Agriculture Sector Development in Nigeria: Empirical Investigation of Rail Infrastructure Quality Effect

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Abstract
For decades, Nigeria's agriculture intermodal mix has been out of balance, leaning heavily on road transport. Seventy per cent of agro-produce transportation is through a crumbling road system. For stakeholders, the return of rail transport services is a good omen. The purpose of this paper was to investigate the effect of rail infrastructure quality on agriculture sector development in Nigeria spanning from 2000 to 2022, using time series data. The autoregressive distributed lag (ARDL) method estimates disclosed that railroad infrastructure quality had an inverse relationship with agriculture value added in Nigeria during the period covered in this study. Nevertheless, the federal government of Nigeria should make more effort to rehabilitate old rail lines and the construction of new ones to complement other modes of transportation across the country. In that regard, effort should be made to attract potential foreign investors in the construction of rail lines. At the same time, engineers should be properly trained in diesel locomotive technology and rail track management.

Keywords: Agriculture, rail transport, Nigeria, production function, auto regressive distributed lag model

1. Introduction

Agriculture is at the centre of the Nigerian economy, providing the main source of livelihood for the majority of Nigerians. The farming sector of this West African country employs about 70 per cent of the entire country's labour force. Nigeria's small farms produce 80 per cent of the total food and 33 per cent of the country's land is under cultivation for this purpose (Borgenproject.org, 2022). This is the leading African country in farming because it has the highest levels of productivity and profitability in this particular sector. Agriculture in Nigeria is the foundation of the economy, as it keeps the people stable in what they do.

However, Nigeria's agricultural sector has been hurt by several shocks: sporadic flooding, Boko Haram (BH) insurgencies, and conflicts between herdsmen and local farmers. Food processing continues to suffer from a lack of financing and infrastructure. Nigeria relies on $10 billion of imports to meet its food and agricultural production shortfalls (mostly wheat, rice, poultry, fish, food services, and consumer-oriented foods) (I.T.A, 2021). Europe, Asia, the United States, South America, and South Africa are major sources of agricultural imports. The Government of Nigeria (GON) has initiated agricultural programs such as the Anchor Borrowers Program (ABP) to diversify its economy away from oil.

The railway sector has played a key role in the diversification of economies, facilitating gross domestic product (GDP) growth and providing a sustainable alternative method of ground transportation. Worldwide, railways play a very important role in moving grains from farms to mills, food manufacturers and international markets. The net impact is profound, triggering several effects across industries (The Nation, 2020).

In 2019, according to global research firm, Statista Research Department, global rail freight traffic amounted to above nine trillion tonnes. Rail freight in Africa, the report says, reached over 150 billion tonnes in 2019, down from over 155 billion in 2018. Indeed, Africa is one of the world's fastest-growing cargo markets. Rapid economic growth has seen volumes surging and freight traffic recording strong performance. While railroads haul various agricultural products, the primary commodities carried are corn, wheat, soybeans, barley, and sorghum, which account for over 90 per cent of yearly rail farm product tonnages, according to analysts (Essiet, 2020).

Rail development in Nigeria dates to 1898 when the British colonial government began construction on a 193-km line connecting Lagos to Ibadan, which was completed in 1901. The Nigerian Railway Corporation (NRC) traces its roots back to the Government Department of Railways, which was created by amalgamation of two state-owned rail services in 1912. The NRC was officially created by the Nigerian Railway Corporation Act in 1955. The core of Nigeria's current rail network, including the 640-km Bornu extension, running from Kano to Maiduguri, was completed in 1964, creating a two-line network, commencing in Lagos and Port Harcourt, and stretching north-east. The NRC reports that the current network comprises a 3505-km route and 4332-km track of 1067-mm lines, as well as a 19-km, 1067-mm gauge extension from Port Harcourt to the deepsea Onne Port, and 277 km of standard, 1435-mm gauge track running between Ajaokuta and Warri via Itakpe (Oxford Business Group, 2022). Rail investment, maintenance and operations have slumped since the 1960s, with cargo volumes falling from 3m tonnes in 1965 to just 15,000 in 2005 (Oxford Business Group, 2022a).

After the Nigerian economy fell into recession in 2016, the federal government unveiled a series of bold plans including the Economic Recovery and Growth Plan (ERGP), which seeks to both revive the country's non-oil economy and kick-start new growth. These plans extended to rail development, and in August 2017, the federal government announced it had begun a $41bn railway expansion plan aiming to boost economic diversification by improving shipping networks between seaports and the interior. As highlighted by ERGP, the government plans to build two new railway lines: an 1100-km line connecting its two largest cities, Lagos and the northern city of Kano, which will carry freight and passengers, as well as a coastal railway connecting Lagos to Calabar in the east (Oxford Business Group, 2022b).

