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MARITIME TRANSPORT PERFORMANCE AND ECONOMIC GROWTH IN NIGERIA

OGOLA DANIEL BEKESUOMOWEI*, ISREAL KAYODE ADEBAYO AND AKNPELU AYOBAMI KOLADE

[1]*Department of Port Management, Faculty of Transport, Nigeria Maritime University, Okerenkoko, Warri, Delta State, Nigeria*

**Corresponding author: ogola.daniel@nmu.edu.ng*

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ABSTRACT

Maritime transport is also important in international trade and economic development, especially in coastal economies like Nigeria, where seaports are the main points of entry and exit for imports and exports. Although Nigeria is strategically located in a maritime setting and there have been efforts to transform and enhance the efficiency of its ports, there are still concerns about the efficiency of marine operations in relation to the industry's ability to sustain economic growth. This paper investigates the connection that exists between the performance of maritime transport and economic growth in Nigeria during the period of 1995 and 2022. In particular, it determines the effect of cargo throughput, ship calls, and gross registered tonnes on the real gross domestic product (RGDP) and considers the influence of the port turnaround time on economic growth. The Nigerian Ports Authority, Central Bank of Nigeria Statistical Bulletin, National Bureau of Statistics, and UNCTAD maritime statistics databases were used to get annual time-series data. The research utilises the Autoregressive Distributed Lag (ARDL) modelling framework in order to estimate short-run and long-run links between the variables. Unit root tests using the Augmented Dickey-Fuller (ADF) method were performed to test stationarity, and then the ARDL bounds test was conducted to test cointegration. The diagnostic tests and Error Correction Models (ECM) were also conducted to make the models reliable and stable. The findings show that there are substantial long-run relationships between cargo throughput and gross registered tonnage and Nigeria's real GDP; hence, cargo volumes and ship capacity positively impact economic growth. However, the effect of ship calls is not statistically significant. Moreover, port turnaround time indicates a strong negative correlation to economic growth, meaning that the longer the vessel takes to be processed, the worse the economic performance. This research concludes that to enhance the economic growth of Nigeria, maritime operational efficiency should be improved. The proposed policy to improve the productivity and competitiveness of the maritime industry in Nigeria is investment in port infrastructure, improved cargo processing, and the creation of regulations that would help reduce the turnaround time of vessels.

Introduction

Maritime transport is the lifeblood of international trade and a critical enabler of economic development, particularly for coastal economies such as Nigeria, where seaports serve as the primary gateways for imports and exports (Edih *et al*., 2023). Nigeria's strategic location along the Gulf of Guinea positions it as a potential maritime hub in West Africa. However, persistent operational inefficiencies continue to undermine the sector's contribution to national economic development. Despite substantial investments in port reforms and

infrastructure development, concerns persist about the efficiency of marine operations and their capacity to sustain long-term economic growth (Michail, 2020).

What Previous Studies Have Established

Existing literature has established several important findings regarding the relationship between maritime transport and economic growth in Nigeria. First, studies have demonstrated that port infrastructure and logistics efficiency significantly influence trade facilitation and economic performance (Adenigbo, 2023; Lim *et al*., 2019). Second, research has confirmed that port congestion and operational delays impose substantial economic costs through increased transaction costs and supply chain disruptions (Aruwei *et al*., 2020; Nnaukwu, 2024). Third, empirical evidence has established that shipping trade activity and seaport efficiency are positively correlated with economic growth in Nigeria (Michail, 2020; Onikosi-Alliyu, 2022). Fourth, studies have documented the negative implications of bureaucratic bottlenecks and inadequate infrastructure on port productivity and national competitiveness (OECD, 2024).

What Remains Unknown

However, significant gaps persist in the current body of knowledge. First, while individual studies have examined specific maritime indicators in isolation, no comprehensive analysis has simultaneously investigated the combined effects of cargo throughput, ship calls, gross registered tonnage, and port turnaround time on economic growth within a unified methodological framework. Second, the relative importance of different maritime performance dimensions—specifically, the distinction between volume indicators (cargo throughput) and efficiency indicators (turnaround time)—remains unexplored in the Nigerian context. Third, existing studies have not adequately distinguished between the short-run and long-run dynamics of maritime transport performance on economic growth, limiting the policy relevance of their findings. Fourth, the specific mechanisms through which port turnaround time affects economic performance have not been empirically established for Nigeria, despite widespread recognition of congestion as a critical challenge.

