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# Impact of Infrastructure on Agricultural Value Chain in Nigeria

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## Abstract
*The agricultural sector was the mainstay of the Nigerian economy not until the shift of attention to the crude oil sector. It was good that the country discovered crude oil; it could have been an added advantage to further the frontier of the agricultural sector by developing the value chain potential in the country. Though the agricultural sector has suffered neglect over the years, it remains the largest employer of labour in the country and it can employ many more if the value chain potential in the sector is developed. This study, thus, examined the impact of infrastructure on the agricultural value chain in Nigeria from 1981 to 2019 using Vector Error Correction Methodology. It was found that electricity infrastructure and public spending on infrastructure did impact the agricultural value chain over the period analysed. Their coefficients of 4.71 and 0.33 respectively imply that a 1% increase in electricity infrastructure and public infrastructure spending brought about a 4.7% and 0.33% increase in the agricultural value chain respectively. On the other hand, a 1% increase in telecommunication infrastructure dropped the agricultural value chain by about 0.01 in the country over the period studied. However, the negative impact of telecommunication infrastructure was a week one. Thus, it was recommended that public infrastructure spending capable of boosting agricultural value chain be made more effective by plugging leakages. Also, partnership between the ministry of agriculture and telecommunication services providers, for development of products that will boost agricultural value chain in the country is important.*
**Keywords: Infrastructure, Agricultural Value Chain, Nigeria**
**JEL Classification: H54, Q13**

## 1. Introduction

Nigeria, like most African countries, is blessed with good conditions for agricultural practices to boom, and serve as a platform to spring development across the sectors of its economy. Season in season out, farmers turn out products as enabled by the prevailing circumstances despite the enormous constraints being faced in the agricultural sector. The sector has been a huge employer of labour in the countries even before independence, though this employment potential of the sector and its derivatives (agricultural value chains) are grossly underutilized as occasioned by poor infrastructural development in the country (Ogunleye, Ajibola, Enilolobo & Shogunle, 2018). Huge public infrastructure spending in most developed economies is considered as one of the factors responsible for initial economic growth recorded in such countries which have brought about their current development status (Cvecic & Istrazivanja, 2018). In the United State alone, $ 1,919.2 billion representing 73.6% of the GDP was spent on capital expenditure from 2010-2019; while that of Nigeria stood at 11,253.98 billion Naira representing 1.19% of the GDP (Central Bank of Nigeria annual Statistical Bulletin, n.d.). This shows that public intervention is inevitable towards improving the economic welfare of the citizenry through the provision of basic infrastructural facilities.

Nigeria's resource endowment abounds with 77.7% of its total land area being 910.8 thousand square kilometres of which 37.3% is arable land, 7.4% is under permanent crop and 9.0% is under forest (World Bank, 2016). The country agricultural activities are sub-grouped into crop, livestock, fishery and forestry which are part of the sub-group that contribute a large percentage to the agricultural value chain. Activities in crop sub-sector accounting for 90.0% of agricultural production in the country, livestock 7.0%, Fishing 2.0% and forestry 1.0% (Olorunwa, 2018).

These activities have the potential to create substantial value chains that can generate significant employment in the economy, however, infrastructural constraints have limited agricultural value chains production in the country. The agricultural value chain is composed of the full range of activities designed to transform agricultural commodities from their primary states to intermediate and final states en-route the end-users (Maestre, Poole & Henson, 2017). Also, (Adeyemo & Okoruwa, 2018) remarked that the agricultural value chain entails the assessment of a specific area of an agricultural sector where upstream agents in production and distribution processes are linked to downstream partners by technical, economic, territorial, institutional and social relationships. All the segments made up of an agricultural value chain need some basic infrastructural facilities to perform efficiently. For instance, distribution processes in the cause of the value chain need a motor-able road network to easily facilitate the movement of goods to wholesale or final consumers.

In this regard, Yirga, Rashid, Behute and Lemma (2019) identifies poor road system as one of the core factors affecting the agricultural sector which drastically reduce efficiency in agricultural value chain performance. For effective performance of the agricultural value chain, every stakeholder in the system creates value which depends to a large extent on the following: factor input net value-added rather than overall revenue, cost build-up and the distribution of burden or benefit, a collaboration between the agricultural sector and other supporting agencies, the dynamic relationship between the business and the environment, inter-relations between physical and information flow, constraints and opportunities within each segment and human capital investment (Kilelu, Klerkx, Omore, Baltenweck, Leeuwis & Githinji, 2017).

In Nigeria, the agricultural sector is noted as one of the drivers of the economy before Nigeria's independence. Oladipo, Iyoha, Fekile, Asaleye and Eluyela (2019) revealed that in the 1960s, the agricultural sector contributed lion share to the government's coffers with approximately 75% to Federal Government earnings then. Even, as of today, the sector alone is the highest employer of Nigeria's labour force and food provider of the nation. The sector alone employed up to 70% of the country's labour force with the ability to reduce poverty to the barest minimum and provide food security for the country when efficient utilized through the provision of needed facilities (Enilolobo, Mustapha & Ikechukwu, 2019).

Deficiencies in transportation, energy, and telecommunications would be a critical bottleneck for future growth in agriculture, economic output and poverty alleviation in developing countries. Indeed, severe rural infrastructure deficiencies undermine the huge potential of the agriculture sector in developing countries to contribute to growth and poverty reduction (Norton, Alwang & Masters, 2021).

