Port Infrastructure Quality and Economic Growth in Nigeria

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Abstract
Given the critical role that ports play in facilitating trade and economic growth, there is a strong need to assess the quality of Nigeria's port infrastructure and its impact on the country's economic performance. Sequel to this therefore, the study investigates the relationship between port infrastructure quality and economic growth in Nigeria. The study is based on quantitative method of secondary data collection method. Ex - post-facto research design was adopted to achieve the objectives of the study. The study draws its data from the annual reports of the Nigerian Port Authority and World Bank Statistical Bulletin with focus on information in the post-concession era from 2006 – 2022 for the period of 17 years. The ARDL Bound Test approach was adopted in estimating the relationship between the variables. The study findings shows that port infrastructure quality have insignificant relationships with economic growth in both the short-run and long-run. Specifically, the test of hypothesis one showed that there is no positive and statistically significant relationship between vessel traffic and gross domestic product in Nigeria. Similarly, the test of hypothesis two showed that there is positive and statistically significant relationship between cargo throughput and gross domestic product in Nigeria. Based on the findings, the study recommends that the government should modernize port facilities; increase the use of technology like automated systems, and enhancing cargo handling capacity. Finally, the government should expand the capacity for exports, especially of non-oil goods, to leverage on the increase in cargo throughput for broader economic benefits.

Keywords: *Port Infrastructure Quality, Vessel Traffic, Cargo Throughput, Economic Growth, Gross Domestic Product*

1.0 Introduction

Nigeria is Africa's largest economy, heavily reliant on sectors such as oil and gas, agriculture, and manufacturing. With the vast majority of Nigeria's international trade conducted via seaports, ports serve as critical infrastructure for importing and exporting goods. Ports facilitate the movement of essential commodities such as crude oil, natural gas, agricultural products, and manufactured goods to international markets. Nigeria's key seaports such as Apapa, Tin Can Island, Onne, and Port Harcourt are essential for trade and commerce, connecting the

country to global markets. Port infrastructure quality and logistics system has been noted as a vital industry that can facilitate adequate growth and development in emerging economy (Ndalu & Okene, 2024).

However, Nigeria's economy faces numerous challenges related to infrastructure deficiencies, particularly in the port sector. Congestion, inefficiency, inadequate facilities, and outdated technology at Nigerian ports have become barriers to smooth trade and economic growth (Oyewole, 2019). The poor state of port infrastructure increases operational costs, reduces the competitiveness of Nigerian goods, and hampers the country's economic potential. Consequently, improving port infrastructure is key to unlocking the full potential of Nigeria's economy, particularly by enhancing international trade and reducing logistics costs. Globally, port infrastructure plays a vital role in facilitating trade and economic growth by ensuring the smooth flow of goods in and out of a country. Efficient and high-quality port infrastructure is closely linked to a nation's economic performance (Ahmed, Bouzir, Mbarek, & Benammou, (2023). In Nigeria, improving port infrastructure is essential for reducing logistics bottlenecks, minimizing trade costs, and driving industrial expansion. The efficient operation of ports can enhance the flow of raw materials and finished goods, contributing to GDP growth and increasing the nation's global trade presence.

Ihugba, Odii, Njoku, (2014) found that Nigerian logistic system is too poor to facilitate adequate growth. Victor (2015) remarks that inefficiency in logistics system translate to loss of essential materials when it fail to meet-up with their schedule in the manufacturer's supply chain. More so, poor inefficiency in logistics performance affect both manufacturers and final consume, therefore resulting in loss of gain when essential materials fail to meet-up as schedule. Hausman, Lee and Subramanian (2012) revealed that well developed port infrastructure and logistic system in developed countries has continue to increase the probability of exporting to international markets and attracting foreign direct investment, while emerging economic are still lagging behind.

Oriaku and Venables (2011), in trying to assess the contribution of Port infrastructure quality to economic growth and development wrote that, Seaport is a major entry and exit point in international trade and are regarded as the most important link in the transport chain and for the development of regional and international trade. He added that Tin-can Island Port complex came into existence in 1977 and commissioned to ease the pressure of heavy imports in Apapa Port. As a result of the Oil boom of 1977-1979, the idea of more Ports creation and expansion promoted the Federal Government construct to more Port which included; New Sapele and Warri Port Complex, Calabar Port Complex and Ocean Terminal at Onne, River State. Maritime transport is of significant importance to and greatly influences the development and growth of the Nigeria economy. According to Ndalu and Okene, (2024), there is need to examine the impact of airways, waterways and other means of logistics effect on economic growth in emerging countries like Nigeria in this era of globalization. It is against this background therefore, that this study is aimed at determining the impact of port infrastructure quality on economic growth in Nigeria.