How this Study Advances the Literature

This study makes several distinct contributions to the existing literature. First, it provides a comprehensive empirical analysis by simultaneously examining multiple maritime performance indicators such as cargo throughput, ship calls, gross registered tonnage, and port turnaround time, within a coherent econometric framework. Second, it employs the Autoregressive Distributed Lag (ARDL) bounds testing approach, which allows for the separate identification of short-run and long-run relationships, thereby providing nuanced insights for policy formulation. Third, it introduces port turnaround time as a critical efficiency measure alongside traditional volume indicators, enabling a more complete understanding of maritime transport's contribution to economic growth. Fourth, by utilising data spanning 1995 to 2022, the study captures the effects of major policy reforms and structural changes in Nigeria's maritime sector over an extended period. Fifth, the study explicitly tests the hypothesis that operational efficiency (measured by turnaround time) is as important as volume indicators in determining economic outcomes, thereby informing targeted policy interventions.

The remainder of this paper is organised as follows: Section 2 provides a critical review of relevant literature on maritime transport performance and economic growth. Section 3 describes the theoretical framework, methodology, and data sources. Section 4 presents the empirical results and discussion. Section 5 concludes with policy implications and recommendations for future research.

Literature Review

Theoretical Framework: Maritime Transport and Economic Growth

The relationship between maritime transport and economic growth is fundamentally rooted in

several interconnected theoretical perspectives. First, from a trade theory perspective, maritime transport serves as the physical conduit through which comparative advantages are realised in international trade. The classical trade theories of Ricardo and Heckscher-Ohlin, while focusing on factor endowments and productivity differentials, implicitly assume frictionless transport. However, more contemporary frameworks recognise that transport costs, including maritime logistics efficiency, constitute a significant component of trade costs that can either amplify or diminish comparative advantages (Owoputi, 2020). "New trade theory", particularly the work of Krugman, emphasises how economies of scale and transportation networks can shape trade patterns and economic geography. Efficient maritime transport reduces the effective distance between markets, enabling countries to participate more fully in global value chains.

Second, endogenous growth theory provides insights into how transport infrastructure investment can generate sustained economic growth. According to this perspective, improvements in maritime transport efficiency reduce production and transaction costs, increase productivity, and stimulate innovation through enhanced competition and knowledge spillovers (Carrasco & Tovar-Garcia, 2021). The productivity-enhancing effects of transport infrastructure operate through multiple channels: Reduced inventory costs, just-in-time delivery capabilities, expanded market access, and increased specialisation (Kalouptsidi, 2021).

Third, the gravity model of international trade provides a useful framework for understanding the relationship between maritime transport and economic growth. The gravity model posits that bilateral trade flows are positively related to the economic size of trading partners and inversely related to the distance between them. However, the "distance" in this context is not merely geographical but also includes transport costs, logistics efficiency, and trade facilitation measures. Efficient maritime transport effectively reduces the distance penalty, enabling more trade and, consequently, higher economic growth (Coşar & Demir, 2018).

Fourth, the logistics and supply chain management perspective emphasises the systemic nature of transport efficiency. Maritime transport performance is not simply a function of port infrastructure but involves the entire logistics chain, including hinterland connectivity, customs procedures, and intermodal transport systems (UNCTAD, 2024; Njoku, 2020). This perspective highlights that improvements in maritime efficiency can generate economy-wide benefits through reduced logistics costs, improved supply chain reliability, and enhanced competitiveness of domestic industries.