However, with several initiatives and programmes to improve transport infrastructure as well as public sector reforms in Nigeria in recent times, it becomes necessary to analyse the impact of rail transport infrastructure on agricultural output in Nigeria. Some studies have been done in Nigeria in the area of transport infrastructure and agricultural output (Abdulraheem et al., 2021; Ogunleye et al., 2018; Adepoju & Salman, 2013; Onakoya, et al., 2012; Tunde & Adeniyi, 2012; Ighodaro, 2011; Inoni & Omotor, 2009), but most of the studies concentrated on road transport infrastructure since road transport is the most common network linking the villagers to the market where agricultural products are being sold. Little is known about the relationship between railroad transportation infrastructure and the agricultural sector in Nigeria. Thus, this study specifically attempts to examine the effect of rail infrastructure quality on value-added agriculture in Nigeria using recent data. Value-

added agriculture entails changing a raw agricultural product into something new through packaging, processing, cooling, drying, extracting or any other type of process that differentiates the product from the original raw commodity (Matthewson, 2007).

The remainder of the paper is organized as follows. In Section 2, the literature review is presented. Section 3 presents the empirical model and data source. In Section 4, results and discussion are carried out. Finally, section 5 is reserved for summary, conclusion and suggestions.

2. Literature Review

For centuries, agriculture has remained the backbone of the world's economic development, with nearly 60% of the population depending on agriculture and related activities for survival. In the United States alone, agricultural-related industries contribute roughly $ 1 trillion to the country's annual GDP. This, however, is just a drop in the ocean. When accounting for the industries that rely on agriculture such as hospitality (which accounts for nearly 10% of the world's GDP,) textile, fishing, and beverages among others, you will realize agriculture is central to the economy (Post, 2020). According to Lawal et al. (2018), the role of agriculture in pioneering the growth and development of the nation's economy cannot be overemphasized as it fosters sustainability in economic activities; ensures food security; provides employment to dwellers in rural areas; and reduces poverty; among others. Sekyi et al. (2017) added that agriculture continues to be the mainstay of most developing countries in Africa with the majority of the people farming at a subsistent level with very low incomes. Notably, both agricultural and economic growth can be attributed to effective transportation services.

Like many industries, the agriculture industry cannot function all on its own. The agriculture industry often needs the support of surrounding industries to speed up production and increase the reach of agricultural produce. Transportation is one of the most essential facets of successful, bountiful agriculture. The agriculture industry relies heavily on transportation services to transport agricultural goods short and long distances to keep food on tables (The Junction LLC, 2022). Therefore, rail transport can catalyze the growth of agriculture. Your dictionary (2023) defines rail transport as the transport of passengers and goods using wheeled vehicles specially designed to run along railways or railroads.

Although primitive rail systems existed by the 17th century to move materials in quarries and mines, it was not until the early 19th century that the first extensive rail transportation systems were set. Rail transportation has been the product of the industrial era, playing a major role in the economic development of Western Europe, North America, and Japan, where such systems were first massively implemented (Rodrigue & Slack, 2023). It represented a significant improvement in land transport technology and has introduced significant changes in the mobility of freight and passengers. This was not necessarily because of its capacity to carry heavy loads but because of its higher ubiquity level and speed. Rail transport systems dramatically improved travel time as well as the possibility of offering reliable and consistent schedules that could be included in the planning of economic activities such as production and distribution. The coherence of economic activities and social interactions was thus substantially improved. Rail transportation was the first mode that brought scheduling and reliability to transportation systems, as its assets and services needed to be planned and geographically allocated.

As in most countries, one of the main advantages of rail transport is the ability to efficiently move large volumes of goods. Compared to road transport, rail systems have higher capacity and can carry heavier loads over longer distances. By investing in the development and expansion of rail networks, countries can improve their logistics infrastructure, reduce transportation costs, and encourage cross-border movement of goods.

Rail transport provides economic benefits predominantly through its cost efficiency. Rail generally has lower operating costs per ton kilometre than road transport. This affordability translates into lower prices for consumers and businesses and makes products more accessible and competitive in the marketplace. By choosing rail as their primary mode of transportation, countries can improve their export capacity, attract foreign investment, and promote economic diversification (Hellmuth-Sander, 2023).