1.1 Statement of the Problem

The port serves as the gateway to the nation's economy. Thus, ports are locations on a coastline or shoreline holding one or more harbours where ships can dock and transfer people or cargo

to land. On the other hand, port infrastructure is the base for port operations to serve the vessel, cargo and passengers which pass through ports. The basic infrastructure features include port terminals such as docking areas; port operational equipment such as cranes, tugboats, dredgers; man-made global maritime routes and other tangible infrastructures like electronic gadget Ahmodu & Okeudo, 2021. Therefore, ports infrastructure which link an economy to the global markets contributes to economic growth through decrease in shipping time, decrease in transport cost and employment creation. Meanwhile, Nigeria ports have been characterized with high degree of centralization, high port charges, poor infrastructure, crippling bureaucracy and multiple governmental agencies which made it uncompetitive and unattractive in the West African sub-region (Ahmodu, Okeudo & Ejem, 2021). Also, the pre-concession era witnessed a lot of infrastructural decay with poor service quality leading to poor ship turnaround time, high cargo dwell time, poor port and hinterland connectivity.

As a result of this dismal performance of ports infrastructure, the government came up with concession programme to transform the ports in the year 2006 in order to provide for public ownership of port infrastructure and transfer of cargo operational responsibilities to the private sector for efficient services. This to a large extent, has increased revenue generation and cargo throughout in the port and also led to a drastic reduction in a ship delay period, increased vessel turnaround, berth occupancy and all round operational efficiency and optimal productivity (Ahmodu & Okeudo, 202l; Ndikom, 2013). However, the present port infrastructure are overstretched and as such require further development to deep seaports as shipping companies are leveraging on economies of scale to save costs. For instance, the only existing deep sea ports, Apapa and Tincan Ports in the Lagos axis are overstretched with the attendant inordinate delays in cargo handling and processing. This problem was occasioned by the failure to develop other ports such as Calabar, Onne, Port Harcourt and Warri ports to deep sea ports that could accommodate bigger vessels to decongest the heavy traffic in Apapa and Tincan ports.

Therefore, neighbouring countries like Togo and Ghana with well-developed deep seaports to accommodate bigger vessels are now the hub of containerized cargo and ship to ship transfer in Sub Saharan Africa respectively, Nigerian vessels go to offshore Lomé rather than offshore Lagos to be loaded with cargo (petroleum products) for Nigerian consumers, as well Nigerian importers prefer using Lomé ports to import their containerized cargoes as a result of poor service quality and decayed infrastructure in Nigerian ports. The capital flight as a result of this practice is better imagined as this diminishes the GDP contribution from the maritime sector to the Nigerian economy (Emenyonu, Onyema, Ahmodu & Onyemechi, 2016). As a result of these, Onwuegbuchunam (2018) averred that Nigeria's port reforms program may not have completely addressed the anomalies that it was intended to alleviate because even though investments in facilities and handling equipment has led to a reduction in average waiting times of vessels in Nigerian ports, certain challenges are still noticeable including higher tariffs, delays in cargo clearance, cargo inspection bottlenecks and lack of implementation of infrastructural investment and development plans.

However, the appalling state of access road to Apapa port, Nigeria's biggest port is among the obvious indicators of the travails of port customers in Nigeria (Oritse & Bivbere, 2018; Sessou, 2018). The gridlock in Apapa delayed the exportation of over eighty five million naira worth of solid minerals for more than three months (Okon, 2018). The man hours wasted and delays of export container cargoes on that road negates the economic growth contribution from the

maritime sector. It is against this backdrop that this study is aimed at examining port infrastructure quality and economic growth in Nigeria.

Objectives of the Study

The aim of this study is to determine the relationship between port infrastructure quality and economic growth in Nigeria. The study specific objectives are to:

i. Investigate the relationship between vessel traffic and gross domestic product in Nigeria.
ii. Ascertain the relationship between cargo throughput and gross domestic product in Nigeria.

2.0 Conceptual Review

I. Port Infrastructure Quality

Port infrastructure can be seen as the physical facilities, equipment, and structures that are developed to facilitate the handling, storage, and transportation of goods and passengers through seaports. Ports serve as critical nodes in the global transportation network, connecting land and sea transport and facilitating the movement of goods between different regions and countries. Port infrastructure is essential for efficient and smooth maritime trade. According to Vanelslander, (2014), Port infrastructure means infrastructure and facilities for the provision of transport related port services, for example berths used for the mooring of ships, quay walls, jetties and floating pontoon ramps in tidal areas, internal basins, backfills and land reclamation, alternative fuel infrastructure and infrastructure for the collection of ship-generated waste and cargo residues.