Oyebola, Osabuohien and Obasaju (2020) buttressed the above claims and observed that an unstable power supply would distort the value chain for agricultural products like fruits and vegetables which cannot be preserved for a long-time period due to epileptic power supply. Also, the non-availability of essential infrastructural facilities in developing countries like Nigeria affects the channel of production. For instance, a poor road network affects the transportation of good to final consumers which affect sale and revenue generation in the agricultural sector, leading to waste, reducing production and food insecurity especially when there are no good storage facilities on the ground to preserve such farm products. In the word of Oyebola et al., (2020), the effect of the non-availability of essential infrastructural facilities is not only limited to the agricultural value chain but also affect the regulator of the agricultural sector and financial institutions.

The implications on regulators are that it reduces the income generation through tax from agro-allied firms, reduces production and cause food insecurity in the agricultural sector; while it discourages investment and borrowing from financial institutions. Given this, Evbuomwan and Okoye (2017) remark that lack of accessibility to credit by farmers for agriculture discourages large scale production in the sector which directly reduces the performance of the agricultural value chain. Meanwhile, severe rural infrastructure deficiencies undermine the huge potential of the agriculture sector in developing countries to contribute to growth. Well-improved infrastructural facilities within a rural community discourage brain drain which reduces poverty through the engagement of able body men in agricultural activities. Provision of infrastructural facilities like roads links farmers not only with their input markets but also with their product markets and; while only about 30% of rural communities in developing countries have access to all-season roads (Sewell, Desai, Mutsaa & Lottering, 2019).

Accordingly, this study raised such questions as what impact has public infrastructure spending, telecommunication infrastructure and electricity infrastructure on the agricultural value chain in Nigeria. This study looks at agricultural value chain as further economic benefits derived by processing diverse agricultural primary as well as secondary products into various other products and thus, bringing in more income to the farmer (where they self-process their farm produce) or generating downstream jobs for many in the economy (where farmer are independent of processing firms). This process necessarily requires other inputs beyond those needed on the farm. For instance, processing agricultural farm produce requires electricity, a good road network for transporting farm produce to processing factories, telecommunication for easy link-up between farmers and processing firms or markets. It is also possible for the output of a processing firm to be the input of another firm. While the number of operators in an agricultural supply chain needs to be optimized, the economic benefits in the agricultural value chain are obvious.

The economic recession of 2015 has reawakened discussion on the need to diversify the Nigerian economy and the only sector that can trigger that within a short space of time is the agricultural sector. Even at that, the agricultural value chain has been given the role of the driver. The contribution of agriculture to total export earnings has been insignificantly small. In 2019, agriculture accounted for less than 2% of total exports earnings compared to 76.5% for crude oil (National Bureau of Statistics [NBS], 2020). This is notwithstanding the drop in crude oil price in the international market. Agricultural value chain growth will necessarily translate to more contribution to Gross Domestic output given that basic infrastructure is in place. For instance, agricultural export declined by about 11% from N302.2 billion in 2018 to N269.8 billion in 2019. Nigeria's agricultural imports rose by 12.7% from N851.6 billion to N959.5 billion during the same period. Most of the constituents of the country's imports are items that can be produced in Nigeria. An example of such is sugar. The paper is organised into five sections, the preceding being background, followed by a review of some relevant literature, methodology, discussion of results and conclusion in that order.

## 2. Literature Review

### 2.1 Conceptual Clarifications

Infrastructure means those basic facilities and services which facilitates different economic activities and thereby help in the economic development of the country, Education, Health, Transport and Communication, banking and insurance, irrigation and power and science and technology are examples of infrastructure. These do not directly produce goods and services but induce production in agriculture, industry and trade by generating external economies. For example, an industry situated on or near the railway line or national highway will transport its commodities at less cost. Here railway line is an example of economic infrastructure. They generate external economies and thus induce investment. Economic infrastructure means those basic facilities and services which directly benefit the process of production and distribution in an economy. Irrigation, power, transport and communication are examples of economic infrastructure. The perception of infrastructure in this study is that it entails all practical supports that gives reinforcement to an enterprise and thus enable it to achieve its goals optimally. This is in agreement with the stance that infrastructure engenders good management through the effectiveness and efficiency of an enterprise (Farooq, Fu, Hao, Jonathan & Zhang, 2019).

Accordingly, corporate and public perception towards the importance of infrastructures can be seen through the quantum of resources they channel into it as well as advocacy in its respect. In addition, some strands of the literature have shown that research and development also constitute infrastructure as it leads to the emergence of new techniques in various aspects of the economy and also throws up policy options on matters of infrastructure (Nagatani & Fujuno, 2019)

On the other hand, the agricultural value chain involves products transformation from the primary stage to various conceivable forms, the output from one firm becoming the input for another. In addition, the agricultural value chain provides intermediate products which serve as inputs for various industries and in the process, wealth is created, jobs are also created and sustained (Culot, Orzes & Sartor, 2019). It follows that the chain must not be broken at any time else, production and hence, jobs will be lost along the line. An effective value chain approach to development seeks to address the major constraints at each level of the supply chain rather than concentrating on just one group (De Marchi, Giuliani & Rabellotti, 2018). Along the chain, value is added which give such a product a competitive advantage in terms of quality or value and attracts a higher price in the market (Gereffi, 2018). In other words, an agricultural value chain is a series of activities or processes that aims at creating and adding value to produce, analyzing the opportunity cost of the new sequence along with the product's worth (Lee, Szapiro & Mao, 2018).