In addition to its economic benefits, rail transport also contributes to environmental sustainability. Compared to road or air transport, rail is considered a more environmentally friendly mode of transport due to its lower greenhouse gas emissions. Trains are more energy efficient and emit fewer pollutants per unit of freight than trucks or aeroplanes. By shifting freight from road to rail, countries can significantly reduce their carbon footprint and mitigate the negative impacts of climate change.

2.1 Empirical Review

There is a handful of empirical literature about the rail transport-agriculture development nexus both in developed and developing countries. For instance, in the United States of America, Atack & Margo (2011) examined the impact of access to rail transportation on agricultural improvement. Using a new GIS-based transportation database linked to county-level census data, the study estimated that at least a quarter (and possibly two-thirds or more) of the increase in cultivable land can be linked directly to the coming of the railroad to the Midwest. Farmers responded to the shrinking transportation wedge, which raised agricultural revenue productivity, by rapidly expanding the area under cultivation and these changes, in turn, drove an increase in farm and land values.

Zhou et al., (2021) used the opening of China's high-speed railway (HSR) as a quasi-natural experiment and deployed a multi-period DID model to explore the impact and mechanism of HSR on agriculture-related enterprises' exports. The results showed that HSR can promote export growth of agriculture-related enterprises by 6.9%, and it will reach 10% in 5 years. Furthermore, Herranz-L (2011) examined the role of railways in the export-led growth of the Uruguayan rural economy between 1870 and 1913 using OLS estimation. The results showed that Uruguayan railways did produce some positive effects.

Iimi et al., (2019) using a large sample of data comprising more than 190,000 households over eight years in Ethiopia, estimated the impact of rail transport on agricultural production. With the fixed effects and instrumental variable techniques combined, an agricultural production function is estimated. 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 Nigeria, Tunde & Adeniyi (2012) examined the impact of road transport on agricultural development in Ilorin East L.G.A of Kwara State. Descriptive and analytical statistical methods were both employed to analyze the data gathered. The study found that road transport had both positive and negative impacts on agricultural development.

Ogunleye et al., (2018) investigated the effects of road transport infrastructure on agricultural sector development in Nigeria from 1985 to 2014. The study concluded that a positive and statistically significant relationship exists between road transport infrastructures (LRT). Also, evidence was found of a unidirectional causality from agricultural sector development to transport infrastructure.

Inoni & Omotor (2009) examined the effect of road infrastructure on agricultural output in Delta State, Nigeria. The results indicated that rural roads have a significant positive effect on agricultural output. Abdulraheem et al., (2021) focused on the impact of transportation on agricultural practices and production in rural areas in Nigeria. From the data collected, some effects were identified as militating against the effective and productive practice of agriculture in the study area.

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 total factor productivity model used revealed that farm size and labour were positive and significantly affected productivity at 5% and 1% levels of probability respectively.

Although many studies have analyzed the transportation infrastructure effects on agriculture output in Nigeria as shown in the literature, little is known about the relationship between rail transportation infrastructure and the agricultural sector.

3. Empirical Model and Data

3.1 Theoretical Framework

The production function expresses a functional relationship between quantities of inputs and outputs. It shows how and to what extent, output changes with variations in inputs during a specified period of time. Algebraically it can be expressed as

$Y=F(X_1, X_2 /X_3 \ldots\ldots X_n)$ ……(1)

Where,

Y = Farm Output e.g. maize, cassava, yam, fish, goats, etc.

X_1 and X_2 - variable inputs e.g. fertilizer, farmland

X_3-------X_n = fixed inputs e.g. labour, capital, etc.

In this model, two variable inputs are combined to produce a given level of farm output.

3.2 Specification of the Model

To examine the relationship between railroad transport infrastructure quality and agricultural value added (Value-added) is changes made to primary agriculture products (crops and livestock) that increase the product's value) in Nigeria, equation (1) is specified as follows:

$LNAGVAL_t = \mathfrak{A}_0 + \mathfrak{A}_1 LNRAILQ_t + \mathfrak{A}_2 LNPS_t + \mathfrak{A}_3 LNREXR_t + \mathfrak{A}_4 LNINFR_t + \mathfrak{A}_5 LNTECH_t + \mathfrak{A}_6 LNMKT_t + \mathfrak{A}_7 LNIHC_t + \Psi_t$ …….. (2)

where AGVAL is agriculture value added (% of GDP). Value added in agriculture measures the output of the agricultural sector less the value of intermediate inputs. Also, the quality of railroad infrastructure quality (RAILQ), 1(low) - 7(high) is one of the components of the Global Competitiveness Index. It represents an assessment of the quality of the railroad system in a given country. Apart from the rail transport infrastructure quality (RAILQ), other variables were included to control for economic factors and various governmental and industrial policies which could affect agricultural value added: political stability(PS) (Index of Political Stability and Absence of Violence/Terrorism measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism); real exchange rate(REXR); inflation rate (INFR); TECH is technology (it is measured in foreign direct investment (FDI)); MKT is market size (it is measured in GDP per capita (GDPC). This shows the purchasing power; the Index of Human Capital per person (IHC) was included because human capital, or an individual's collective skill set and knowledge to create economic value, plays a fundamental role in economic growth and is a keystone to development. The index of human capital per person was based on years of schooling and returns to education: $\mathfrak{A}$ is the error term.