The approach used to estimate economic impact of port infrastructure quality is based on the neo-classical economic perspective of transport infrastructures proposed by Lakshmanan (2011). We have assumed that investments into port infrastructure are exogenous, which improve the quality of port infrastructure (QPI). Better QPI (such as modern technologies and equipment) would help improve the logistics performance (LP) of a country (that is, greater reliability, less damage, ability to track and trace shipments, timeliness of delivery etc.). Improved QPI and LP would increase the local and global accessibility of a country, including opportunities to expand markets worldwide. The realisation of those opportunities can be expressed in the form of a country's total international trade (herein, seaborne trade). Gains from trade can be characterised by improved labour supply, expanded production, diffusion of innovation, competitive pressures, economic restructuring, etc., leading to total factor productivity and GDP growth (Lakshmanan, 2011).

Lakshmanan (2011) proposed that investment into transport facilities improves logistics ability and reduces freight costs. Wilmsmeier and Hoffmann (2008) estimated the role of liner shipping connectivity (LSC) and port infrastructure in determining freight rates in the Caribbean. They found that a one-standard-deviation increase in LSC implies an expected reduction of USD 287 in freight rate, and that a one-standard deviation increase in port infrastructure for an importing country implies an expected reduction of USD 225 in freight rate. Furthermore, Sánchez, Hoffmann, Micco, Pizzolitto, Sgut & Wilmsmeier, (2003) found that freight costs are lower in efficient ports after controlling for distance, liner service

availability, and type of product and insurance costs. Also, an increase in port efficiency from the 25th to the 75th percentile is expected to reduce shipping costs by 12% (Clark, Dollar & Micco 2004). Quality of infrastructure and transport costs is important for export-led economic growth (Limao and Venables, 2001). Thus, it can be derived that efficient ports have better quality infrastructure and logistics performance than inefficient ones. Additionally, an efficient port system with enhanced logistic abilities is a key determinant of foreign direct investment into a country (Panayides, Parola & Lam, 2015). On the other hand, inefficient ports reduce national and international trade and affect economic growth adversely (Clark et al., 2004).

The quality of port infrastructure refers to the overall condition, capabilities, and efficiency of the physical facilities and equipment in a port. It encompasses a range of factors that contribute to the effectiveness and competitiveness of the port in facilitating the movement of goods and vessels. According to Baştuğ, Haralambides, Esmer, and Eminoğlu, (2022), the quality of port infrastructure plays a significant role in determining the competitiveness of a port and its ability to attract shipping lines and cargo traffic. Ports that invest in maintaining and upgrading their infrastructure are better positioned to handle increasing trade volumes and contribute to regional economic development (Erie, 2004). Evaluating and continuously improving the quality of port infrastructure is essential for meeting the evolving demands of global trade and logistics.

Vessel Traffic

Vessel traffic is seen as the movement and navigation of ships or boats in a particular area, such as ports, harbours, waterways, or open seas. It encompasses the flow of maritime transportation, including cargo vessels, passenger ships, fishing boats, and other types of watercraft (Ndalu & Okene, 2024). Vessel traffic management is crucial for maintaining maritime safety, efficiency, and order. According to Robards, Silber, Adams, Arroyo, Lorenzini, Schwehr, and Amos, (2016), various organizations, authorities, and technologies are involved in managing and monitoring vessel traffic to prevent collisions, ensure navigational safety, and facilitate the smooth flow of maritime activities. Some key aspects of vessel traffic include: Vessel Traffic Services (VTS); Navigation and Routing; Regulatory Measures; Communication Systems; Traffic Control Centers etc.

Cargo Throughput

Cargo throughput refers to the total volume or quantity of goods and merchandise that passes through a specific transportation node, such as a port, airport, railway station, or other logistics hubs, within a given period. According to Seifegha, Ndalu and Okene (2023), cargo throughput is the entire volume of cargo that a port handles over a specific time period and often referred to as port throughput, and it is a crucial indicator of port performance. Cargo throughput is a measure of the amount of cargo handled by a particular infrastructure or transportation system (Lam, Ng, Seabrooke, & Hui, 2004). Cargo throughput is typically expressed in terms of weight (tonnage) or volume (cubic meters), and it provides a quantitative assessment of the efficiency and capacity utilization of transportation and logistics facilities. The measurement of cargo throughput is essential for assessing the performance of these nodes and understanding their role in facilitating trade and commerce (Bichou & Gray, 2004).

Cargo throughput refers to the total volume of cargo (measured in tons, twenty-foot equivalent units (TEUs), or other relevant metrics) handled by a port within a specific period, usually annually. It encompasses all goods imported, exported, or transhipped through a port and is a critical measure of a port's efficiency, capacity, and economic significance. High cargo throughput is often associated with increased economic activity, better port infrastructure, and advanced logistics systems. Conversely, low cargo throughput can indicate inefficiencies, infrastructure deficits, or economic downturns.