## 2.2 Theoretical Review

Macroeconomic modelling and policy analysis must of necessity be situated within economic theories. Over the ages, economic thoughts have emerged and they have shaped economic analyses and policy formulation aimed at addressing economic issues in many economies. Among such economic theories are the classical, neoclassical, Keynesian, endogenous theories. The Classical posited that economic growth is a function of investments and improving production capacity. Thus, three factors were identified as crucial for economic growth: land, capital and labour. Further discussion among the classical economist brought to fore the contribution of Solow (1957) which reduced the problem of economic growth to technical progress given that the aforementioned factors' contributions to economic growth were not enough to explain causes of growth in an economy. Solow's growth model extended the Harrod-Domar model by adding labour and technology. The theory posits that advancement in technology stimulates growth to a large extent (Onyinye, Idenyi & Ifeyinwa, 2017). Accordingly, the Solow growth model rates economies progress based on their income, population sizes and level of technological advancement. Nigeria has the population and the resources to emerge as a high-income economy but technological advancement is very low (Owolabi, Nsafon & Huh, 2019).

Tavani and Zamparelli (2017 highlighted that Economic progress, measured by output and income distribution is attainable under the neoclassical theory, based on technology, consumer preferences, and endowments of productive factors and these are considered as exogenous. Aggregate demand is given no role as in the exogenous and endogenous growth models. Growth is said to be determined by supply factors alone based on Say's law. Factor substitution is possible up to their full employment, due to the presence of many modes of production. A factor is employed more intensively if its price falls due to the oversupply of such a factor.

In addition, the relative scarcity of factors influences income distribution. The mix of technology and factor endowments works out the equilibrium marginal product of each factor, and this is the wage paid by profit-maximizing firms. Decreasing marginal products leads to a fall in relative factor prices and hence factors supply. In addition, savings and consumption decisions in an economy affect the stock of factors of production, and thus, output growth and income distribution. The presence of a representative agent, who earn wages and gets interest income, being an owner of capital assets, is a feature of every economic environment. Recently, Paul Romer has shown that advances in education, research and technological level in society are key to productivity increases. Thus, infrastructure development and technological advancement are inextricably tied together. The implication of this is that economies that have succeeded in advancing technology have all it takes to develop their infrastructural capacity for greater efficiency and economic progress.

Economic progress is anchored on several pillars among which are the pursuits of private economic interests by representative agents in an economy. This consequentially generates a series of benefits to the entire economy. However, economic agents have to be incentivised to invest their resources in an economy since cost might be initially too high for them in addition to many other factors that have to be considered before venture decisions. This is where the Keynesian theory comes into play. Keynes's income-expenditure model suggests that real out in an economy can be disentangled into aggregate expenditures on consumption, investment, government, and net exports. The income-expenditure model considers the relationship between these expenditures and current real national income. Aggregate expenditures on investment, government spending and net exports are independent of current income. Keynes argues that aggregate consumption expenditures are determined primarily by current real national income. Thus purposeful government spending in an economy is capable of engendering a substantial positive effect on investments and output growth as well as on innovation processes and labour productivity growth (Deleidi & Mazzucato, 2019).

## 2.3 Empirical Review

Obot, Osuafor, Nwigwe and Ositanwosu (2021) studied the effect of agricultural policy on the catfish value chain in Akwa Ibom State, Nigeria. The study adopted the Policy Analysis Matrix (PAM) in analyzing the effect of government policies on the catfish value chain using the Nominal Protection Coefficient (NPC) on tradable outputs and input techniques. The findings from the result revealed that NPC on tradable outputs was less than unity indicating that the catfish value chain industry in the study area was undervalued by ₦0.8/kg. Therefore, implying that the catfish value chain industry was not protected by policy and was subjected to substantial output taxation. In addition, NPC on tradable inputs was less than unity which showed that government support or subsidy maybe reduce tradable inputs cost for the catfish value chain industry by ₦0.8/kg. Also, the Effective Protection Coefficients (EPCs) were equally less than unity in the study area and faced taxation of ₦0.8/kg on value-added resulting from employing domestic factors of production. This indicated that value addition processes in the catfish value chain industry were not protected through policy intervention and that they faced a net tax of 0.92%.

Infrastructure has been found to have the potential for promoting productivity and growth in an economy by lowering cost, mitigating wastages, opening up the economy, creating jobs and ameliorating the impact of poverty (Siyan & Adegoriola, 2017)

Abdulkadir, Ibrahim, Hassan and Nasir (2020) investigated the effect of the development of a web application on the agricultural product value chain in Nigeria. Finding from the study revealed that a web application coupled with other communication infrastructural facilities directly and significantly influenced the agricultural product value chain in Nigeria. The study concluded that web application has contributed significantly to the growth of the agricultural value chain in Nigeria and recommended that government should promote investment in the communication and information sector.

Richardson, Johnson and Abah (2019) conducted a study on optimizing the agricultural value chain in Nigeria and found that over the years, the potential in the agricultural value chain to boost the economy in the country, has been under-tapped and attributed this to poor infrastructural facilities in the area like storage facility, poor road and poor communication system and electricity generation and supply. The study concluded that to optimize the value chain in Nigeria's agricultural sector, a multifaceted approach is needed. Such an approach would offer the enablers of agricultural value chains development with innovation, cooperation, market power, governance and required intervention, especially for private small scale farmers.