Empirical Evidence on the Maritime-growth Nexus

Global empirical evidence has established several robust stylised facts regarding the maritime-growth relationship. Maduechesi *et al*. (2023) demonstrated a strong positive relationship between world economic growth and seaborne trade volume, quantifying an elasticity of approximately 0.8, indicating that maritime trade is pro-cyclical with economic growth. IMF (2024) showed that shipping costs significantly affect trade volumes and patterns, with a 10% reduction in shipping costs associated with a 5-8% increase in trade volumes. Coşar (2018) provided compelling evidence that containerisation a maritime innovation, substantially increased global trade, estimating that the adoption of container shipping increased trade volumes by over 300% between 1966 and 2000.

Evidence from Developing Economies

Empirical research from other developing economies provides important comparative insights. Osadume & Okuoyibo examined seaport efficiency and trade balance in Africa, finding that improvements in port efficiency significantly enhance trade performance. Chasomeris (2021) reviewed empirical evidence on port efficiency determinants globally, concluding that institutional quality, private sector participation, and infrastructure investment are key drivers of port performance. Jiang *et al*. (2018)

demonstrated mutually reinforcing relationships between trade growth and transport logistics activities in ASEAN countries.

Evidence from Nigeria

Studies specific to Nigeria have produced mixed but generally supportive evidence. Adenigbo *et al*. (2023) employed the Vector Error Correction Model (VECM) and found a significant long-run relationship between shipping trade activity and economic growth. Their findings suggested that improvements in logistics and shipping operations can spur economic performance through enhanced trade connectivity and expanded market reach. Lim (2019) analysed seaport efficiency and economic growth, concluding that seaport operational efficiency benefits Nigeria's economic performance through improved trade flows and logistics productivity (Ndalu & Okene, 2024). Appraised shipping trade influence and found positive but modest effects on economic growth.

Contradictory Evidence and Debates

Despite the consensus on the positive role of maritime transport, important contradictions and debates exist. First, while some studies emphasise quantity indicators (cargo volumes, ship calls), others argue that quality indicators (efficiency, turnaround time) are more important for economic development. This debate has important policy implications: Should countries focus on expanding port capacity or improving operational efficiency? Second, the relationship between maritime activity and economic growth may be bidirectional, raising endogeneity concerns. While maritime activity may stimulate growth through trade facilitation, economic growth also generates increased demand for maritime services. Third, some studies suggest that the benefits of maritime transport are not automatic but depend on complementary factors such as institutional quality, infrastructure connectivity, and human capital (Njoku *et al*., 2020). Fourth, there is debate regarding whether maritime transport primarily benefits large firms and exporters or also benefits small enterprises and domestic markets.

Theoretical Mechanisms Linking Maritime Performance to Growth

The theoretical mechanisms through which maritime transport performance affects economic growth can be categorised into several interconnected channels. Fundamentally, efficient maritime transport lowers the overall cost of trade by reducing shipping, insurance, and inventory expenses (Lai *et al*., 2019). This cost reduction consequently leads to lower consumer prices, enhances the competitiveness of domestic industries, and broadens access to international markets. Building upon this cost efficiency, the reliability channel posits that enhanced port operations bolster supply chain dependability, thereby supporting just-in-time production, minimising inventory requirements, and improving business predictability, particularly for time-sensitive and perishable goods (UNCTAD, 2024). Furthermore, through the investment channel, well-developed maritime infrastructure not only signals robust institutional quality but also attracts foreign direct investment, especially within the export and logistics sectors, to support global business activities (Maduechesi *et al*., 2024). In addition, the specialisation channel highlights that efficient maritime systems enable countries to focus on industries where they hold a comparative advantage, ultimately fostering greater economies of scale and higher productivity (Carrasco *et al*., 2021). Finally, this extensive connectivity facilitates technology transfer, where cross-border exchange of goods promotes knowledge sharing and technological advancement (Owoputi & Owolabi, 2020).

Research Methodology

Research Design and Data

This study employs an ex post facto research design using annual time-series data from 1995–2022 (28 observations). Data were sourced from the Nigerian Ports Authority (NPA), Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS), and UNCTAD maritime statistics databases.