Each variable in equation (2) is expressed in logarithmic terms (LN); therefore, the estimated coefficients are the relevant elasticities of agriculture value added concerning corresponding variables. The hypothesized signs of the elasticities are $\mathfrak{A}1$- $\mathfrak{A}6 > 0$.

3.3 Data and Estimation Procedure

This study used secondary data spanning from 2000 to 2022 obtained from World Development Indicators, theglobaleconomy.com, indexmundi.com, tradingeconomics.com, countryeconomy.com, worlddata.info, fred.stlouisfed.org, and Statistical Bulletin and Annual Report and Statement of Accounts published by the Central Bank of Nigeria (CBN). The first step in the estimation involves testing the order of integration of the individual series under consideration to ascertain whether they are stationary. Variables that are not stationary can be differenced to make them stationary (Brooks, 2008). Thus, the Augmented Dickey-Fuller unit root tests were carried out. Furthermore, this study employed the ARDL bounds test approach for cointegration to test for the existence of cointegration among the variables.

To examine the long-run relationships or the short-run relationships between the independent and dependent variables, the ARDL (auto-regressive distributed lag) model was applied. The basic form of an ARDL regression model is:

$$y_t = \beta_0 + \beta_1 y_{t-1} + ...+ \beta_k y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + \alpha_q x_{t-q} + \varepsilon_t ,$$

where ε_t is a random "disturbance" term, which is assume to be "well-behaved" in the usual sense.

4. Results and Discussion

4.1 Unit Root Test

Time series data were used in this study. Generally, time series data show trending behaviour (scholastic trend), in other words, there may be a problem of non-stationarity. Therefore, it is necessary to remove such trending behaviour to obtain valid results. Also, it is a pre-condition to test time series properties to identify whether the variable is stationary at levels, first difference or second difference. These results of the unit root test will help to select the appropriate econometric method for the data analysis. This study used Augmented Dicky- Fuller unit root test out of the numbers of unit root tests in econometric literature.

The results of the ADF unit root test in Table 1 show that the logarithms of some variables are non-stationary in their level while some variables became stationary after taking their first difference. In order words, the variables are integrated in a mixed order of I(0) and I(1). The combination of variables which are stationary at the level and first difference gives the reason for the application of the Auto-regressive Distributed Lag (ARDL) bounds test for cointegration can be applied.

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)
LNRAILQ	-1.537543	-3.912056**	---	---	I(0)
LNREXR	-1.876691	-2.819644	-5.521139*	---	I(1)
LNINFR	-3.466959**	---	---	---	I(0)
LNPS	-2.245170	-1.210952	-5.230434*	---	I(1)
LNFDI	-3.121809**	---	---	---	I(0)
LGDPC	-2.906720***	---	---	---	I(0)
LNIHC	-2.307898	-1.023337	-3.504476**	---	I(0)

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 Bounds Test (Cointegration Test)

In carrying out the ARDL bounds testing, the model is specified in its original form where LNAGVAL is the dependent variable and LNRAILQ, LNPS, LNREXR, LNINFR, LNFDI, LNGDPC and LNIHC 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 Unrestricted Constant and No Trend, and the model selection criteria was the Akaike information criterion. 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.

The bounds test for cointegration in Table 2 indicates that the computed F-statistic of 6.183965 is greater than the lower and upper bounds critical values of 2.96 and 4.26, respectively, at the 1 per cent significance level. Therefore, the null hypothesis of no cointegration is discarded, meaning that there is evidence of a long-run relationship among LNAGVAL, LNRAILQ, LNPS, LNREXR, LOGINFR, LNFDI, LNGDPC and LNIHC. The next stage of the procedure would be to estimate the coefficients of the long-run relations and short-run (as well as the associated error correction model (ECM)) using the ARDL approach.