Iyoboyi, Okereke and Musa-Pedro (2018) evaluated the link between the agricultural value chain and macroeconomic policy in Nigeria from 1981–2016. The study used Error Correction Model (ECM) technique. The ECM revealed that government expenditure and broad money supply that was used as a proxy for the macroeconomic policy had a significant and direct effect on the agricultural value chain. On energy infrastructure, the same conclusion was confirmed between the duos. The study concluded that infrastructural facilities such as energy, government expenditure on infrastructural facilities and money supply jointly influence the agricultural value chain. It was recommended that there should be an enabling macroeconomic policy framework, which emphasizes improved budgetary allocation to the agricultural sector, increases the money supply, and promotes agencies that can directly impact the level of finance to agricultural value chain related businesses in Nigeria.

A similar study by (Adeyemo & Okoruwa, 2018) examined the effect of value addition on the productivity of farmers in the cassava system in Nigeria using retrospective panel data from 482 cassava farmers over the period 2015–2017. They found that higher value addition farmers had better efficiency and non-reducing productivity in the periods studied. This suggests that some farmers have the opportunity to further process their farm produce to other forms that give move value to their farm produce, thus, making more profit. The opportunity to further transform farm produce is determined by the availability of several infrastructures.

Ogunleye et al., (2018) investigated the effects of road transport infrastructure on agricultural sector development in Nigeria. Using series over 1985 to 2014 and adopting ordinary least squares technique, the study found a positive and statistically significant relationship between road transport infrastructures and agricultural sector development in Nigeria and as well found unidirectional causality running from agricultural sector development to transport infrastructure. The study thus underscores the importance of road infrastructure for agricultural development and enhancement of the sector to contribute to economic growth in Nigeria. However, the depth of the tool of analysis used could have left out some information that is of policy relevance to the nexus between the agricultural sector productivity and the selected variables.

The empirical literature reviewed shows that investigation into the linkage between agricultural value chain and infrastructure are few and even among the few studies, the approach seems not to be consistent with the behaviour of the data used for the reviewed studies. In addition, the literature is skewed in favour of survey studies while the macro-studies in the literature focused more on the contribution of the agricultural value chain to economic growth ignoring the key determinants of the agricultural value chain itself – infrastructure. Moreover, findings in respect of the link between the agricultural value chain and some infrastructure that are key to it are mixed.

This study adopted the Keynesian theory of aggregate demand and Solow's Growth Model as the theoretical framework. The Keynesian theory of aggregate demand assumes that public spending is essential for raising the level of investments, enhancing output growth, triggering innovation processes and also promotes labour productivity increases. Inadequate and inefficient public spending is typical of developing countries and these have kept them lagging in terms of economic development: a product of low growth and investment occasioned by low capital formation and accumulation.

In this respect, Ehigiamusoe and Lean (2019) observed that Nigeria's local financial market lack sufficient funds to stimulate growth and development. Given this, it is obvious that an increase in government expenditure on infrastructural development coupled with external aids of both resources and technical know-how is needed to advance agricultural output. According to Bako and Syed (2018), Nigeria is naturally blessed with fertile land for agricultural practices and this potential is not being fully utilized to deal with issues of poverty and unemployment that have been a menace in the country. Deploying appropriate and adequate infrastructural facilities to the sector, through increased government investment, can increase its productivity and enable it to contribute more to economic growth. Keynes theory places emphasis on the importance of government spending on infrastructure. The national account of an open economy is given by:

$$Y_t = C_t + I_t + G_t + (X\text{-}M) \qquad (1)$$

Where: $Y_t$ = National output, $C_t$= consumption, $I_t$ = investment and $G_t$ = Government consumption and (X-M) is net exports.

Equation (1) implies that $Y_t$ and $G_t$ are positively related. The larger and efficient the quantum of G, the higher Y will be, and thus, the faster the pace of economic progress.

## 3. Methodology

This study employed the ex-post-facto design and its model woven around Iyoboyi et al., (2018) which focused on the effect of government policy on the agricultural value chain in Nigeria. Their model was given as:

$$Avc_t = \beta_0 + \beta_1 GE + \beta_2 M2 + \beta_3 EN + U_t \quad (2)$$

Where:

$Avc_t$= Agricultural value chain

GE = Government expenditure (Fiscal policy);

M2 = Broad money supply (monetary policy)

EN = Energy (a control variable);

$U_t$= Error term.

This study, however, turn the searchlight on the link between the agricultural value chain and infrastructure (particularly, electricity, road and telecommunication infrastructures as well as public capital spending in the agricultural sector)

$$Avc_t = \partial_0 + \partial_1 Infraexp_t + \partial_2 Electfra_t + \partial_3 Telfra_t + U_T \quad (3)$$

A-priori expectations are$\partial_0$, $\partial_1$, $\partial_2$, $\partial_3$ and > 0

Where: $Avc_t$ = Agricultural Value Chain

$Infraexp_t$ = Public Capital Spending on Infrastructure

$Electfra_t$ = Electricity Infrastructure

$Telfra_t$ =Telecommunication Infrastructure

**Table 1: Variables construct and measurement**

| Variable | Measurement |
|---|---|
| $Avc_t$ | It is measured as agriculture value-added as a share of GDP. The value-added is the net output of a sector after taking the sum of all outputs and deducting intermediate inputs |
| $Infraexp_t$ | Capital expenditure on infrastructure by the government as a share of GDP |
| $Electfra_t$ | Electricity production from oil, gas and coal sources (% of total). |
| $Telfra_t$ | Fixed telephone subscriptions (per 100 people). |

**Source: Author's Design, 2021**

Vector Error Correction (VECM) method was used for this study based on the properties of the time series employed in the study. VECM is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. The VEC has co-integration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

