Transport Infrastructure, Institutional Quality and Agricultural Sector Performance in Nigeria

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https://doi.org/10.61090/aksujacog.2024.011

Abstract
This research paper investigated the interaction among transport infrastructure, institutional quality and agricultural sector performance in Nigeria using annual data from 2000 to 2022. The ADF unit root test, Auto-regressive Distributed Lag (ARDL) bounds test, and Dynamic Ordinary Least Squares (DOLS) technique were deployed in the analysis of data. The empirical findings revealed that road infrastructure quality (LNROADQ) significantly influenced agriculture sector development. However, port infrastructure quality (LNPORTQ) was shown to negatively impact agriculture sector performance. Furthermore, the result revealed that institutional quality (LNREQ) significantly contributed to agriculture sector development in Nigeria. Therefore, the government should invest heavily in road transport, giving priority to roads that are mostly used for economic purposes such as agriculture, oil transportation and other economic-driven activities. Also, institutional quality should be improved.

Keywords: transport, institutional, agriculture value added, Nigeria, Dynamic Ordinary Least.

1. Introduction

Agriculture is the foundation of the economy of a country, however, economic development theorists have identified infrastructure as critical in agricultural productivity. This implies that the productivity capacity of agriculture depends on the adequacy of infrastructure, especially those that aid agricultural productivity. In other words, the level of infrastructure in the agricultural sector is one of the major factors that could explain regional imbalances in the growth of the agricultural sector (Venkatachalam, 2003). For instance, the differences in the condition of the nation's transport infrastructure can contribute to the heterogeneity of agricultural productivity across nations. Transport infrastructure has direct and indirect impacts on agriculture, unlike capital and technology, they can influence across countries more easily. Nevertheless, the lack of quality institutions (e.g., research institutes and agencies, agriculture training and management institutes, etc.) causes low productivity of conventional inputs like labour, infrastructure and other resources in the agricultural sector (all of these reinforce weak and inefficient institutions), as efficient institutions help translate the

potential for capital accumulation and savings from increased agricultural productivity into actual increase in investment (Aderinto et al., 2021).

Several studies have examined the impact of institutions on agricultural growth in Nigeria (Ugwu & Ihechituru, 2007; Omojimite, 2012, Aderinto et al., 2021). Similarly, many studies have analyzed the transportation infrastructure effects on the agriculture sector in Nigeria (Abdulraheem et al., (2021); Ogunleye et al., (2018); Adepoju & Salman, 2013; Onakoya, et al., 2012; Tunde & Adeniyi, 2012; Ighodaro, 2011; Inoni &Omotor, 2009). However, the link between infrastructure quality, institutional quality and agriculture sector performance based on implications for economic growth has not been investigated in Nigeria. Moreover, there are mixed findings on each of the subject matter, hence, the importance of this work. Also, the foregoing gap in the literature serves as the motivation for the study. In this regard, the basic objective of this study is to consider the trio of transport infrastructure, institutional quality and agriculture sector performance (using agriculture value added), especially for Nigeria. The study attempts to extend the study period to recent times and apply robust econometric techniques in the analysis. The remainder of this paper is organized as follows. Section 2 gives a review of the literature. Section 3 presents the research methodology and data. Section 4 discusses the empirical results, while Section 5 concludes the paper.

2. Literature Review

A country that adequately develops its agricultural sector is believed to have settled one of the major challenges bedevilling it. When we talk of agriculture, food comes to mind which is one of the necessities of life. To a layman, agriculture generally refers to food production but it goes far beyond that. The healthiness and stability of a country can be best seen in the agricultural contribution to its Gross Domestic Product (GDP) (Etale et al., 2021). Myrdal (1984) explained that the battle for long-term economic growth will be won or lost in the agricultural sector. Agriculture plays a crucial role in the economy of developing countries and provides the main source of food, income and employment to their rural populations. According to FAO in 2000, it was established that the share of the agricultural population in the total populace is 67%; that agriculture accounts for 39.4% of the GDP; and that 43% of all exports consist of agricultural goods (Khanna & Solanki, 2014).