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

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.183965	10%	2.03	3.13
K	7	5%	2.32	3.5
		2.5%	2.6	3.84
		1%	2.96	4.26

Source: Author's computation using Eviews 10

4.3. ARDL Estimates

4.3.1 Presentation of Result

Table 3 delineated both long-run and short-run coefficients for the model specification. From Table 3, the coefficient of the parameter of error correction mechanism (ECM) (-0.718408) has the hypothesized negative sign and is statistically significant at 1% level. This showed that about 71.84 per cent of disequilibria in the agriculture value added in the previous year were corrected for in the current year. It, therefore, follows that the ECM could rightly correct any deviations from short run to long-run equilibrium relationship of the dependent and the explanatory variables.

In the long run, as shown in Table 3, all the variables are significant in influencing agriculture value added in Nigeria. However, railroad infrastructure quality (LNRAILQ), political stability (LNPS), inflation (LNINFR), and market size (proxy by GDP per capita (LNGDPC) had a negative impact on agriculture value-added, while exchange rate (LNREXR), foreign direct investment (LNFDI) (a proxy for

technology (TECH)), and the index of human capital per person (LNIHC) had a positive impact on agriculture value added.

Specifically, the coefficient of railroad infrastructure quality (LNRAILQ) in the long run is negatively signed (not in line with apriori expectation) and statistically significant at a 10 per cent significance level. This means that a percentage increase in railroad infrastructure quality will reduce agriculture value added by 1.017078%.

The analysis equally showed that the coefficient of political stability (LNPS) is inversely related to agriculture value added in the long run. Thus, a percentage increase in political stability will decrease agriculture value added by 2.538704%. This result is statistically significant at a 10% significance level. The same negative sign is maintained in the short run but the statistical significance is at 1% significance and the coefficient of the current value of political stability is -1.255178.

Similarly, a 1% increase in the inflation rate (LNINFR) decreases agriculture value added by approximately 0.641707% at a 10% significance level in the long run but in the short run agriculture value added decreases by 0.234163% for every 1% increase in the current value of inflation rate. In the same vein, for every 1% increase in market size (proxy by GDP per capita (LNGDPC)), agriculture value added declines by 4.374691% in the long run. This same negative effect is observed in the short run but the magnitude of the coefficient of the current value of market size is small (-0.910437) and statistically significant at the 1% significance level.

Nonetheless, a 1% increase in the exchange rate (LNREXR) will boost agriculture value added by about 4.476596%. This outcome shows statistical significance at the 5% significance level. The same positive effect is experienced in the short run. Also, at a 5% significance level, every 1% increase in technology (proxy by foreign direct investment (LNFDI) spurs agriculture value added by 1.216797% in the long run but in the short run by 0.527005% at a 1% significance level. Similarly, agriculture value added is substantially improved (by 17.22446%) for every 1% increase in the index of human capital per person (LNIHC) in the long run but in the short run, it dropped slightly to 14.56502% for every 1% rise in the index of human capital per person (LNIHC).

Table 3: ARDL Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long Run Esitmates				
LNRAILQ	-1.017078	0.497754	-2.043335	0.0803***
LNPS	-2.538704	1.092838	-2.323038	0.0532***
LNREXR	4.476596	1.790822	2.499744	0.0410**
LNINFR	-0.641707	0.287331	-2.233338	0.0607***
LNFDI	1.216797	0.378119	3.218023	0.0147**
LNGDPC	-4.374691	1.402228	-3.119814	0.0168**
LNIHC	17.22446	5.830429	2.954236	0.0213**
Short Run Estimates				
D(LNPS)	-1.255178	0.203763	-6.159986	0.0005*
D(LNREXR)	0.654751	0.099702	6.567050	0.0003*
D(LNINFR)	-0.234163	0.037150	-6.303232	0.0004*
D(LNFDI)	0.527005	0.052868	9.968299	0.0000*
D(LNGDPC)	-0.910437	0.121658	-7.483565	0.0001*
D(LNIHC)	14.56502	1.683432	8.651980	0.0001*
ECM(-1)	-0.718408	0.072223	-9.947031	0.0000*