Table 1: Variable definition and measurement

Variable	Symbol	Definition	Source	Expected Sign
Real GDP	RGDP	Naira millions (2010 prices)	CBN, NBS	Dependent
Cargo Throughput	CT	Metric tonnes	NPA	Positive (+)
Ship Calls	SC	Vessel arrivals (count)	NPA	Positive (+)
Gross Registered Tonnage	GRT	Tonnes	NPA	Positive (+)
Port Turnaround Time	PTT	Days	NPA	Negative (-)

All variables were transformed into natural logarithms to stabilise variance, enable elasticity interpretation, and improve statistical properties. The log-linear models are:

$$In(RGDP_t)=\beta_0+\beta_1 In(CT_t)+\beta_2 In(SC_t)+\beta_3 In(GRT_t)+\mu_t In(RGDP_t)=\alpha_0+\alpha_1\ In(PTT_t)+\varepsilon_t$$

Econometric Methodology

Justification for ARDL Approach

The Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran *et al*., 2001) is employed for four reasons: (i) It accommodates variables with mixed integration orders [I (0)] and [I (1)], (ii) it performs well with small samples (28 observations), (iii) it provides separate short-run and long-run coefficient estimates, and (iv) it implicitly addresses endogeneity through lag selection.

Model Specification

The unrestricted error correction model for Model 1 is:

$$\Delta In(RGDP_t)=\beta_0+\sum_{i=1}^{p}\beta_{1i}\,\Delta In(RGDP_{t-i})+\sum_{i=0}^{q}\beta_{2i}\,\Delta In(CT_{t-i})+\sum_{i=0}^{r}\beta_{3i}\,\Delta In(SC_{t-i})+\sum_{i=0}^{s}\beta_{4i}\,\Delta In(GRT_{t-i})+\gamma_1 In(RGDP_{t-1})+\gamma\, In(CT_{t-1})+\gamma_3\, In(SC_{t-1})+\gamma\, In(GRT_{t-1})+\mu_t$$

Model 2: $\Delta In(RGDP_t)=\alpha_0+\sum_{i=1}^{p}\alpha_{1i}\Delta In(RGDP_{t-i})+\alpha_{2i}\,\Delta In(PTT_{t-i})+=\delta_1\, In(\mathrm{RGDP}_{t-i})+\delta_2\ \mathrm{In}(\mathrm{PTT}_{t-i})+\varepsilon_t$

Lag Selection

The optimal lag length was determined using Akaike (AIC), Schwarz (SIC), and Hannan-Quinn (HQIC) criteria with a maximum lag of 4 (appropriate for annual data with 28 observations).

Table 2: Lag selection results

Model	Optimal Lag	AIC	SIC	HQIC	Selected ARDL
Model 1	1	5.87*	6.23*	6.01*	ARDL (1,1,1,1)
Model 2	1	3.18*	3.39*	3.25*	ARDL (1,1)

Note: *indicates the minimum value for each criterion

Justification for Separate PTT Estimation

Port turnaround time is estimated separately because it is highly correlated with cargo throughput, has different policy and theoretical implications, aligns with previous studies, and separate modelling provides more reliable estimates with the available sample size (Chasomeris, 2021; Osadume & Okuoyibo, 2020; Lim *et al*., 2019).

Unit Root Testing

The Augmented Dickey-Fuller (ADF) test examines stationarity:

$$\Delta Y_t=\gamma_0+\gamma_t t+\delta Yt\text{-}1+\sum_{i=1}^{k}\phi_i\Delta Y_{t-i}+\varepsilon_t$$

With H_0:$\delta=0$(*unit root*) vs. H_1:$\delta<0$ (*stationary*)

Cointegration Testing

The DL bounds test examines the null hypothesis of no cointegration:

Model 1: $H_0: \gamma_1=\gamma_2=\gamma_3=\gamma_4=0$

Model 2: $H_0: \delta_1=\delta_2=0$

Cointegration exists if the F-statistic exceeds the upper-bound 266 critical value (Pesaran *et al*., 2001; Narayan, 2005) for small samples.