Transport is regarded as an important factor involved in agricultural development all over the world. It is the only means by which food produced at farm sites is moved to different homes as well as markets (Ajiboye & Afolayan, 2009) Transport creates a market for agricultural produce, enhances interaction among geographical and economic regions and opens up new areas to economic focus. Saloodo (2023) defines transportation as the movement of people, animals and goods from one place to the other. The movement can be done through different modes of transport such as air, land, sea, cable, pipeline and space transport. Since transportation modes vary, the means of transporting people and goods also vary. The most known means are through vehicles, trains, ships, spacecraft and pipes. Akintayo (2010) stated the assertion by economists that goods have not been produced until they have been transported to the final consumers who will satisfy their want (utility) by the consumption of such products. Therefore, moving goods from the point of production to the point of consumption is the fulfilment of production.

The transportation system has several elements or essentials without which it cannot function, the elements are way or infrastructure which is the path or network which the vehicles ply such as roads, railways, airways, canals, pipelines, etc.: vehicles which is the carrying capacity (unit) such as automobiles, trains, aeroplanes, etc; operations which deal with the planning, organizing, controlling, and directing of the entire transport system such as traffic, signal, and ramp meters, railroad switches, air traffic control etc., as well as significant transport policies, such as transport financing and management; nodes or terminals for fragmentation and consolidation of goods. Examples are airports, railway stations, bus stations, and seaports.

In recent years, researchers have explained how other factors can improve agricultural productivity. Most of these studies concluded that the main difference in productivity among various

regions results from institutional heterogeneities. North (1990) defines institutions as constraints that govern human life and interaction. As constraints, institutions are viewed as policies on what can be done and what cannot. From North's (1990) definition, it can be ascertained that there are different types of institutions, i.e., one for each aspect of human life - economic, legal, social, political, etc. The role of institutions in every area of the economy has been brought to light in most recent literature such as Bradfield et al., (2021), among others. Productivity increases are caused by technological advancements and institutions (Djoumessi, 2021; North, 1991). Institutions are government infrastructure in an economy (Lio & Liu, 2008). Therefore, the dimensions of these institutions determine the quality of the policies implemented (Bradfield et al., 2021). These dimensions include government effectiveness, control of corruption, the rule of law, voice and accountability, political stability, and regulatory quality (Kaufman et al., 2005)

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a. Review of Empirical Studies

Few authors have examined the relationship between institutions and agricultural sector performance using different measures of institutions. Rizov (2007) measured the link between institutions, reform policies and productivity growth in agriculture using evidence from 15 former communist countries. Applying a GMM-IV estimator, results indicated that economic reforms via democratic institutions positively contributed to the productivity growth of agriculture in former communist countries.

Omojimite (2012) examined the nexus between institutions, macroeconomic policy and growth of the agricultural sector in Nigeria using the fully modified ordinary least square technique. Dummy variables were used to capture institutions in this study and results indicated a positive relationship between deficit financing income, institutional reforms and credit to the agricultural sector while the interest rate was negative.

Aderinto et al., (2021) investigated the effect of institutional quality on Agricultural Sector Performance in Nigeria. Co-integration and Error Correction Mechanism (ECM) technique with annual time series data covering the period 1981 to 2018 was employed. Data was obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin and Political Risk Service Database. Results revealed that there was a negative relationship between Agricultural output and Institutional Quality proxy with Bureaucratic Quality and Corruption. The study deduced that better institutions would enhance a greater performance in the Nigerian Agricultural Sector.

Obilor (2013) evaluated the impact of commercial banks' credit on the agricultural sector under the agricultural credit guarantee scheme fund in Nigeria. The result revealed that the agriculture credit guarantee scheme fund and government fund allocation to agriculture produced a significant positive effect.

Transport is key to development. It fosters wealth, equality and well-being and is crucial to any nation, even more so for less-developed countries. Many studies evaluated the transportation infrastructure's effects on the agriculture sector. For instance, Tabasam & Ismail's (2019) study responded to standing views about the importance of infrastructure for agricultural trade in Pakistan. A gravity model was used for panel analysis of twenty countries for the period 2005 to 2015. Guided by the results, it inferred that improved port facilitation can promote the agriculture sector of Pakistan as the majority of trade activities are performed through ports because of their cost-effectiveness. Likewise, the air network affects agricultural exports positively owing to the reduced time it takes for the air cargo to reach the destination country. Improved connectivity through roads is required to speed up the process across the regions effectively.