Economic Growth

Economic growth is the increase in the value of goods and services produced by an economy over time. It is commonly measured as the percentage change in the Gross Domestic Product (GDP) of a country. GDP is the total market value of all final goods and services produced within a country in a specific period. According to Seifegha, Ndalu and Okene, (2023), the percentage change in real gross domestic product (GDP) from one year to the next is typically used to measure economic growth. Economic growth is a key indicator of a nation's economic health and development. It generally implies an expansion of an economy's productive capacity and an improvement in the standard of living for its citizens (Friedman, 2017). Onyimadu (2015) defined economic growth as increase in growth rates of income per capital. One of the core values of economic growth is that it reveals the available resources within a society and the proportion allocated to individuals in trying to satisfying their utility preferences.

Factors contributing to economic growth include increased productivity, technological advancements, population growth, investment in capital and infrastructure, and favourable government policies. According to Zhuang, Gunatilake, Niimi, Khan, Jiang, Hasan, and Huang, (2009), sustained economic growth is essential for reducing poverty, generating employment opportunities, and funding public services. However, it's important to note that while economic growth is a crucial aspect of development, policymakers also need to consider issues such as income distribution, environmental sustainability, and the overall well-being of the population. For the majority of the population, economic growth entails progress in ensuring a decent life, access to education, and basic healthcare (Belshaw & Livingstone, 2016). With a better understanding of the term "economic growth," the sense of the term "development" becomes clearer. Economists define economic growth as the increase in a country's real production per capita over time. While other metrics can be used, the gross national product is the most convenient way to calculate production (GNP). This means that the increase in a country's per capita GNP is used to calculate economic development. As a result, economic growth is described as a sustained expansion of production capabilities as measured by an increase in real GDP over time (Chow, & Li, 2002).

As Hong Kong, South Korea, Taiwan, and other Asian economies have shown, sustained rapid economic growth can turn a poor country into a wealthy one (Bade & Parkin, 2012). Growth and development, according to Malizia and Feser (2000), are complementary since one makes the other possible. They're often sequentially occurring alternating cycles. Growth refers to an increase in production, while growth refers to a systemic transition, such as a technical or legal change. Growth improves the economy, but progress must lead to more balanced income and wealth distribution. Growth and development, on the whole, contribute to a wider range of economic options.

II. Theoretical Foundation

This study is anchored on Resource Based View theory developed by Barney (1991). This is because the study objective aligns with Resource Based View by treating infrastructure as a key resource that can offer competitive advantage in international trade and logistics.

Resource Based View Theory

Resource based view theory developed by Barney (1991), posits that a firm's or country's competitive advantage is derived from its valuable, rare, inimitable, and non-substitutable (VRIN) resources. In the context of port infrastructure, RBV suggests that high-quality port infrastructure serves as a strategic resource for Nigeria's economy, as it facilitates the efficient movement of goods, enhances trade, and supports industrial activities. The Resource-Based View (RBV) Theory provides a valuable framework for understanding how internal resources, such as port infrastructure, contribute to economic growth. In the context of the study "Port Infrastructure Quality and Economic Growth in Nigeria", RBV helps explain how the quality and availability of port infrastructure act as strategic resources that can enhance a nation's economic performance. RBV also suggests that organizations or countries that optimize the use of their resources are better positioned to achieve long-term success. The quality of port infrastructure is crucial for sustaining economic activities such as trade, logistics, and industrial output. RBV emphasizes the importance of resources that enhance firms or nation's productivity and efficiency (Lim, 2022). Efficient port infrastructure reduces transaction costs, minimizes delays, and ensures the smooth flow of goods in and out of the country. This contributes to higher productivity in other sectors, including manufacturing and services, which are key drivers of economic growth.

III. Empirical Reviews

The existing literatures on port infrastructure quality and economic growth have yielded different results and are presented below:

Ndalu and Okene, (2024) studied the impact of port infrastructure and logistics efficiency on economic growth in Nigeria: The Nigerian Port Authority Experience from 2006 – 2022. The study draws its data from the annual reports of the Nigerian Port Authority and Central Bank of Nigeria Statistical Bulletin with focus on information in the post-concession era from 2006 – 2022 for the period of 16 years. The ARDL Bound Test approach was adopted in estimating the relationship between the variables. The study findings show that both quality of port infrastructure (QPI) and logistics efficiency (CTR) have insignificant relationships with economic growth in both the short-run and long-run. Specifically, the test of Hypothesis One showed that the quality of port infrastructure exhibited an insignificant negative relationship with economic growth, as indicated by the β coefficients of -2996.500 (short-run) and -110071.1 (long-run) with p-values of 0.4602 and 0.7904, respectively. Similarly, the test of Hypothesis Two showed that logistics efficiency, measured by cargo throughput (CTR), demonstrated an insignificant positive relationship with economic growth.