Error Correction Model

The ECM captures short-run dynamics:

$$\Delta In(RGDP_t)=\beta_0+\sum_{i=1}^{p}\beta_{1i}\Delta In(RGDP_{t-i})+\sum_{i=1}^{q}\beta_{2i}\Delta In(CT_{t-i})+\sum_{i=1}^{r}\beta_{3i}\Delta In(SC_{t-i})+\sum_{i=1}^{s}\beta_{4i}\Delta In(GRT_{t-i})+\lambda ECT_{t-1}+\mu_t$$

A negative and significant λ confirms cointegration, with the magnitude indicating adjustment speed.

Diagnostic Tests

Model diagnostics include tests for serial correlation (Breusch-Godfrey), heteroskedasticity (Breusch-Pagan-Godfrey), normality (Jarque-Bera), functional form (Ramsey RESET), and parameter stability (CUSUM and CUSUM of squares).

Results

Descriptive Statistics

Table 3: Descriptive statistics (1995–2022)

Variable	Mean	Std Dev	Min	Max	Skewness	Kurtosis	JB (p-value)
RGDP	53,221.65	18,789.45	21,881.56	74,752.42	0.12	2.34	1.45 (0.48)
CT	53,947,234	44,101,892	13,273,053	163,748,274	1.45	4.67	12.34 (0.00)
SC	4,247.11	663.48	3,023	5,232	-0.23	2.12	2.34 (0.31)
GRT	117,411,648	27,892,145	78,838,624	191,116,321	0.89	3.12	6.78 (0.03)
PTT	5.34	0.68	3.9	6.3	-0.45	2.56	3.45 (0.18)

Source: Author's computation, 2026

Interpretation: RGDP shows moderate variation (mean = 53,221.65, SD = 18,789.45) with normal distribution (p = 0.48). CT exhibits the highest variability (SD = 44,101,892) and non-normal distribution (p = 0.00), reflecting policy shifts and infrastructure changes. GRT shows moderate variation (SD = 27,892,145) with slight non-normality (p = 0.03). PTT averages 5.34 days (range: 3.9–6.3 days), indicating substantial variation in operational efficiency. The normality of RGDP, SC, and PTT supports parametric estimation.

Unit Root Tests

Table 4: ADF unit root tests

Variable	Levels: ADF	p-value	Stationary?	1st Diff: ADF	p-value	Stationary?	Integration Order
RGDP	-2.45	0.14	No	-4.87	0	Yes	I (1)
CT	-1.89	0.34	No	-5.34	0	Yes	I (1)
SC	-2.12	0.24	No	-4.56	0	Yes	I (1)
GRT	-1.76	0.4	No	-5.12	0	Yes	I (1)
PTT	-3.12	0.03	Yes	-	-	-	I (0)

Note: Critical value at 5% = -3.58 (levels), -3.59 (1st diff)

Source: Author's Computation, 2026

Interpretation: All variables except PTT are non-stationary at levels but become stationary after first differencing. PTT is stationary at levels (ADF = -3.12, p = 0.03). The mixed integration order [I (0)] and [I (1)] confirms the appropriateness of the ARDL bounds testing approach, as traditional cointegration methods require all variables to be integrated of the same order.

Cointegration Tests

Table 5: ARDL bounds test for cointegration

Model	F-Statistic	10% I (0)	10% I (1)	5% I (0)	5% I (1)	1% I (0)	1% I (1)	Result
Model 1 (CT, SC, GRT)	5.87	2.45	3.52	2.86	4.01	3.74	5.06	Cointegration
Model 2 (PTT)	6.45	2.37	3.2	2.79	3.67	3.65	4.66	Cointegration

Note: Critical values from Pesaran *et al*. (2001) for k=3 and k=1

Source: Author's computation, 2026

Interpretation: For both models, the F-statistics (5.87 and 6.45) exceed the upper-bound critical values at all significance levels, rejecting the null hypothesis of no cointegration. This confirms stable long-run equilibrium relationships between maritime transport performance indicators and economic growth in Nigeria.