Hine et al., (1983) conducted a study in Ghana and found that poor accessibility may adversely affect agriculture through the inability to obtain finance. Two related reasons explained the inability to obtain loans i.e. (i) the physical measurement of the field/farm (a necessary part of the finance application process) was difficult due to remoteness; and (ii) the difficulty and higher cost of making follow-up trips for the loan progress. Hine et al., (1983) also indicated that villages located further from major markets experienced lower farm-gate prices due to higher transport charges.

Iimi et al., (2019) using a large sample of data comprised of more than 190,000 households over eight years in Ethiopia, estimate the impacts of rail transport on agricultural production. It was found that deteriorated transport accessibility to the port had a significantly negative impact. The use of fertilizer particularly decreased with increased transport costs.

In the context of Nigeria, few studies have been conducted to estimate the nexus between transport infrastructure (road, rail, sea) and economic growth, and also transport infrastructure and agriculture output. For instance, Adepoju & Salman (2013) examined access to infrastructure and its effects on agricultural productivity in Surulere and Ife East Local Government Areas (LGAs) of Oyo and Osun States. The result revealed that farm size and labour were positive and significantly affected productivity at 5% and 1% levels of probability respectively. Rabirou etal., (2012) assessed the influence of intermediary mode of transportation (IMT) on food farmer's productivity. The results indicated that transportation modes used in addition to walking include bicycles, motorcycles, and cars with an increasing trend in the use of motorcycle.

Tunde & Adeniyi (2012) examined the impact of road transport on agricultural development in Ilorin East L.G.A of Kwara State. The study employed the use of both primary and secondary data. The study found out that road transport has both positive and negative impact on agricultural development.

Oladosu et al., (2018) examined the effect of rural transport infrastructure of agricultural produce on farmers' income. The result showed that the major crop grown in the area is yam and head loads were the major means of transportation. Omoke et al., (2018) researched seaports and the Nigerian economy, utilising Apapa Port as a case study. It was discovered that the vessel's gross registered tonnage considerably influenced Nigeria's GDP at the 0.05 level of significance. In contrast, cargo throughput and vessel traffic had a favourable effect on the economy but did not significantly affect Nigeria's GDP at that level.

Adeniran & Oladun's (2020) study aimed to stress the implication of transport development models on agricultural development with an emphasis on rural transport. Among the relevant models that supported the significance of transport development on agricultural transformation were the spatial interaction model, the theory of regionalization, and the transport phase theory. It was therefore concluded that the revitalization of rural transportation is vital to enhance agricultural output.

Inoni & Omotor (2009) examined the effect of road infrastructure on agricultural output. Using household agricultural production and income data from 288 rural dwellers, the study examined the effect of road infrastructural development on the agricultural output and income of rural households in Delta State, Nigeria. The results indicated that rural roads have a significant positive effect on agricultural output.

Iwuoha et al., (2022) using the Nigerian experience interrogated the impact of the implementation of Nigerian Ports Authority (NPA) regulatory frameworks on the management of 2006 port concession in the maritime industry. Based on qualitative and content analysis of data, the article argued that poor articulation and implementation of the NPA regulatory frameworks were implicated in the level of port asset management, operational efficiency, quality of port service, compliance capacity of terminal operators, and patronage system in the maritime industry. Abdulraheem et al., (2021) focused on the impact of transportation on agricultural practices and production in rural areas in Nigeria. The method of investigation used was a questionnaire designed for the farmers. From the data collected, some effects were identified, militating against the effective and productive practice of agriculture in the study area. However, some recommendations were made to assist in solving the problems.

3. Research Methodology and Data

3.1 Data

The nature of this study requires employing quantitative techniques of analysis. The study used time series data from secondary sources. The sources were World Development Indicators, the globaleconomy.com,indexmundi.com, tradingeconomics.com, countryeconomy.com and the

Statistical Bulletin of the Central Bank of Nigeria (CBN), spanning from 2000 to 2022. The variables include:

agriculture value added (% of GDP). Value added in agriculture measures the output of the agricultural sector less the value of intermediate inputs. Agriculture comprises value added from forestry, hunting, and fishing as well as the cultivation of crops and livestock production. Data are in constant 2005 U.S. dollars.

The quality of port infrastructure indicator (PORTQ),1(low) - 7(high) is one of the components of the Global Competitiveness Index published annually by the World Economic Forum (WEF). It represents an assessment of the quality of port facilities in a given country.