Seifegha, Ndalu and Okene, (2023) investigated seaborne trade and economic growth in Nigeria from 1997 – 2022. The study is inferential and based on quantitative method of

secondary data collection sourced from the National Bureau of Statistics (NBS), the United Nations Development Programme (UNDP) and Central Bank of Nigeria (CBN). The data collected were subjected to multivariate time series analysis using ARDL Bound Test approach in estimating the multiple regression model and Granger Causality used in estimating the effect of shipping export (Ship_exp) and cargo throughput (CTP) on Real Gross Domestic Product (RGDP) and industrial employment (Ind_emp) with the aid of E-views version 12.0. The sample size for this study is 25 years spanning from 1997 to 2022. The study findings show that in the short-run, shipping export (Ship_exp) had a positive and significant impact on RGDP while it had a positive and insignificant impact on RGDP in the long run. Meanwhile, cargo throughput (CTP) had a positive and significant impact on RGDP both in the short run and in the long run. The study further shows that shipping export and cargo throughput do not granger cause industrial employment.

Ahmodu, Okeudo and Ejem (2021) studied the development of port infrastructure and service quality in the Nigerian ports from 2000- 2019. The objective of the study is to examine the relationship between quality of port infrastructure index on service quality vis a vis ship turnaround time and average time spent at berth. The paper used the method of Ordinary Least Square (OLS) regression analysis based on secondary data on quality of port infrastructure index, ship turnaround time and average time spent at berth obtained from Nigerian Ports Authority Abstract Statistic and World Economic Forum. Before the estimation of the Ordinary Least Square (OLS) regression analysis, the variables were subjected to Augmented Dickey Fuller (ADF) unit root test to stabilize the data; and the result showed that all the variables were stationary to forestall spurious regression result. The estimated OLS results showed that the quality of port infrastructural has a negative and significant relationship with both ship turnaround time and average time spent at berth (service quality in the Nigerian ports).

Senquiz – Diaz (2021) examined transport infrastructure quality and logistics performance in exports. This study measures the effects of transport-freight common modals and logistics performance on the exports of goods in 29 developing economies based on micro fixed-effects panel data for the period 2012–2018. The endogenous model proved a positive relationship with countries' outward orientation, highlighting the importance of transport infrastructure and logistics resources. The results revealed that the quality of roads and ports contribute significantly to higher exports in developing economies. However, the quality of airport infrastructure and logistics show a harmful effect. Notably, the logistics services level is a detrimental factor impacting the export of goods in developing economies. These results may adversely impact the potential contributions of other transport assets based on intermodal transport functionality and global market participation.

Akani and Ndiokho, (2021) studied the relationship between modernization of infrastructure and ports performance in Nigerian Ports, Rivers Sate. It adopted effectiveness and efficiency as measures of port performance. The study adopted the cross-sectional survey in its design. The population of the study were the two seaports in Rivers State with 58 participants captured as respondents. Given the size of the population and its corresponding participants, the study adopted census in the determination of its sample size, thus adopting 58 as the study sample size. The research instrument was validated through the supervisor's scrutiny and approval while the reliability of the instrument was ascertained using the Cronbach Alpha coefficient with all the items scoring above 0.70. Data obtained was analysed and presented using both descriptive and inferential statistical tools. The hypothesis was tested using the Spearman's

Rank Order Correlation Statistics. However, in view of the findings of the study, it is thus concluded that modernization of infrastructure is a necessary strategic action to promote port performance in Ports in Rivers State.

Osadume and University (2020) carried out a study on port revenue performance and economic growth which hinged on Neoclassical Growth Theory. It employed Ordinary Least Square Regression and Engle-Granger Co-integration to analyze the secondary time series data used for study. Results indicated that total revenue to gross registered tonnage had impact on economic growth.

3.0 Methodology

This study examines port infrastructure quality and economic growth in Nigeria using vessel traffic and cargo throughput as proxies of port infrastructure quality while gross domestic product (GDP) was used as a measure of economic growth. Ex - post-facto research design was adopted to achieve the objectives of the study. This study draws its data from the annual reports of the Nigerian Port Authority and Central Bank of Nigeria Statistical Bulletin with focus on information in the post-concession era i.e. from 2006 – 2022 (CBN, 2022) (NPA, 2022). The descriptive statistics such as mean, standard deviation and standard error was used to organize, summarize and explain the features of the distribution of the collected data. While the inferential statistic of Ordinary Least Squares **(**OLS**)** regression was used to describe the relationship effect from the independent quantitative variables on the dependent variables.