Long-run Coefficients

Table 6: ARDL long-run coefficients

Model	Variable	Coefficient	Std Error	t-stat	p-value	95% CI
Model 1	ΔCT	0.42	0.08	5.25	0	[0.26, 0.58]
	ΔSC	0.15	0.1	1.5	0.148	[-0.05, 0.35]
	ΔGRT	0.31	0.06	5.17	0	[0.19, 0.43]
Model 2	ΔPTT	-0.28	0.05	-5.6	0	[-0.38, -0.18]

Source: Author's computation, 2026

Interpretation: Increasing ship arrivals alone does not significantly impact economic growth; efficiency and cargo volume per call are more important. This aligns with the findings of Nnaukwu (2024) and Aruwei and Eko-Raphaels (2022).

Short-run Dynamics (Error Correction Model)

Table 7: Short-run ECM results

Model	Variable	Coefficient	p-value	ECT (-1)	p-value	Adjustment Speed
Model 1	ΔCT	0.18	0.032	-0.65	0.001	65% annually
	ΔSC	0.07	0.21			(1.5 years)
	ΔGRT	0.12	0.025			
Model 2	ΔPTT	-0.12	0.018	-0.71	0	71% annually
						(1.4 years)

Source: Author's computation, 2026

Interpretation: Short-run coefficients confirm immediate effects: CT (0.18, p = 0.032), GRT (0.12, p = 0.025), and PTT (-0.12, p = 0.018) significantly affect GDP in the current year. SC remains insignificant (0.07, p = 0.210). The error correction terms (-0.65 and -0.71) indicate rapid adjustment to long-run equilibrium (65-71% annually, approximately 1.4–1.5 years), suggesting close linkage between maritime performance and macroeconomic outcomes.

Diagnostic Tests

Table 8: Diagnostic test results

Test	Model 1 (p-value)	Model 2 (p-value)	Result
Serial Correlation (BG-LM)	0.412	0.378	No autocorrelation
Heteroskedasticity (BPG)	0.345	0.256	Homoskedastic
Normality (Jarque-Bera)	0.484	0.31	Normal residuals
Functional Form (RESET)	0.678	0.451	Correct specification
Stability (CUSUM/ CUSUMSQ)	Within 5% band	Within 5% band	Stable parameters

Discussion of Findings

Cargo Throughput and Economic Growth

The positive and significant effect of cargo throughput (0.42 elas tic ity) confirms that cargo handling capacity is a primary driver of economic growth in Nigeria. This finding is consistent with Adenigbo *et al*. (2023), who reported a 0.35 elasticity for shipping trade activity, and Li *et al*. (2019), who found seaport efficiency positively affects economic performance.

From a theoretical perspective, cargo throughput serves as a fundamental driver of economic growth by facilitating trade specialisation and economies of scale. Furthermore, it stimulates job creation, attracts foreign direct investment, and enhances export competitiveness by significantly reducing overarching logistics costs. In evaluating port performance, cargo throughput is consistently regarded as a more robust and critical metric than the mere number of ship calls. While ship calls primarily reflect the frequency of vessel arrivals, throughput accurately captures operational efficiency, capacity utilisation, and the generation of value-added maritime activities. Consequently, maximising the volume of cargo handled per vessel call yields substantially greater economic dividends. Grounded in these theoretical mechanisms, it is imperative for Nigerian ports to strategically prioritise enhancing cargo throughput capacity over merely increasing the frequency of vessel arrivals to optimise their economic contributions.

Port Turnaround Time: The Critical Role of Efficiency

The strong negative relationship between PTT and economic growth (-0.28 elasticity) underscores that operational efficiency is paramount. This aligns with (Nnaukwu, 2024) & (Aruwei & Eko-Raphaels, 2022), who found that congestion and delays significantly undermine economic performance. Longer turnaround times raise shipping and inventory costs, disrupt supply chains, reduce export competitiveness, and deter foreign investment, with each extra port day increasing shipping costs by 3-5%.

Reducing turnaround time should be prioritised, as even small decreases can significantly boost GDP. Strategies include investing in infrastructure, adopting digital technologies, streamlining regulations, and enhancing capacity.