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 results show that in the long run railroad infrastructure quality has a negative impact on agriculture. This is not surprising because p*oor transport* infrastructure has long been a big hindrance to economic development in Nigeria. As Oluwagbemi (2016) observed, after a prolonged neglect of the nation's railway, recent efforts by the government to revive and modernise the transport mode have not yielded the desired results. Many resources have been committed to increasing food production in Nigeria in recent years; however, the challenge of post-harvest losses remains a nagging reality. This could have been properly addressed by using rail transport to address the enormous wastages that occur while moving commodities from rural areas to urban centres (Ojewale, 2021). The Agriculture Promotion Policy of the Federal Ministry of Agriculture highlighted that current post-harvest loss rates are as high as 60% for perishable crops. In Tomatoes for instance, out of an annual demand of 2.2 million metric tonnes, the country's actual production is 1.5 million tons but 0.7M tons (almost half) is lost post-harvest (Ojewale, 2016). There was a short-lived ray of hope in 2017, when a tomato shipment from Kano, arrived in Lagos by train for the first time in 58 years. For those in the value chain, however, more still needs to be done to address postharvest losses by using trains, particularly refrigerated carriages to freight more commodities across the country. However, as noted by Huso (2016), the American Association of Railroads in a publication on "The Environmental Benefits of Moving Freight by Rail" noted that railroads are the most environmentally sound way to move freight over land. On average, trains are four times more fuel-efficient than trucks. They also reduce highway gridlock, lower greenhouse gas emissions, and reduce pollution.

Similarly, political stability (LNPS) was shown to inversely relate to agriculture value added in the long run. This result agrees with Messer et al.'s (1998) estimate that during periods of conflict, agricultural production drops. Political instability is a common occurrence in Nigeria which always affects the unity and peaceful co-existence of the country as a nation. The increasing farmers-herdsmen conflict in the country disrupts the supply and distribution of inputs and outputs, creates price shocks and causes massive displacement of labour. These compounding challenges make agricultural investments difficult to maintain in politically volatile environments.

Though inflation rate is not new in Nigerian economic history, the recent rates of inflation have been a cause of great concern to many. The result from this study shows that the inflation rate (LNINFR) has a negative effect on agriculture value added. This implies that inflation has a generally negative effect on the agricultural sector compared to any other sector since it is highly competitive, most of the outputs are perishable and that is the least sector able to pass input cost increases directly into higher output prices (Obasi, 2007). This results in a decline in agriculture sector performance. More so, market size (proxy by GDP per capita (LNGDPC)) revealed a negative effect on agriculture value added. This result is contrary to Ubi & Udah, 2019 whose results indicated that market size can drive agricultural sector performance in Nigeria.

However, an exchange rate (LNREXR) was found to be positively associated with agriculture sector development. Exchange rate changes impact Nigerian agriculture export prices, the price of imported inputs, and the competitiveness of the Nigerian agriculture sector. This result aligns with Ogunjobi et al., 2021; Awolaja & Okedina, 2020 that real exchange rate appreciation has a significant positive effect on the agricultural sector. This implies that as the exchange rate experiences upward fluctuation due to the depreciation of the local currency, it causes the imports to become dearer while the exports of local commodities become cheaper in the international markets. This forces down Nigeria's agricultural commodity prices due to the excess demand created by the devaluation. Invariably a decrease or depreciation of the local currency will make producers more competitive and generally would increase exports and improve agriculture sector development. Additionally, technology (proxy by foreign direct investment (LNFDI)) spurred agriculture value added as shown in this study. This result conforms to Akinwale et al., (2020) and Ogbanje & Salam's (2022) studies which showed that foreign direct investment had a significant effect on the agricultural sector in Nigeria. In a similar manner, agriculture value added is substantially improved by index of human capital per person (LNIHC). The outcome of this study supports Aderounmu & Osabohien (2018) and Osinowo et al., (2021) findings which revealed that human capital positively and significantly influences agricultural sector development in Nigeria.

4.4 Diagnostic Analysis

This study went further to conduct various diagnostic tests to ascertain the validity, appropriateness and stability of the estimated model as well as the robustness of the results. Initially, two residual tests were deployed: Correlograms Q-Statistics and the Breusch-Godfrey LM tests. From the Correlogram in Table 5, the Q-statistics are significant at all lags, indicating significant serial correlation in the residuals of the model. That is, there is the presence of serial correlation. This was confirmed by the Breusch–

Godfrey test Obs*R-squared (16.17408) with Prob. Chi-Square (2) of 0.0003 which is significant, thus the hypothesis of no serial correlation is rejected (see Table 6).
Table 7 shows that the null hypothesis that no heteroskedasticity exists cannot be rejected. This is because of the high and insignificant probability value of 0.775037 for the computed F-statistic (0.6766), and also the Obs*R-squared (13.37280) with Prob. Chi-Square (14) of 0.4974 which is insignificant. The Jarque-Bera normality test statistics (0.881991) in Figure 1 indicates that the residual of the model is normally distributed since the p-value of 0.643396 is greater than the significance level of 5%, i.e., 0.643396 > 0.05.