Model Specification

The model specification is as indicated below:

The study modifies the model developed by Seifegha, Ndalu & Okene, (2023), Idris & Suleiman (2019) and Inyiama (2013). In accordance with their models, the model for this study is as follows:

GDP = f(VTF, CTP)……. ……. (1)

Where;
GDP = Gross Domestic Product
VTF = Vessel Traffic
CTP = Cargo Throughput
f = functional relationship
From equation (1), the formula is further stated in an econometric form as:
$GDP = \propto 0 + \propto 1\ VTF + \propto 2\ CTP + \mu$ ……. ……(2)
Where:
$\propto 0$ = Intercept of relationship in the model
$\propto 1 - \propto 5$ = Coefficients of each independent or explanatory variable
μ = Stochastic or Error term

4.0 Results and Discussions

4.1 Data Analysis

Table 4.1: Descriptive Statistics

	GDP	VTF	CTP	EXR
Mean	62157.30	4660.588	73188653	216.3965
Median	67977.46	4721.000	74910284	157.5000
Maximum	74639.47	5369.000	99015400	405.5000
Minimum	41126.68	3972.000	49173324	118.5700
Std. Dev.	10903.30	490.5721	11985210	95.66226
Skewness	-0.720224	0.047811	-0.145920	0.717913
Kurtosis	2.107167	1.625251	3.148255	1.949689
Jarque-Bera	2.034362	1.345180	0.075898	2.241697
Probability	0.361613	0.510385	0.962762	0.326003
Sum	1056674.	79230.00	1.24E+09	3678.740
Sum Sq. Dev.	1.90E+09	3850576.	2.30E+15	146420.3
Observations	17	17	17	17

Source: Author's Eviews12 Computation, 2024.

Table 4.1 provides descriptive statistics for four variables: GDP (Gross Domestic Product), VTF (Vessel Traffic), CTP (Cargo Throughput), and EXR (Exchange Rate), with 17 observations for each. The averages (mean) and central values (median) indicate the general levels of the variables. For example, the mean of the GDP is 62,157.30, while the median is higher at 67,977.46, suggesting slightly skewed data. The values fluctuate widely, such as GDP ranging from 41,126.68 to 74,639.47, and EXR from 118.57 to 405.50, showing volatility in exchange rates. EXR has a high standard deviation (95.66), indicating large fluctuations compared to other variables. The skewness indicates the asymmetry of the data distribution. Most variables show mild skewness, with GDP and CTP being slightly negatively skewed, while EXR is positively skewed. Kurtosis measures the "tailedness" of the data distribution. The values are generally near 3, indicating moderately peaked distributions. Jarque-Bera & Probability assesses normality. All variables have probability values above 0.05, suggesting that none of the distributions significantly deviate from normality.

Unit Root Tests

Unit root tests are statistical tests used to determine if a time series variable is non-stationary. A time series is considered non-stationary if its statistical properties change over time. This can make it difficult to analyse and forecast the variable.

Table 4.2: Unit Root Tests

Variable	Test stat	Critical val. @ 5%	Probability	Integration
GDP	-3.0818	-3.0655	0.0486	I(0)
VTF	-3.0820	-1.9662	0.0046	I(1)
CTP	-4.8721	-1.9662	0.0001	I(1)
EXR	-3.2842	-1.9662	0.0029	I(1)

Source: Author's Eviews12 Computation, 2024.

Table 4.2 presents the results of the Augmented Dickey-Fuller Unit Root Test of all the variables. The Stationarity Test reveals that all variables are stationary at order one, 1(1) except GDP which is stationary at level 1(0). The null hypothesis is thus rejected that there is no presence of unit root in the series.

Johansen Co-integration Test

The test shows the long run relationship between all the variables. The Null hypothesis (H0) states that there is no significant co-integrating relationship between the variables if the trace statistic and maximum eigen value is greater than the 5% level of significance.

Table 4.3: Cointegration Trace Test

Date: 09/08/24 Time: 15:34
Sample (adjusted): 2007 2022
Included observations: 16 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP VTF CTP EXR
Lags interval (in first differences):

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.896626	90.27598	69.81889	0.0005
At most 1 *	0.818446	53.96554	47.85613	0.0120
At most 2	0.697854	26.66633	29.79707	0.1101
At most 3	0.241124	7.516784	15.49471	0.5184
At most 4	0.176245	3.102105	3.841465	0.0782

Source: Author's Eviews12 Computation, 2024.