A VECM is a linear equation model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining variables. The VECM represents all variables as a dependent which have the dynamic power to reflect the impact of random disturbances on the variable, thereby modelling every endogenous variable as a function of the lagged values of all the endogenous variables in the system. The justification for applying the VECM in establishing the relationship among the variables is conditional on the assumption of stationarity of the variables constituting the VECM. If the time series are non-stationary, the stability condition of VAR will not be met, implying that usual statistical techniques of coefficient evaluation will not be valid. In this case, it is recommended that the co-integration and Vector Error correction modelling be utilized in examining the multivariate relationship among the set of non-stationary variables (Fisher et al. 2019)

After we tested for the order of integration and confirmed integration at the first difference for all the variables, we carried out the Johansen co-integration test and found, based on maximum Eigenvalue and trace statistics that one co-integrating equation exists, thus confirming long-run equilibrium relationship among the variable in the model. The confirmation of one co-integrating equation permitted the specification of a Vector Error Correction (VEC) model**.** Given that the variables are co-integrated**,** the VECM representation for the specified equation for this study is:

$$\Delta Avc_t = \alpha_0 + \sum_{i=1}^{k} \beta_{1i}\, \Delta Avc_{t-i} + \sum_{i=1}^{k} a_{1j} \Delta Infraexp_{t-j} + \sum_{i=1}^{k} d_{1r}\, \Delta Electfra_{t-r} + \sum_{i=1}^{k} g_{1v}\, \Delta Telfra_{t-v} + \rho_1 ECT + \mu_{1t} \quad (4)$$

$$\Delta Infraexp_t = \pi_0 + \sum_{i=1}^{k} \beta_{2i}\, \Delta Avc_{tI} + \sum_{i=1}^{k} a_{2j}\, \Delta Infraexp_{tj} + \sum_{i=1}^{k} d_{2r}\, \Delta Electfra_{t-r} + \sum_{i=1}^{k} g_{2v}\, \Delta Telfra_{t-v} + P_2 ECT + \mu_{2t} \quad (5)$$

$$\Delta Electfra_t = \Omega_0 + \sum_{i=1}^{k} \beta_{3i}\, \Delta Avc_{t-I} + \sum_{i=1}^{k} a_{3j}\, \Delta Infraexp_{t-j} + \sum_{i=1}^{k} d_{3r}\, \Delta Electfra_{t-r} + \sum_{i=1}^{k} g_{3v}\, \Delta Telfra_{t-v} + P_3 ECT \;\; \mu_{3t} \quad (6)$$

$$\Delta Telfra_t = \gamma_0 + \sum_{i=1}^{k} \beta_{4i}\, \Delta Avc_{t-I} + \sum_{i=1}^{k} a_{4j}\, \Delta Infraexp_{ti} + \sum_{i=1}^{k} d_{4r}\, \Delta Electfra_{t-r} + \sum_{i=1}^{k} g_{4v}\, \Delta Telfra_{-v} + P_4 ECT\, \mu_{4t} \quad (7)$$

## 4. Results and Discussion

**Table 2: Descriptive Statistics**

| | LOG(AVC) | LOG(ELECTFRA) | LOG(INFRAEXP) | LOG(TELFRA) |
|---|---|---|---|---|
| Mean | 3.117479 | 4.247715 | 0.977647 | -1.171710 |
| Maximum | 3.624794 | 4.411691 | 2.238976 | 0.169087 |
| Minimum | 2.465879 | 4.062770 | -0.440032 | -2.931442 |
| Std. Dev. | 0.232760 | 0.106781 | 0.625770 | 0.762817 |
| Skewness | -0.592610 | 0.165301 | -0.275660 | -0.404151 |
| Kurtosis | 4.044678 | 1.792894 | 2.463696 | 2.845940 |
| Jarque-Bera | 4.056162 | 2.545405 | 0.961310 | 1.100264 |
| Probability | 0.131588 | 0.280074 | 0.618378 | 0.576874 |
| Sum | 121.5817 | 165.6609 | 38.12822 | -45.69670 |
| Sum Sq. Dev. | 2.058730 | 0.433283 | 14.88036 | 22.11181 |
| Observations | 39 | 39 | 39 | 39 |

**Source: Computation from Eviews 10**

Table 2 displays descriptive statistics on the series used for the study. For instance, the skewness statistic shows that the data set is moderately skewed as it approximately falls between -0.5 and 0.5 Also, the Jarque-Bera statistic indicates that the data set is normally distributed, as their probabilities are greater than 0.05. The Augmented Dickey-Fuller (ADF) and Philip-Perron unit root tests were used to examine the stationarity of the series. This is displayed in table 3.

**Table 3: Results of Philip Peron and Augmented Dickey-Fuller Unit Root Test**

| Philip Peron | | | Augmented Dickey-Fuller | | |
|---|---|---|---|---|---|
| Variable | Test.Stat | 1% CV | Test.Stat | 1% CV | I(d) |
| $Avc_t$ | -7.8660 | -4.2268 | -6.8486 | -4.2349 | I(1) |
| $Infraexp_t$ | -8.9788 | -4.2268 | -8.9788 | -4.2268 | I(1) |
| $Electfra_t$ | -7.5559 | -4.2268 | -7.4825 | -4.2268 | I(1) |
| $Telfra_t$ | -2.7860 | -2.9484 | -4.3007 | -4.2268 | I(1) |

**Source: Computation from Eviews 10**

Table 3 shows the Philip Peron and Augmented Dickey-Fuller (ADF) test at first differences. The test shows that the four variables were all stationary at the first difference for Philip Peron and Augmented Dickey-Fuller tests.