Finally, the cumulative sum of recursive residuals (CUSUM) and CUSUM of square tests were also applied to assess parameter stability. Figures 2 and 3 plot the results for CUSUM and CUSUMSQ of squares tests. The CUSUM Test graph is fitted inside the 5% significance strip, defined by the upper and lower lines which is an indication of stability. However, the CUSUM of the square tests graph appeared at some point to be outside the upper and lower lines even though in the later part remained stable inside the 5% significance strip.

Table5: Correlogram

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
****| . |	****| . |	1	-0.520	-0.520	6.8046	0.009
. |* . |	.**| . |	2	0.102	-0.231	7.0813	0.029
. *| . |	.**| . |	3	-0.105	-0.230	7.3859	0.061
.**| . |	*****| . |	4	-0.254	-0.624	9.2802	0.054
. |*** |	.**| . |	5	0.417	-0.291	14.691	0.012
.**| . |	***| . |	6	-0.207	-0.376	16.105	0.013
. |* . |	.**| . |	7	0.212	-0.292	17.693	0.013
. *| . |	. *| . |	8	-0.099	-0.186	18.060	0.021
. *| . |	. *| . |	9	-0.148	-0.132	18.949	0.026
. |* . |	. | . |	10	0.148	0.039	19.912	0.030
. *| . |	. | . |	11	-0.190	-0.001	21.654	0.027
. |**. |	. | . |	12	0.226	0.042	24.358	0.018

Source: Author's computation using Eviews 10

Table 6: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	6.940575	Prob. F(2,5)	0.0361
Obs*R-squared	16.17408	Prob. Chi-Square(2)	0.0003

Source: Author's computation using Eviews 10

Table 7: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.775037	Prob. F(14,7)	0.6766
Obs*R-squared	13.37280	Prob. Chi-Square(14)	0.4974
Scaled explained SS	1.244387	Prob. Chi-Square(14)	1.0000