The cointegration trace test results in Table 4.3 suggest the presence of long-run relationships among the variables (GDP, VTF, CTP, EXR) in the model. The null hypothesis of no cointegration ("None") is rejected since the trace statistic (90.28) exceeds the critical value (69.82) at a 5% significance level, with a probability of 0.0005. The null hypothesis of "at most one" cointegrating equation is also rejected, as the trace statistic (53.97) exceeds the critical value (47.86) with a probability of 0.0120. Thus, there are two cointegrating equations among the variables, implying a long-term equilibrium relationship.

Test of Hypotheses

Ho_1: There is no significance relationship between vessel traffic and gross domestic product in Nigeria

Ho_2: There is no significance relationship between cargo throughput and gross domestic product in Nigeria.

Decision Criteria: **If,** *p*-value < 0.05, then the variable is significant **Reject H_0**
p-value > 0.05, then the variable is significant **Accept H_0**

Table 4.4: Regression Output Table
Dependent Variable: GDP
Method: Least Squares
Date: 09/08/24 Time: 15:24
Sample (adjusted): 2007 2022
Included observations: 16 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
VTF(-1)	8.400111	5.613184	1.496497	0.1627
CTP(-1)	0.000480	0.000145	3.296989	0.0071
EXR(-1)	82.75025	27.87528	2.968589	0.0128
C	-23704.62	25172.69	-0.941680	0.3666

R-squared	0.844191	Mean dependent var	63471.71
Adjusted R-squared	0.787533	S.D. dependent var	9771.319
S.E. of regression	4504.010	Akaike info criterion	19.91363
Sum squared resid	2.23E+08	Schwarz criterion	20.15506
Log likelihood	-154.3090	Hannan-Quinn criter.	19.92599
F-statistic	14.89976	Durbin-Watson stat	1.614013
Prob(F-statistic)	0.000205		

Source: Author's Eviews12.0 Computation, 2024

Table 4.4 present the results of a regression analysis with Gross Domestic Product (GDP) as the dependent variable and with vessel traffic (VTF) and Cargo throughput (CTP) as the independent variables. Meanwhile, Exchange Rates (EXR) serve as the control variable. The regression output examines the relationship between GDP and several lagged independent variables (VTF, CTP, EXR). Here's a concise interpretation:

Vessel Traffic (VTF): The coefficient (8.400111) suggests a positive relationship with GDP, but it's not statistically significant (p = 0.1627). Cargo throughput (CTP): A positive and statistically significant relationship with GDP (coefficient = 0.000480, p = 0.0071), meaning improvements in CTP are associated with GDP growth. Exchange Rate (EXR): Shows a positive and significant effect on GDP (coefficient = 82.75025, p = 0.0128), indicating that exchange rate fluctuations impact economic performance. R-squared: 0.8441, meaning 84.4% of the variation in GDP is explained by the independent variables. Adjusted R-squared 0.7875

accounting for the degrees of freedom, showing the model fits well. F-statistic: Significant (p = 0.000205), indicating the overall model is statistically significant. Durbin-Watson Statistic (1.614) indicates some level of autocorrelation in the residuals, which may require further analysis. This analysis suggests that CTP and EXR significantly influence GDP, while VTF do not have a statistically significant impact during the period studied.

Post-Estimation Diagnostic Tests

Post-estimation diagnostic tests are statistical procedures used to assess the validity and reliability of a statistical model after it has been estimated. These tests help identify potential problems or issues in the model that could affect the accuracy of its predictions or inferences.

Serial Autocorrelation Test

The Breusch-Godfrey Serial Correlation LM Test is used to assess the presence of serial correlation in the residuals of a regression model.

Table 4.5: Serial Correlation LM Test:

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.668884	Prob. F(2,9)	0.5360
Obs*R-squared	2.070493	Prob. Chi-Square(2)	0.3551

Source: Author's Eviews12 Computation, 2024

The Breusch-Godfrey Serial Correlation LM Test in table 4.5 shows the following results:
The F-statistic is 0.668884, with a p-value (Prob. F(2,9)) of 0.5360, which is greater than the standard significance level (e.g., 0.05). This suggests that there is no significant evidence of serial correlation in the residuals. The Obs*R-squared value is 2.070493, with a p-value (Prob. Chi-Square (2)) of 0.3551, which also exceeds 0.05, further confirming no serial correlation. Thus, the null hypothesis of no serial correlation up to 2 lags is accepted, meaning there is no autocorrelation in the model's residuals.

Heteroskedasticity Test

The test is used to ascertain whether the variance of the errors in the model /variables is constant. The Null hypothesis (H0) states that there is no significant Heteroskedasticity if the p-value is greater than the 5% level of significance.

