.70	4.89	3.26	479.37
2,303.51	1,759.12	399.69	76.69	68.01	170.28	127.54	9.42	4.81	22.04	3.48	2.99	253.76	19.31	6.93	12.38	4.10	2.98	443.35
2,731.06	2,180.91	428.10	78.08	43.97	203.57	163.51	6.91	4.09	22.68	3.33	3.04	202.38	15.50	7.83	7.67	5.46	4.13	421.45
2,986.84	2,427.10	421.63	86.59	51.51	180.15	144.76	6.66	3.04	19.11	3.47	3.10	202.89	13.52	5.12	8.40	8.53	4.49	396.57
2,891.67	2,330.00	433.43	87.59	40.65	180.22	146.50	4.93	2.85	19.30	3.51	3.14	204.92	14.43	5.35	9.08	6.37	6.35	399.57
3,174.57	2,581.60	444.27	88.91	59.79	180.52	148.25	3.84	3.15	18.54	3.54	3.19	206.97	15.88	5.40	10.49	8.34	7.77	403.38
3,325.95	2,710.67	453.16	67.31	94.81	180.96	151.22	2.83	2.73	17.36	3.59	3.23	210.16	17.26	5.84	11.42	15.03	14.74	408.37
3,464.72	2,828.59	462.22	72.61	101.29	184.57	154.24	2.89	2.78	17.70	3.66	3.30	214.36	19.36	6.36	13.00	24.05	26.22	418.30
3,590.84	2,955.88	454.82	74.79	105.35	189.86	160.41	2.28	2.79	17.97	3.72	2.68	217.68	19.91	6.36	13.55	28.34	18.33	427.45
3,674.79	3,044.55	458.92	76.51	94.81	199.20	170.04	1.64	2.54	17.62	3.97	3.39	229.29	21.46	7.10	14.36	39.76	26.38	449.94
3,743.67	3,132.84	461.67	78.04	71.11	205.30	178.54	1.30	2.87	14.73	4.37	3.49	245.08	22.71	7.20	15.51	54.50	30.67	473.09
3,839.68	3,226.83	466.29	80.07	66.49	205.59	181.22	0.06	2.59	13.26	4.96	3.51	255.67	23.60	7.74	15.87	70.92	41.72	484.87
3,977.38	3,336.54	485.87	81.83	73.14	208.58	183.03	0.04	2.72	13.45	5.76	3.58	271.82	23.64	7.61	16.02	121.14	135.44	504.05
4,133.55	3,463.00	499.96	82.24	88.35	213.74	186.69	0.05	2.80	13.86	6.62	3.72	291.52	23.95	7.78	16.17	212.93	114.81	529.21
4,305.68	3,611.91	512.46	82.98	98.33	220.75	192.29	0.05	2.87	14.00	7.61	3.93	320.19	24.14	7.73	16.41	269.65	166.00	565.09
4,475.24	3,752.77	526.30	83.98	112.20	229.60	199.02	0.06	2.91	14.28	9.14	4.20	363.18	23.81	7.23	16.58	309.02	139.30	616.60
4,703.64	3,949.42	541.03	85.07	128.12	238.12	204.99	0.06	2.96	14.63	10.97	4.52	414.81	24.43	7.33	17.11	498.03	224.77	677.36
4,840.97	4,067.90	553.48	86.35	133.25	246.35	211.34	0.06	3.03	15.22	11.84	4.85	455.91	25.18	7.47	17.70	239.45	314.48	727.43
5,024.54	4,222.48	570.08	88.07	143.91	257.69	220.43	0.07	3.10	15.83	13.03	5.24	814.98	107.93	89.80	18.13	438.70	903.46	1,180.60
7,817.08	6,977.88	597.50	88.69	153.02	307.00	261.51	0.07	2.85	18.84	15.18	8.55	946.49	121.84	102.35	19.49	321.38	500.99	1,375.33
8,364.83	7,493.02	622.56	90.02	159.23	310.77	264.60	0.07	2.84	20.23	15.18	7.85	1,075.80	140.96	119.88	21.09	241.69	500.82	1,527.53
8,888.57	7,956.66	663.03	95.87	173.02	465.19	415.91	0.08	3.01	21.42	16.08	8.70	1,450.39	163.65	140.27	23.38	351.30	565.70	2,079.23
9,516.99	8,524.15	707.87	101.55	183.43	495.13	442.53	0.08	3.18	22.66	17.03	9.65	1,765.77	175.23	149.39	25.83	519.50	785.10	2,436.13
10,222.47	9,162.65	756.73	107.66	195.43	529.99	473.40	0.09	3.37	24.37	18.07	10.70	2,213.22	185.00	156.35	28.65	552.39	677.54	2,928.21
10,958.47	9,826.77	809.16	114.25	208.29	567.51	506.58	0.09	3.58	26.21	19.18	11.86	2,800.41	195.48	163.70	31.78	759.32	1,264.60	3,563.40
11,645.37	10,437.99	864.19	121.22	221.97	607.81	542.20	0.10	3.80	28.20	20.36	13.16	3,575.14	204.59	169.35	35.24	960.89	1,336.00	4,387.54
12,330.33	11,046.16	920.20	128.31	235.66	650.21	579.68	0.10	4.01	30.44	21.48	14.51	4,596.65	213.15	174.32	38.83	1,152.80	1,652.65	5,460.01
13,048.89	11,683.90	979.56	135.72	249.71	694.77	619.14	0.11	4.23	32.67	22.65	15.98	5,955.06	222.26	179.47	42.79	883.87	1,907.58	6,872.10
13,429.38	12,017.19	999.40	142.46	270.32	736.24	637.00	0.12	3.81	51.89	26.96	16.45	6,083.05	294.55	250.39	44.16	918.55	2,237.88	7,113.84
14,329.71	12,919.54	972.76	146.09	291.31	711.08	601.85	0.15	3.75	54.10	33.39	17.83	6,268.51	332.94	286.97	45.97	874.83	2,628.78	7,312.53
14,750.52	13,247.80	1,030.94	154.31	317.47	738.08	616.13	0.16	3.92	59.14	39.14	19.60	6,783.07	395.58	328.76	66.81	1,108.39	2,950.56	7,916.73
15,380.39	13,793.45	1,086.85	161.34	338.75	770.69	639.30	0.17	4.26	60.87	44.69	21.39	7,257.06	382.44	300.21	82.23	783.12	3,275.03	8,410.19
15,952.22	14,274.94	1,151.32	167.26	358.70	805.46	667.81	0.18	4.62	63.12	47.11	22.62	7,708.11	367.31	272.43	94.88	818.37	3,082.41	8,880.88
16,607.34	14,894.45	1,185.12	171.64	356.13	808.60	679.31	0.18	4.69	60.05	46.58	17.79	7,858.70	335.25	231.57	103.68	634.80	2,985.13	9,002.54

Source: Central Bank of Nigeria statistics.