**Table 4: Lag Length Selection**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -285.8693 | NA | 115.8621 | 16.10385 | 16.27980 | 16.16526 |
| 1 | -188.9074 | 166.9900 | 1.299120 | 11.60597 | 12.48570* | 11.91302* |
| 2 | -175.5406 | 20.05022 | 1.559008 | 11.75226 | 13.33577 | 12.30495 |
| 3 | -152.4261 | 29.53526* | 1.152473* | 11.35700* | 13.64431 | 12.15533 |

* indicates the lag order selected by the criteria

**Source: Analysis from Eviews 10**

AIC was used in testing for unit root. For consistency, the AIC criterion selected three lags as the optimal lag length, thus, this was considered in testing for co-integration.

**Table 5: Johansen Co-Integration Test**

| **Trace Max-Eigen Statistics** | | | | **Max-Eigen Statistics** | | |
|---|---|---|---|---|---|---|
| $H_0$ | Trace | Critical | Prob. | Max-Eigen | Critical value | Prob. |
| r = | 59.75 | 47.85 | 0.0026* | 31.71 | 27.58 | 0.0139* |
| r = | 28.04 | 29.79 | 0.0787 | 17.78 | 21.13 | 0.1381 |
| r = | 10.25 | 15.49 | 0.2619 | 8.91 | 14.26 | 0.2939 |
| r = | 1.34 | 3.84 | 0.2464 | 1.34 | 3.84 | 0.2464 |

**Trace test indicates 1 co-integrating eqn. at the 0.05 level & * denotes rejection of the**

**Source: Analysis from Eviews 10**

The results from both Traces and Max-Eigen statistics established the presence of one co-integrating equation, therefore, a long-run relationship exists among the variables. The normalisation was carried out on $Avc_t$ as the target variable and the coefficients of $Infraexp_t$, $Electfra_t$ and $Telfra_t$ are presented in equations (8) and (9). $Electfra_t$ and $Infraexp_t$ had positive statistically significant long-run impacts on $Avc_t$ at 1% and 5% respectively while $Telfra_t$ had negative but insignificant long run impact on $Avc_t$. Thus, the null hypothesis of no co-integration was rejected. The short run coefficients of the VECM were all statistically significant and had positive impacts except for the coefficient of $Electfra_t$ which had negative impact.

$$\mathrm{LogAvc}_{t-1} = -23.45 + 4.71\mathrm{LogElectfra}_{t-1} + 0.33\mathrm{LogInfraexp}_{t-1} - 0.01\mathrm{LogTelfra}_{t-1}$$

t (4.66) *** (2.14)** (-0.14) (8)

CointEq1: ($\Delta$Log(Avc))

-0.2047 $R^2$: 0.3163 Adj$R^2$squared: 0.2060

(-3.2073) F-statistic: 2.8688 Prob. F = 0.0305

$\Delta(\log Avc_t(-1))$ $\Delta(\log Infraexp_t(-1))$ $\Delta(\log Electfra_t(-1))$ $\Delta(\log Telfra_t(-1))$

0.2697 0.0874 1.1616 -0.1649 (9)

(1.785)* (1.621)* (2.772)** (-1.729)*

t-statistics in ( ), *** indicate significant at 1% ** is significant. at 5% * is significant. at 10%

The VECM estimate shows that the error-correcting term in the co-integrating equation was correctly signed (negative) and statistically significant at 1% judging from the estimated t-statistics (-3.21). This suggests that the long-run equilibrium among the variables is stable and convergent. The estimated coefficient of the error-correcting term implies that about 20.5% of disequilibrium among the variables are corrected annually. In addition, Granger causality/block homogeneity Wald tests were conducted to determine causality. The test result showed that causality runs from all the variables to the agricultural value chain as the joint p-values of Chi-square were less than 0.05.

**Table 6: VEC Granger Causality/Block Exogeneity Wald Tests**

| | | | |
|---|---|---|---|
| Included observations: 37 | | | |
| Dependent variable: D(LOG(AVC)) | | | |
| Excluded | Chi-sq | df | Prob. |
| D(LOG(ELECTFRA)) | 7.684566 | 1 | 0.0056 |
| D(LOG(INFRAEXP)) | 2.628162 | 1 | 0.1050 |
| D(LOG(TELFRA)) | 2.992552 | 1 | 0.0836 |
| All | 8.870491 | 3 | 0.0311 |

**Source: Analysis from Eviews 10**

The model stability was investigated using the inverse of AR characteristic root and all roots lied within the unit circle, thus, the null hypothesis of model instability was rejected. VEC residual serial correlation LM test was conducted and the hypothesis of non-serial correlation at lag h and lag 1 to h were accepted as p-values were greater than 0.05 VEC residual heteroskedasticity test with and without cross terms all confirmed homoscedasticity.