The quality of railroad infrastructure indicator (RAILQ), 1(low) - 7(high) is one of the components of the Global Competitiveness Index published annually by the World Economic Forum (WEF). It represents an assessment of the quality of the railroad system in a given country.

The quality of air transport infrastructure indicator (AIRQ), 1(low) - 7(high) is one of the components of the Global Competitiveness Index published annually by the World Economic Forum (WEF). It represents an assessment of the quality of airports in a given country.

The road infrastructure quality indicator (ROADQ), 1(low) - 7(high) is one of the components of the Global Competitiveness Index published annually by the World Economic Forum (WEF). It represents an assessment of the quality of roads in a given country.

Regulatory Quality (REQ): The index of regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

3.2 Theoretical Framework

Neoclassical growth theory is an economic theory that outlines how a steady economic growth rate results from a combination of three driving forces - labour, capital, and technology. The National Bureau of Economic Research names Robert Solow and Trevor Swan as having the credit for developing and introducing the model of long-run economic growth in 1956. The model first considered exogenous population increases to set the growth rate but, in 1957, Solow incorporated technology change into the model (NBER, 2008). An important assumption of the neoclassical growth model is that capital (K) is subject to diminishing returns provided the economy is closed. Provided that labour is fixed or constant, the impact on the total output of the last unit of the capital accumulated will always be less than the one before. In the short term, the rate of growth slows down as diminishing returns take effect, and the economy converts into a "steady-state" economy, where the economy is steady, or in other words, in a relatively constant state (CFI Team, 2023).

Neoclassical growth theory is based on the Cobb-Douglas production function and posits that the accumulation of capital within an economy, and how people use that capital, is important for economic growth. Further, the relationship between the capital and labour of an economy determines its output. Finally, technology is thought to augment labour productivity and increase the output capabilities of labour.

Therefore, the production function of neoclassical growth theory is used to measure the growth and equilibrium of an economy. That function is:

$$Y = AF(K, L) \qquad \ldots\ldots(1)$$

Where; Y denotes an economy's gross domestic product (GDP); K represents its share of capital; L describes the amount of unskilled labor in an economy; A represents a determinant level of technology

However, because of the relationship between labor and technology, an economy's production function is often rewritten as:

$$Y = F(K, AL) \qquad \ldots\ldots(2)$$

Increasing any one of the inputs shows the effect on GDP and, therefore, the equilibrium of an economy. However, if the three factors of neoclassical growth theory are not all equal, the returns

of both unskilled labour and capital on an economy diminish. These diminished returns imply that increases in these two inputs have exponentially decreasing returns while technology is boundless in its contribution to growth and the resulting output it can produce.

One of the major limitations of the Neo-Classical model of growth is that its approach to the theory of economic development is narrow and inadequate. The assumptions narrowed down the scope of their analysis; the neo-classicists believe that economic development is a gradual, continuous and harmonious process and hence they could not correctly analyse the possibilities of cyclical fluctuations in the process of development. Another drawback of the neo-classical analysis is its assumption of full employment which is very unrealistic. Because of this assumption, they could not analyse how an economy can be maintained at the full employment level (Suman, 2023). The neo-classical could not recognise the important role which government can play in creating conditions for economic development. In the present era intervention of government, is a must to solve various problems of developing countries like Nigeria. That is one of the reasons for establishing institutions (government infrastructure in an economy).

Criticisms of the Solow-Swan neoclassical growth model, whether directed at the aggregate production function with a single capital good or at the homogeneity of technical change, were viewed as a model with an oversimplified parable (Dimand, 2019). It was, however, the simplicity of the neoclassical growth model that kept it tractable, and made it so useful and influential as a framework for organizing thinking about economic growth in this study.

3.3 Model Specification

Based on the standard neoclassical production function which is rooted in the Cobb-Douglas production function, and with some modifications, this study examines the influence of transport infrastructure quality on agricultural sector development in Nigeria. Transport infrastructure quality was included as one of the production inputs besides other traditional production inputs determining agriculture sector development. Also, institutional quality was introduced as a control variable. This is because, for many developing countries like Nigeria, lack of quality institutions causes low productivity of conventional inputs like labour, land, infrastructure and other resources in the agricultural sector. In the context of the agricultural sector, institutions can be defined as the laws, regulations, policies, norms that are put in place to enhance the performance of the sector. As such, the following model is specified implicitly:

$$AGDEV = f\ (LAB, TRAN, INST) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where;

AGVAL = agriculture value added (% of GDP) (proxy for agriculture sector performance).