Insignificance of Ship Calls

Ship calls are insignificant because many vessels have low cargo loads, transhipment offers limited benefits, poor infrastructure causes congestion,

minimal value-added activities reduce impact, and additional calls yield diminishing returns.

This contrasts with findings from highly efficient ports (e.g., Singapore, Rotterdam) where vessel calls positively affect growth through network externalities. The difference reflects Nigeria's lower port efficiency and institutional quality. The policy implication: Focus on efficiency and cargo utilisation rather than attracting more vessel calls.

Gross Registered Tonnage and Infrastructure Quality

The positive economic impact of Gross Registered Tonnage (GRT), demonstrated by an elasticity of 0.31, reflects several interconnected operational mechanisms. Foremost among these is the realisation of economies of scale, as deploying larger vessels significantly reduces per-unit shipping costs. Complementing this cost advantage are network effects; a port's ability to accommodate these larger vessels inherently enhances its broader maritime connectivity and integration into global trade routes. Furthermore, GRT serves as a crucial indicator of infrastructure quality, directly reflecting essential physical attributes of the port, such as sufficient navigational depth and advanced cargo-handling capacity. Ultimately, these interrelated elements culminate in enhanced modal efficiency, demonstrating that facilitating larger vessels is instrumental in establishing a highly cost-effective and optimised shipping ecosystem.

Adjustment Speed and Policy Relevance

The estimated error correction terms, ranging from -0.65 to -0.71, indicate a rapid speed of adjustment to long-run equilibrium within approximately 1.4 to 1.5 years. This swift adjustment period carries several significant economic and policy implications. Primarily, it suggests quick returns on investment, demonstrating that implementing targeted maritime reforms and infrastructural improvements will generate rapid economic benefits. Building upon this timeline, the findings emphasise that immediate policy action is required; any administrative or developmental delays will inevitably impose immediate economic costs on the system. Ultimately, this rapid adjustment highlights a close structural linkage, proving that maritime sector performance and broader macroeconomic outcomes are tightly and dynamically interconnected.

Theoretical and Policy Implications

This study offers several significant theoretical and methodological contributions to the existing maritime economics literature. Primarily, it establishes a clear conceptual distinction between volume-based indicators—such as Cargo Throughput (CT) and Gross Registered Tonnage (GRT)—and efficiency metrics like Port Turnaround Time (PTT). Furthermore, the research provides robust empirical support for the multiple theoretical transmission channels linking maritime performance to economic growth. Importantly, it contextualises these dynamics within a developing economy framework, offering fresh empirical evidence on port economics in emerging markets. Methodologically, the study enriches the analytical landscape by employing the Autoregressive Distributed Lag (ARDL) approach, which effectively accommodates variables with mixed orders of integration.

Translating these theoretical insights into actionable governance, the findings delineate a comprehensive framework for policy priorities across varying timelines. In the immediate term (0–6 months), achieving operational efficiency is of high priority; authorities must focus on automating customs clearance, implementing single-window systems, digitising operations, and reducing inter-agency delays. Following closely (6–12 months), high-priority regulatory reforms should be executed to streamline bureaucratic procedures, minimise redundant inspections, and actively promote Public-private Partnerships (PPPs). Concurrent with these reforms (6–18 months), there is a critical need for high-priority technology adoption—

encompassing advanced digital systems, data analytics, and real-time tracking—complemented by medium-priority capacity-building initiatives aimed at training personnel and adopting international best practices. Over a broader horizon of 1 to 3 years, high-priority infrastructure investments remain paramount, necessitating the deepening of navigational channels, expansion of terminal capacities, modernisation of handling equipment, and the improvement of hinterland connectivity. Finally, to ensure the sustained efficacy of these interventions, ongoing medium-priority performance monitoring must be institutionalised through regular Key Performance Indicator (KPI) measurements, continuous benchmarking, and proactive stakeholder feedback.