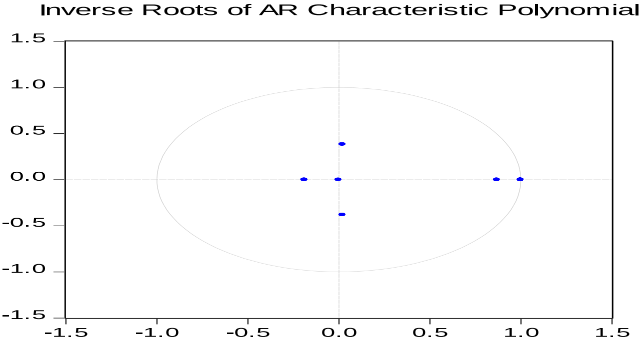


**Figure 1: Stability Test**

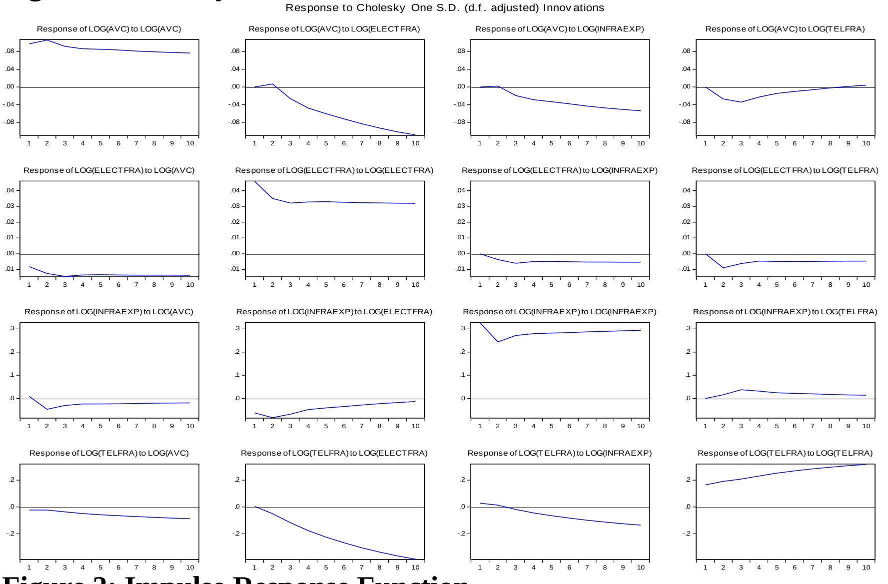


**Figure 2: Impulse Response Function**

## Table 7: Variance Decomposition

| Variance Decomposition of LOG(AVC): | | | | | |
|---|---|---|---|---|---|
| Period | S.E. | LOG(AVC) | LOG(ELECTFRA) | LOG(INFRAEXP) | LOG(TELFRA) |
| 1 | 0.097656 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.147034 | 96.40072 | 0.224853 | 0.021056 | 3.353368 |
| 3 | 0.179673 | 90.72676 | 2.269995 | 1.182982 | 5.820263 |
| 4 | 0.208325 | 84.78768 | 6.921695 | 2.772839 | 5.517788 |
| 5 | 0.235894 | 79.27706 | 11.91854 | 4.119671 | 4.684731 |
| 6 | 0.263398 | 73.67461 | 17.03576 | 5.385100 | 3.904532 |
| 7 | 0.291248 | 68.08507 | 22.09876 | 6.579063 | 3.237114 |
| 8 | 0.319422 | 62.82794 | 26.83127 | 7.644848 | 2.695949 |
| 9 | 0.347783 | 58.05633 | 31.09930 | 8.568991 | 2.275378 |

| | | | | | |
|---|---|---|---|---|---|
| 10 | 0.376200 | 53.79668 | 34.88352 | 9.363340 | 1.956460 |
| Variance Decomposition of LOG(ELECTFRA): | | | | | |
| Period | S.E. | LOG(AVC) | LOG(ELECTFRA) | LOG(INFRAEXP) | LOG(TELFRA) |
| 1 | 0.046580 | 3.068531 | 96.93147 | 0.000000 | 0.000000 |
| 2 | 0.060433 | 6.098233 | 91.34642 | 0.371538 | 2.183814 |
| 3 | 0.070483 | 8.651465 | 87.96830 | 1.003589 | 2.376642 |
| 4 | 0.079205 | 9.760446 | 86.83208 | 1.183015 | 2.224461 |
| 5 | 0.087122 | 10.40554 | 86.16206 | 1.284859 | 2.147541 |
| 6 | 0.094288 | 10.92743 | 85.57477 | 1.386199 | 2.111608 |
| 7 | 0.100868 | 11.35516 | 85.09086 | 1.477379 | 2.076604 |
| 8 | 0.106995 | 11.70180 | 84.70105 | 1.554751 | 2.042402 |
| 9 | 0.112751 | 11.99174 | 84.37350 | 1.622702 | 2.012060 |
| 10 | 0.118194 | 12.24131 | 84.08967 | 1.683972 | 1.985047 |
| Variance Decomposition of LOG(INFRAEXP): | | | | | |
| Period | S.E. | LOG(AVC) | LOG(ELECTFRA) | LOG(INFRAEXP) | LOG(TELFRA) |
| 1 | 0.331865 | 0.085203 | 3.552826 | 96.36197 | 0.000000 |
| 2 | 0.423190 | 1.259145 | 6.024529 | 92.57561 | 0.140713 |
| 3 | 0.509597 | 1.215883 | 5.909238 | 92.23974 | 0.635136 |
| 4 | 0.584615 | 1.089322 | 5.153150 | 92.98007 | 0.777458 |
| 5 | 0.651209 | 1.006023 | 4.537405 | 93.68903 | 0.767543 |
| 6 | 0.712033 | 0.944546 | 4.028988 | 94.29231 | 0.734157 |
| 7 | 0.768799 | 0.888844 | 3.588261 | 94.82790 | 0.694999 |
| 8 | 0.822283 | 0.838678 | 3.209505 | 95.29938 | 0.652433 |
| 9 | 0.873010 | 0.794272 | 2.886888 | 95.70890 | 0.609937 |
| 10 | 0.921402 | 0.754766 | 2.612048 | 96.06350 | 0.569682 |
| Variance Decomposition of LOG(TELFRA): | | | | | |
| Period | S.E. | LOG(AVC) | LOG(ELECTFRA) | LOG(INFRAEXP) | LOG(TELFRA) |
| 1 | 0.169640 | 1.827484 | 0.084208 | 2.815574 | 95.27273 |
| 2 | 0.262157 | 1.481080 | 3.721344 | 1.457013 | 93.34056 |
| 3 | 0.357173 | 1.860214 | 12.66373 | 1.044152 | 84.43190 |
| 4 | 0.465290 | 2.197997 | 21.79560 | 1.521261 | 74.48514 |
| 5 | 0.581645 | 2.380954 | 28.91389 | 2.217960 | 66.48719 |
| 6 | 0.702446 | 2.484418 | 34.29988 | 2.911876 | 60.30383 |
| 7 | 0.825708 | 2.549794 | 38.42001 | 3.540396 | 55.48980 |
| 8 | 0.949925 | 2.592060 | 41.61060 | 4.084585 | 51.71276 |
| 9 | 1.073916 | 2.619554 | 44.11953 | 4.547838 | 48.71308 |
| 10 | 1.196853 | 2.637801 | 46.12605 | 4.941334 | 46.29482 |
| Cholesky Ordering: LOG(AVC) LOG(ELECTFRA) LOG(INFRAEXP) LOG(TELFRA) | | | | | |