LAB = labour force

TRAN =vector of transport infrastructure quality variables such as road infrastructure quality (ROADQ), port infrastructure quality (PORTQ), air transport infrastructure quality (AIRQ), railroad infrastructure quality (RAILQ). Transport infrastructures are assets that are part of fixed capital in national account.

INST = institutional quality (proxy by regulatory quality (REQ))

Equation (3) can be specified explicitly in a non-linear form as:

$$AGDEV = LAB^{\alpha 1}.\ TRAN^{\alpha 2}.\ INST^{\alpha 3}. \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Taking the double-log of the variables in order to linearise equation (4) and to give it a more explicit functional form:

$$LNAGVAL_t = \beta_0 + \beta_1 LNLAB_t + \beta_2 LNAIRQ_t + \beta_3 LNRAILQ_t + \beta_4 LNROADQ_t + \beta_5 LNPORTQ_t + \beta_6 LNREQ_t + \acute{\varepsilon}_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where; β_0 is constant term, β_1 - $\beta 6$ are parameters to be estimated, LN is the logarithm of that variable and sub – script *t* is time trend. $\acute{\varepsilon}$ is the random error term assumed to be normally, identically and independently distributed. Apriori expectation: $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 > 0$.

3.4 Estimation Techniques

First, the data for the variables used in this study were subjected to a stationary test using the Augmented Dickey-Fuller Unit root test. Thereafter, this study deployed the ARDL bounds test approach for cointegration to test for the existence of cointegration (long-run relationship) among the variables. Furthermore, the long-run estimation approach called the Dynamic Ordinary Least Square (DOLS) technique was used to obtain fully efficient estimation in the long run.

The DOLS adopts a parametric approach in the estimation of a long-run relationship in a model in which the variables are integrated in a different order, but still cointegrated (Masih & Masih, 1996). This model deals with simultaneous bias and small sample bias by including leads and lags (Kurozumi & Hayakawa, 2009). The estimators of DOLS can be obtained from least-squares estimates, and these estimators are unbiased and asymptotically efficient even in the presence of the endogenous problem. The parameters also adjust the possible autocorrelation and residual non-normality (Herzer et al., 2006; Stock & Watson, 1993).

4. Results and Discussion

4.1 Unit Root Test

Time series data are often assumed to be non-stationary and thus, it is necessary to perform a unit root test to ensure that the data is stationary, thereby, the problem of spurious regression can be avoided. To test for the stationarity of the individual variables, the Augmented Dickey-Fuller (ADF) unit root test was performed. It is to check for the presence of a unit root in the variable i.e. whether the variable is stationary or not. The null hypothesis is that there is no unit root. The rule is that if the ADF test statistic is greater in absolute terms than the critical value at all levels of significance, we accept the null hypothesis, i.e. the variable is stationary but if the ADF test statistic is less than the critical value at all levels of significance, the variable is non-stationary; we reject the null hypothesis and go ahead to difference once. If the variable does not become stationary at the first difference we differ twice. However, it is expected that the variable becomes stationary at first difference. In this study, ADF test was conducted using the Schwarz information criterion and the automatic lag selection set at 4 lags. The test was executed using intercept, and trend and intercept. Only test regressions that are integrated of order zero, that is, I(0) or test regressions that are integrated of order one, that is, I(1) are reported. Table 1 reports the results of ADF tests. The unit root test reveals that the variables are integrated in a mixed order of I(0) and I(1). This combination of integration gives the foundation for the use of Auto-regressive Distributed Lag (ARDL) bounds test to check for evidence of a long-run relationship among the variables.