Conclusions and Recommendations

Summary of Findings

This study provides robust empirical evidence on the maritime transport-growth nexus in Nigeria spanning the period from 1995 to 2022, utilising the Autoregressive Distributed Lag (ARDL) bounds testing approach. The empirical results reveal that cargo handling capacity is a primary driver of trade and development, as evidenced by the significant positive impact of cargo throughput (yielding an elasticity of 0.42) on economic growth. Similarly, gross registered tonnage exerts a positive effect (0.31 elasticity), further underscoring the critical role of vessel capacity and underlying infrastructure quality. In stark contrast, the sheer number of ship calls does not significantly influence economic growth, firmly indicating that the qualitative volume of cargo handled matters substantially more than the quantitative frequency of vessel arrivals. From an operational standpoint, port turnaround time shows a significant negative relationship with growth (-0.28 elasticity), underscoring the critical need for operational efficiency to minimise delays. Furthermore, the short-run dynamics corroborate these immediate economic interactions, revealing a rapid annual adjustment rate of 65% to 71% towards the long-run equilibrium. Finally, comprehensive diagnostic tests confirm that the estimated models are structurally stable, well-specified, and statistically reliable for drawing robust policy inferences.

Policy Recommendations

To fully realise the economic potential of the maritime sector, policymakers must pursue a cohesive strategic agenda, with operational efficiency serving as the most immediate priority. Implementing swift measures to reduce Port Turnaround Time (PTT) specifically through comprehensive automation, the integration of single-window systems, digitalisation, and streamlined clearance procedures is critical. Notably, achieving a mere 6.4% reduction in PTT, equivalent to decreasing the duration from 5.34 to 5.0 days, is projected to generate substantial macroeconomic benefits, yielding approximately 954 billion Naira in GDP gains. Concurrently, to sustain and amplify these operational efficiencies, robust infrastructure investments are imperative. Authorities must strategically focus on deepening navigational channels, expanding terminal capacities, modernising handling equipment, and significantly improving hinterland connectivity to elevate overall cargo throughput capacity and comfortably accommodate larger vessels.

Furthermore, these physical and operational enhancements must be firmly underpinned by comprehensive regulatory reforms. This entails systematically dismantling bureaucratic bottlenecks, streamlining inter-agency coordination, implementing risk-based customs clearance frameworks, and actively promoting private sector participation through Public-Private Partnerships (PPPs). Finally, seamlessly tying these multifaceted initiatives together is the essential pursuit of technology adoption and capacity building, ensuring that the integration of advanced digital technologies is matched by rigorous personnel training and the institutionalisation of international best practices in port management and logistics.

Limitations and Future Research

While this study provides robust insights into the maritime-growth nexus, several

methodological and contextual limitations must be acknowledged. Primarily, the empirical analysis is constrained by a relatively small sample size of 28 observations, which inherently limits the number of control variables that could be robustly incorporated into the model. Consequently, due to these data constraints, the current framework omits other pivotal macroeconomic determinants such as trade openness, exchange rate fluctuations, and Foreign Direct Investment (FDI). Furthermore, the reliance on aggregate macroeconomic data masks nuanced sectoral differences, while the single-country focus on Nigeria naturally restricts the broader generalizability of these findings to other diverse maritime economies.

To address these constraints and build upon the current theoretical framework, future research should prioritise comparative studies across multiple African nations to establish a more generalised regional perspective. Additionally, scholars are encouraged to conduct disaggregated sectoral analyses—specifically isolating the agriculture, manufacturing, and services sectors—to uncover sector-specific sensitivities to maritime performance. Methodologically, subsequent studies would benefit from employing Granger causality tests to ascertain the precise directional linkages between the variables. Finally, incorporating variables related to institutional quality and governance, alongside conducting micro-level firm studies on the direct effects of port efficiency, will provide a more granular and comprehensive understanding of how maritime ecosystems drive economic development.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Author's Contributions Statement

The authors confirm their contributions to the article as follows: Study conception and design: Ogola Daniel and Kolade Akinpelu; data collection: Ogola Daniel; analysis and interpretation of results: Adebayo Isreal. All the authors have reviewed the results and approved the final version of the manuscript.

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