**Source: Analysis from Eviews 10**

Structural interpretation of the VECM through the examination of the Impulse response function shows that each of the variables responded positively only to themselves but negatively to the other variables all through the ten periods examined. An examination of the variances decomposition of the variable in the VECM following Cholesky ordering shows that over 85% of changes in electricity infrastructure is due to shock from itself while about an average of 90% of changes in public infrastructure spending is due to shock from itself. However, electricity infrastructure was seen to be responsible for about 35% of changes in the agricultural value chain in the long run but not responsible for any significant changes in the agricultural value chain in the short run. A little over 46% of changes in telecommunication infrastructure was traceable to electricity infrastructure in the long run. The effect of electricity infrastructure on telecommunication infrastructure increased steadily in the long run.

## 4.1 Findings and Implications

First, it was found that public infrastructure spending had a positive and statistically significant impact on the agricultural value chain at 5% and 10% in the long and short runs respectively in the country over the period analysed. The coefficients indicate that a 1% increase in public infrastructure spending led to a 0.32% and 0.09% increase in agricultural value added in the long and short ruins respectively. This finding meets a priori expectation and is consistent with the finding of Iyoboyi et al., (2018) which found a significant positive impact of public infrastructure spending on the agricultural value chain in the country.

Secondly, electricity infrastructure also had a positive significant impact on the agricultural value chain at 1% and 5% in the long and short runs respectively. Its long run and short run estimated coefficients are 4.71 and 1.16 respectively which implies that a 1% increase in electricity infrastructure boosted the agricultural value chain by about 5% in the long run and 1.2% in the short run in the country over the period analysed. The implication of this is that electricity generation in the country has the potential to stimulate the agricultural value chain and has done fairly well within the subsisting scale of operation in the agricultural sector. This finding is at variance with various policy analysts outcry on the state of power generation in Nigeria. It also confirms earlier research findings like those of (Iyoboyi et al., 2018; Abdulkadir, et al. 2020) which found in their studies that a positive and significant relationship existed between electricity infrastructure and the agricultural value chain in Nigeria. Electricity is very fundamental to agricultural value chain development, particularly in the food and beverage industry for the processing and preservation of agro-allied farm products.

Thirdly, telecommunication infrastructure was found to have had a negative insignificant impact on the agricultural value chain both in the short and long runs. However, the impact was only significant in the short run at 10%. The coefficient shows that a 1% increase in telecommunication infrastructure brought about a 0.01% and 0.16% decrease in the agricultural value chain in the long and short runs respectively. The implication of this finding on the agricultural value chain is that those operating in the agricultural value chain have not been able to take advantage of telecommunication to extend the market for their products and thus grow their businesses.

## 5. Conclusion and Recommendations

This study examined the impact of infrastructure on the agricultural value chain in Nigeria from 1981 to 2019. It is concluded based on the findings that public spending on infrastructure and electricity did impact the agricultural value chain over the period analysed. However, telecommunication infrastructure was found to have had week negative impact on the agricultural value chain in the economy over the period examined. Public infrastructure investment is essential for the development of the agricultural value chain in the country. Government agencies such as the national planning commission, ministry of works and power need to articulate plans and policies for effective and efficient infrastructure development that would promote the agricultural value chain in the country. Leakages in public infrastructure spending should be plugged for more effective and efficient public infrastructure investment while channelling more resources towards expanding the infrastructure stock in the country, particularly those capable of impacting agricultural value chain development.

Nigerian electricity regulatory commission should ensure greater efficiency in electricity distribution while working on ways to raise electricity generation capacity in the country. The Telecommunication sector has been contributing significantly to economic growth through other sectors of the Nigerian economy for over a decade now but its effect seems not to be felt by the agricultural value chain activities in the country. As a result, the ministry of agriculture needs to optimally harness the advantages that are from the telecommunication services to further promote the agricultural value chain in the country. The ministry of agriculture can partner with telecommunication services providers to come up with products that will boost agricultural productivity in the country, particularly the value chain aspect.

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