Table 1: Augmented Dickey Fuller (ADF) Unit Root Results

Variable	ADF test				Order of Integration
	Levels		1st difference		
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	
LNAGVAL	-1.912313	-2.516866	-3.573747**	---	I(1)
LNLAB	3.457457	-1.247874	-4.457404*	---	I(1)
LNPORTQ	-0.872134	-1.164925	-3.529876**	---	I(1)
LNRAILQ	-1.537543	-3.912056**	---	---	I(0)
LNROADQ	-2.040552	-2.275920	-6.124014*	---	I(1)
LNAIRQ	-3.256555**	---	---	---	I(0)
LNREQ	-2.258005	-2.349721	-5.363197*	---	I(1)

Note: ADF test was performed using Schwarz information criterion and the automatic lag selection set as 4 lags. Also, *, ** and *** imply statistical significance at 1%, 5% and 10% levels respectively.

Source: Author's computation using Eviews 10

4.2 ARDL Bound Test

The autoregressive distributed lag (ARDL) bounds testing approach to co-integration was applied. The use of this technique has numerous advantages over other techniques of estimation like Engle & Granger (1987) and Johansen (1991). One of the major advantages of this technique is that it can be applied irrespective of the order of co-integration of the independent variables (either I(1) or I(0) or both). More so, the ARDL model is statistically a significant tool of econometric analysis and has advantages over other techniques of analysis because it can accommodate a small sample size. The rule of ARDL bounds testing is that if the computed F-statistic falls below the lower bound, we would conclude that the variables are I(0), so no cointegration is possible, by definition. If the F-statistic exceeds the upper bound, we conclude that we have cointegration. Finally, if the F-statistic falls between the bounds, the test is inconclusive.

ARDL long run form and bounds test is estimated and the result is shown in Table 2. The model is specified in its original form where LNAGVAL is the dependent variable and LNLAB, LNAIRQ, LNRAILQ, LNROADQ, LNPORTQ, and LNREQ are independent variables. Due to the sample size, the study chose a maximum lag length of 1 for the dependent variable and independent variables. In addition, the specification was with Restricted Constant and No Trend, and the model selection criteria was Akaike information criterion. The result in Table 4 revealed that the null hypothesis of no long-run relationship exists is rejected since the F-statistic value 3.395775 is greater than the upper bound I(1) which has a value of 3.28 at a 5% level of significance. However, at a 1% level of significance, the F-statistic (3.395775) falls between the bounds (2.88 and 3.99), the test is inconclusive.

Table 2: F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	3.395775	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source: Author's computation using Eviews 10

4.3 Long-Run DOLS Estimates

4.3.1 Presentation of Result

Table 3 shows the estimated model using the DOLS technique and applying constant (level) trend specification as well as zero lag and lead method. The result shows that road infrastructure quality (LNROADQ) and port infrastructure quality (LNPORTQ) significantly influence agriculture sector performance.

However, port infrastructure quality (LNPORTQ) is shown to negatively impact agriculture sector performance. Thus, a one per cent increase in port infrastructure quality (LNPORTQ) will result in a 1.266400 per cent decrease in agriculture value added (a proxy for agriculture sector performance) at a 5% significance level.

On the other hand, agriculture value added increases by about 1.580061% for every 1 % increase in road infrastructure quality (LNROADQ). This variable exhibits the a priori expectations (positive relationship) in terms of its sign.

From Table 3, it is estimated that if air transport infrastructure quality (LNAIRQ) and railroad infrastructure quality (LNRAILQ) each rise by 1%, agriculture value added will correspondently rise by 0.343732% and 0.424843% in the long run, though the elasticity of air transport infrastructure quality (LNAIRQ) and railroad infrastructure quality (LNRAILQ) are not statistically significant.

The data analysis also shows that, if all other independent variables are taken at zero, a unit increase in institutional quality (LNREQ) will lead to a 0.431942 unit increase in agriculture sector development and statistically significant at a 5% significance level. Whereas, a unit increase in the labour force (LNLAB) will lead to 1.121769 units decrease in agriculture sector development. This relationship is statistically significant at a 1% significance level.