Table 4.6: Heteroskedasticity Result

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.652449	Prob. F(4,11)	0.6371
Obs*R-squared	3.068137	Prob. Chi-Square(4)	0.5465
Scaled explained SS	1.252629	Prob. Chi-Square(4)	0.8694

Source: Author's Eviews12 Computation, 2024

The heteroskedasticity test results using the Breusch-Pagan-Godfrey method in table 4.6 indicate that the data does not suffer from heteroskedasticity. The F-statistic (0.6524) and its associated p-value (0.6371) are not statistically significant, meaning we fail to reject the null hypothesis of homoskedasticity. The Obs*R-squared value (3.0681) with a p-value of 0.5465 and the Scaled explained SS (1.2526) with a p-value of 0.8694 also suggest the same conclusion. Overall, these results confirm that the model's residuals are homoskedastic, implying that the variance of the errors is constant.

5.0 Discussion of Findings

Vessel Traffic and Gross Domestic Product

The findings in table 4.4 relating to vessel traffic and gross domestic product indicate that Vessel Traffic (VTF) coefficient (8.400111) is positive and not statistically significant at (p = 0.1627). This suggests a positive relationship with gross domestic product (GDP), but it's not statistically significant at (p = 0.1627). This suggests that vessel traffic (VTF) do not have a positive and statistically significant relationship with gross domestic product during the period study. This finding is in line with the study of Ndalu and Okene, (2024) who studied the impact of port infrastructure and logistics efficiency on economic growth in Nigeria: The Nigerian Port Authority Experience from 2006 – 2022. The study findings show that both quality of port infrastructure (QPI) and logistics efficiency (CTR) have insignificant relationships with economic growth in both the short-run and long-run. Similarly, the test of Hypothesis Two showed that logistics efficiency, measured by cargo throughput (CTR), demonstrated an insignificant positive relationship with economic growth.

Cargo Throughput and Gross Domestic Product

The findings in table 4.4 relating to cargo throughput and gross domestic product indicate that cargo throughput (CTP) has a positive and statistically significant relationship with GDP (coefficient = 0.000480, p = 0.0071), meaning improvements in CTP are associated with GDP growth. This finding is in line with the study of Diaz (2021) who examined transport infrastructure quality and logistics performance in exports. The results revealed that the quality of roads and ports contribute significantly to higher exports in developing economies.
However, this finding slightly not in consonance with study of Ndalu and Okene, (2024) who studied the impact of port infrastructure and logistics efficiency on economic growth in Nigeria: The Nigerian Port Authority Experience from 2006 – 2022. The study findings show that both quality of port infrastructure (QPI) and logistics efficiency (CTR) have insignificant relationships with economic growth in both the short-run and long-run. Similarly, the test of Hypothesis two showed that logistics efficiency, measured by cargo throughput (CTR), demonstrated an insignificant positive relationship with economic growth.

6.0 Conclusion and Recommendations

6.1 Conclusion

The study empirically investigates port infrastructure quality and economic growth in Nigeria using panel data for the period of 17 years starting from 2006 to 2022. The conclusion of the findings shows that there is no positive and statistically significant relationship between vessel traffic and gross domestic product in Nigeria and there is positive and statistically significant

relationship between cargo throughput (CTP) and gross domestic product in Nigeria. This mix findings show that Nigerian ports play a critical role in facilitating international trade, which is essential for the country's economic development hence, efficient ports will lower logistics costs and increase the competitiveness of Nigerian exports while enabling smoother importation of goods, leading to increased trade volumes and enhanced economic activity. Therefore, there is an urgent need for continued investment and modernization of Nigeria's port infrastructure. It often highlights challenges like congestion, out dated facilities, and poor maintenance, which can hamper the potential benefits of the ports. Investment in port infrastructure can enhance capacity and efficiency, improving Nigeria's integration into the global economy.

6.2 Recommendations

Based on the findings, the study recommends as follows:

i. The government should modernize port facilities**;** increase the use of technology like automated systems and enhancing cargo handling capacity. This could improve the link between vessel traffic and economic performance.

ii. The government should expand the capacity for exports**,** especially of non-oil goods, to leverage on the increase in cargo throughput for broader economic benefits. This would help Nigeria diversify its economy and reduce its dependence on oil, using the ports as a gateway for increased non-oil exports.

6.3 Areas for Further Research

Scholars who are interested to carry out further studies should do so in the following areas:

Future studies could investigate other determinants of port infrastructure quality beyond cargo throughput, such as port operational efficiency, logistics performance, or trade policy effectiveness. This would provide a more comprehensive view of the factors driving GDP growth in Nigeria. For instance, studies could explore how port automation, digitalization, or regulatory frameworks influence economic outcomes.

Another area for further research could focus on the role of foreign direct investment (FDI) in port development and its subsequent effect on cargo throughput and economic growth. Researchers could explore how FDI inflows into the maritime and logistics sectors enhance port performance and GDP.

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