Source: Author's computation using Eviews 10

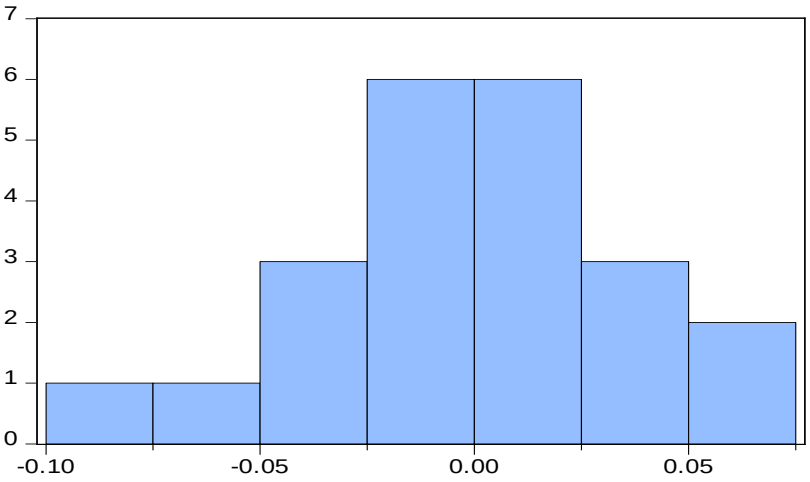

Figure 1: Normality Test
Source: Extracted from Eviews 10

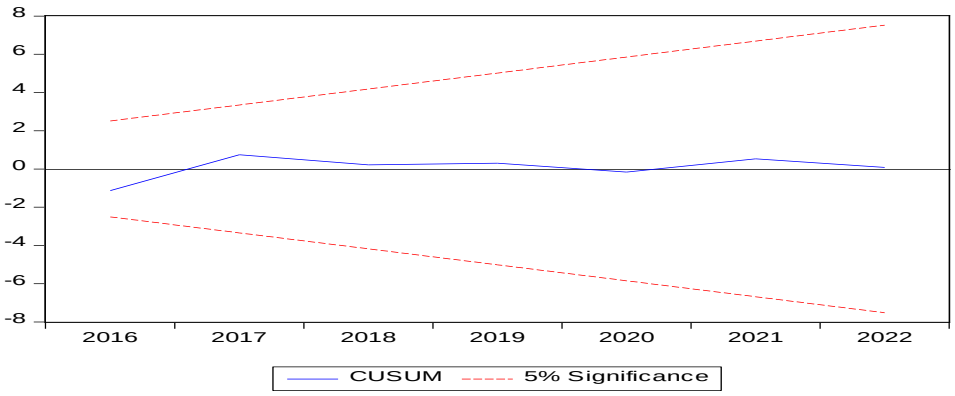

Figure 2: CUSUM Test
Source: Extracted from Eviews 10

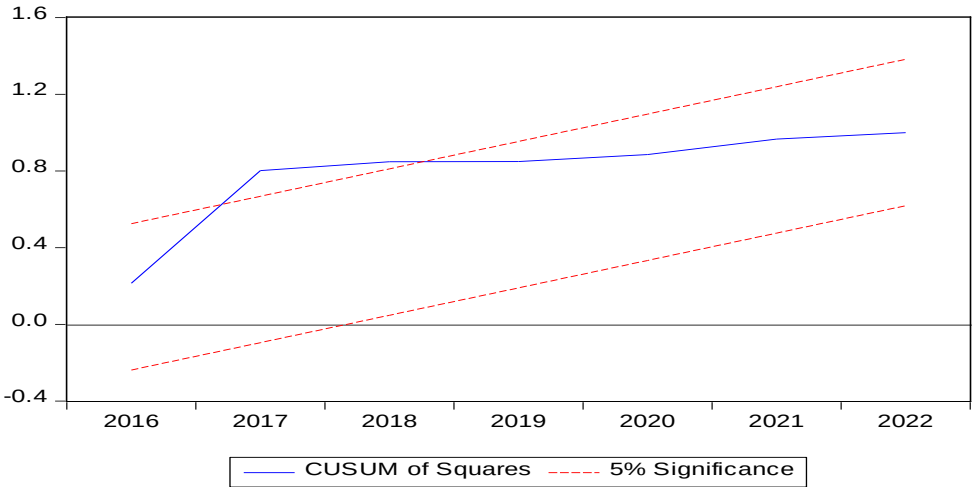

Figure 3: CUSUM of Squares Test
Source: Extracted from Eviews 10

5. Summary, Conclusion and Recommendations

Transportation is an essential component of economic development and quality of life considerations. In recent years, Nigeria has embarked on what is easily the most ambitious railway rehabilitation and expansion programme in its history. The purpose of this paper was to investigate the effect of rail infrastructure quality on agriculture sector development in Nigeria. The data for the research from 2000 to 2022 were gathered from World Development Indicators, theglobaleconomy.com, indexmundi.com, tradingeconomics.com, countryeconomy.com, worlddata.info, fred.stlouisfed.org, and Statistical Bulletin and Annual Report and Statement of Accounts published by the Central Bank of Nigeria (CBN). The period was decided due to data availability.

This study used an augmented Dicky- Fuller unit root test to check for stationarity of the variables. Based on the feature of the unit root tests at the level and first difference, the Autoregressive Distributed Lag (ARDL) estimation method is applied to estimate the short and long-run relationships.

As the result shows, the coefficient of railroad infrastructure quality (LNRAILQ) in the long run is negatively signed and statistically significant at a 10 per cent significance level. The coefficient of political stability (LNPS) is inversely related to agriculture value added
in the long run. The same negative sign is maintained in the short run. Similarly, a 1% increase in the inflation rate (LNINFR) decreases agriculture value added by approximately 0.641707% at a 10% significance level in the long run but in the short run agriculture value added decreases by 0.234163% for every 1% increase in the current value of inflation rate. In the same vein, for every 1% increase in market size (proxy by GDP per capita (LNGDPC)), agriculture value added declines by 4.374691% in the long run. This same negative effect is observed in the short run.

Nonetheless, a 1% increase in the exchange rate (LNREXR) will boost agriculture value added by about 4.476596%. A positive effect is also experienced in the short run. Also, at a 5% significance level, every 1% increase in technology (proxy by foreign direct investment (LNFDI) spurs agriculture value added by 1.216797% in the long run but in the short run, by 0.527005% at a 1% significance level. Similarly, agriculture value added is substantially improved (by 17.22446%) for every 1% increase in the index of human capital per person (LNIHC) in the long run but in the short run, it dropped slightly to 14.56502% for every 1% rise in the index of human capital per person (LNIHC).

Conclusively, railroad infrastructure quality has an inverse relationship with agriculture value added in Nigeria during the period covered in this study. Nigeria is a large country in terms of land mass, so the distances over which agricultural product is shipped are sufficiently great so much so that the rail transport system should be of economic advantage. The fact is that there is a need to put in place effective and efficient rail transportation in the country. This is because railroads are crucial to nearly every aspect of agriculture, including the movement of products essential to farming, such as finished farming equipment and agricultural chemicals, as well as the food found on grocery shelves and dinner tables across the country and around the world. As such, the federal government of Nigeria should make more effort to rehabilitate old rail lines and construct new ones to link the other modes of transportation across the country. In that regard, effort should be made to attract potential foreign investors in the construction of rail lines. At the same time, engineers should be properly trained in diesel locomotive technology and rail track management.

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