Table 3: DOLS Estimates (Long -Run)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLAB	-1.121769	0.288766	-3.884696	0.0037*
LNROADQ	1.580061	0.655773	2.409463	0.0393**
LNAIRQ	0.343732	0.193045	1.780583	0.1087
LNRAILQ	0.424843	0.255230	1.664553	0.1304
LNPORTQ	-1.266400	0.432714	-2.926643	0.0168**
LNREQ	0.431942	0.178134	2.424821	0.0383**
C	22.51240	5.051195	4.456847	0.0016*
R-squared	0.861326	Mean dependent var		3.187571
Adjusted R-squared	0.676428	S.D. dependent var		0.154925
S.E. of regression	0.088127	Sum squared resid		0.069897
Long-run variance	0.003885			

Note: *, ** and *** imply statistical significance at 1%, 5% and 10% levels respectively.
Source: Author's computation using Eviews 10

4.3.2 Discussion of Result

The result shows that road infrastructure quality (LNROADQ) showed a positive significant impact whereas seaport infrastructure quality (LNPORTQ) depicted a negative significant effect on agriculture sector performance. The result of this study aligns with Ogunleye et al., (2018) and Ighodaro (2009) whose studies concluded that a positive and statistically significant relationship exists between road transport infrastructures and agriculture sector development in Nigeria. Even though Nigeria solely relies on roads for the transportation of goods, the network of roads is not sufficient and so many roads are in deplorable state. Though the result of this study shows that port infrastructure exerts a significant negative effect on agriculture sector development, presently, the Nigerian seaports narrative has changed from serious deficiency. The ports now have wrested cargoes, hitherto, lost to neighbouring countries due to improved infrastructure, effective traffic management, and law enforcement that make the ports more efficient. Nigerian ports, before now have been described as the most expensive and inefficient in the West and Central Africa sub-region. This made the nation's seaports unattractive to importers who prefer diverting cargoes meant for Nigerian ports to neighbouring countries that have efficient port systems (Abiodun, 2024).

The result shows that air transport infrastructure quality (LNAIRQ) and railroad infrastructure quality (LNRAILQ) showed a positively insignificant impact on agriculture sector development. Despite the insignificant impact, the positive relationship implies that as air transport infrastructure quality and railroad infrastructure quality increase over time, agriculture sector development tends to rise. The insignificant relationship can be adduced to a continuous decline in government expenditures in the transport sector relative to other sectors in Nigeria over the years.

Furthermore, the result reveals that institutional quality (LNREQ) significantly contributes to agriculture sector performance in Nigeria during the period covered in this study. It is confirmed at the 5% significance level. This shows the ability of the government to formulate and implement sound policies and regulations that permit and promote agriculture sector development. The result of this study

aligns with Uduma et al., (2023) whose study showed that institution has a significant positive impact on agricultural productivity in low and middle-income African Countries.

Though labour force (LNLAB) is highly significant at a 1% significance level, it shows an inverse relationship with agriculture value added (a proxy for agriculture sector performance). However, Adeyeye (2020) reported that the number of persons in Nigeria's labour force decreased as the number of persons within the working age increased. The World Bank reported that the number of Nigerians active in the labour force plunged by 20 million between 2018 and 2020 (Tunji, 2021). According to Adeyeye (2020), perhaps the decline in the labour force suggests a shift to "undocumented" employment in the country. Undocumented here means income-generating ventures that are illegal, but gaining prominence among the working-age population in the country.

4.4 Post-Estimation Diagnosis

The diagnostic test results to ascertain the adequacy of the regression results for the models are reported here. In Table 4, the Correlograms Q-Statistics were deployed to conduct the residual test for serial correlation. The Q-statistics are significant in five lags out of the 12 lags as depicted by their probability value, indicating the presence of some serial correlation in the residuals of the model. However, the Jarque-Bera test statistic (0.146820) for normality based on regression residuals indicates that the residual of the model is normally distributed since the p-value of 0.929220 is greater than the significance level of 5%, i.e., 0.929220 > 0.05 (see Figure 1).

Table 4: Correlograms Q-Statistics

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. *| . |	. *| . |	1	-0.095	-0.095	0.2256	0.635
****| . |	****| . |	2	-0.560	-0.574	8.5100	0.014
. |* . |	. | . |	3	0.098	-0.060	8.7784	0.032
. |* . |	. *| . |	4	0.201	-0.171	9.9686	0.041
. | . |	. |* . |	5	0.017	0.087	9.9773	0.076
. *| . |	. *| . |	6	-0.191	-0.198	11.175	0.083
. | . |	. | . |	7	-0.032	-0.009	11.211	0.130
. |* . |	. *| . |	8	0.107	-0.148	11.646	0.168
. | . |	. *| . |	9	-0.055	-0.120	11.767	0.227
. *| . |	.**| . |	10	-0.149	-0.296	12.740	0.239
. | . |	. *| . |	11	0.043	-0.161	12.830	0.305
. |**. |	. | . |	12	0.248	0.020	16.076	0.188

Source: Author's computation using Eviews 10

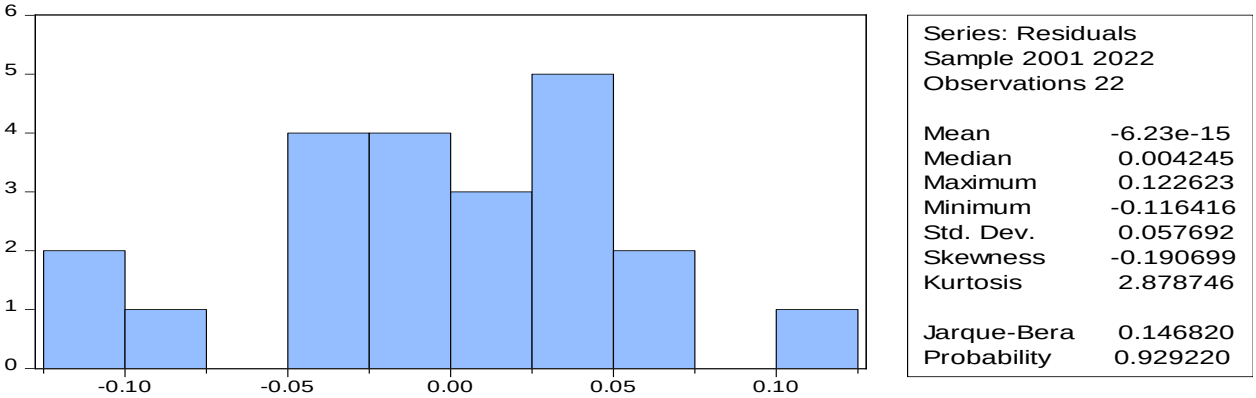

Figure1: Normality Test
Source: Extracted from Eviews 10

5. Summary, Concluding Remark and Policy Recommendation

Transportation as an important part of human activity forms the basis of all socioeconomic interactions as a lack of effective transport facilities often hinders economic development. This empirical study investigated transport infrastructure, institutional quality and agricultural sector performance in Nigeria by using annual data spanning from 2000 to 2022. The ADF unit root test reveals that the variables are integrated in a mixed order of I(0) and I(1). This combination of integration gives the foundation for the use of the Auto-regressive Distributed Lag (ARDL) bounds test to check for evidence of a long-run relationship among the variables. Thereafter, the study employed the Dynamic Ordinary Least Squares (DOLS) approach to estimate long-run elasticities. The empirical findings reveal that road infrastructure quality (LNROADQ) and port infrastructure quality (LNPORTQ) significantly influence agriculture sector development. However, port infrastructure quality (LNPORTQ) is shown to negatively impact agriculture sector performance. It was also shown that if air transport infrastructure quality (LNAIRQ) and railroad infrastructure quality (LNRAILQ) each rise by 1%, agriculture value added will correspondently rise by 0.343732% and 0.424843% in the long run, though the impact is statistically insignificant. Furthermore, the result reveals that institutional quality (LNREQ) significantly contributes to agriculture sector development in Nigeria. Lastly, the labour force (LNLAB) shows an inversely significant relationship with agriculture value added (a proxy for agriculture sector performance).

Nevertheless, the agriculture sector plays a strategic role in the process of economic development of a country. It has already made a significant contribution to the economic prosperity of advanced countries and its role in the economic development of developing countries like Nigeria is of vital importance. Since transport infrastructure is one of the major factors that could explain agriculture sector performance based on the empirical findings of this study, therefore, government should invest heavily in road transport, giving priority to roads that are mostly used for economic purposes such as agriculture, oil transportation and other economic driven activities. The government should urgently upgrade and construct other modern transport infrastructure like railroad, seaport, and airport that will facilitate transportation and drive efficiencies in the agriculture sector. Also, effectively connecting these different transportation modes will help bring down the cost of production in the agriculture sector.

Also, institutional quality should be improved by improving policies and regulatory environment for the government to certify and reward outstanding transport and logistics organisations with incentives, thus leading to growth through increased investments in human capital development, strategic partnerships as well as mergers and acquisitions in the transport industry.

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