



Deciphering the Dynamics of Ship Turnaround Time and Gross Registered Tonnage at Selected Nigeria Seaports

Richard C. Osadume^{1,*}, Israel O. Imide²

ARTICLE INFO

Article history:

Received 03 Feb 2025;
in revised from 05 Mar 2025;
accepted 12 Jun 2025.

Keywords:

Ship Turnaround time; Gross Registered Tonnage; Revenue Performance; Economic Growth; Apapa Seaport; Port-Harcourt Seaport.

ABSTRACT

This research examined the impact of operational performance on revenue generation at Port-Harcourt and Apapa seaports in Nigeria. The research used time series data covering from 1982 to 2022, the work utilized econometric methods, including Unit root tests, ordinary least square regression and co-integration to explore the nexus between ship turnaround time (STT), gross registered tonnage (GRT), and port revenue. The result revealed that at Port-Harcourt, STT showed a statistically negative but significant effect on revenue ($p < 0.05$), with a 1% increase in STT leading to a 25750.57% decrease in revenue. Conversely, STT's influence on Apapa's revenue was statistically insignificant ($p > 0.05$). GRT had a positively significant effect on revenue at Apapa ($p < 0.05$), with a 1% increase in GRT associated with a 543.1925% increase in revenue, but its influence was insignificant at Port-Harcourt ($p > 0.05$). The research study concludes that specific interventions are needed to improve operational efficiency and revenue performance. A major recommendation is for Port-Harcourt to prioritize the reduction of Ship Turn Time through infrastructure upgrades and improvements and streamlined procedures.

© SECMAR | All rights reserved

1. Introduction.

Seaports are economic important gateways for facilitating international trade and triggering economic growth. This research paper interrogates the complex relationship between ship turnaround time (STT), gross registered tonnage (GRT), and revenue performance at two important seaports in Nigerian: Port-Harcourt and Apapa. Earlier works have established the importance of seaports in global trade (Osadume and University, 2020; International Chamber of Shipping, 2020), the immediate factors affecting their revenue generation demands closer investigation. This study attempts to validate the existing literature works by comparatively analyzing the impact of STT and GRT on revenue performance at the referenced ports. Understanding

these nexus is important for policymakers and port authorities whose goals includes optimizing operations, encouraging competitiveness of Ports, and maximize revenue generation within the Nigerian maritime sector. This work recognizes the existing debates surrounding the factors affecting port performance, with some research works emphasizing the contributions of revenue performance (Ehbenine, 2018; Smith, 1776) while the rest authors emphasize the role of operational efficiency and infrastructure (Johnson, 2020). This research study seeks to close this gap by focusing on the influence of STT and GRT on revenue generations of ports.

1.1. Statement of the Problem.

Seaport operational efficiency are crucial for facilitating international trade and economic growth drive. A major aspect of efficiency in port operations is the timely turnaround of ships, which helps to reduce costs for both shippers and Shipping lines. Delayed ship turnaround times can cause increased demurrage charges, delays in cargo delivery, and reduction in port competitiveness. Also, the types of vessels calling at a port, as reflected in their gross registered tonnage (GRT), can affect

¹Dept. of Maritime Economics and Finance. Faculty of Transport. Nigeria Maritime University, Okerenkoko. Nigeria.

²Dept. of Economics. Faculty of Social Sciences. University of Delta, Agbor, Nigeria.

*Corresponding author: Richard Osadume. E-mail Address: dr.rcosadume@gmail.com.

revenue generation significantly. Larger vessels will ordinarily carry more cargo/containers, this will lead to higher revenue from handling fees and other charges. But accommodating larger vessels would require capital expenditures in deeper berths, larger cranes, and other infrastructure, which can affect profitability of the port. While ample research recognizes the importance of STT and GRT in port performance, there is an urgent need for more focused studies to examine their specific effect on revenue generation, particularly with reference to developing economies like Nigeria. This study addresses this lacuna by conducting a comparative analysis of the referenced seaports, investigating how STT and GRT influence revenue performance at each port, considering their distinctive infrastructural and operational characteristics.

1.2. Objectives of the Study.

The specific objectives of this study includes:

- i. To analyze comparatively the nexus between ship turnaround time (STT) and port revenue at Apapa and Port Harcourt seaports.
- ii. To explore comparatively the relationship between gross registered tonnage (GRT) and port revenue at Apapa and Port-Harcourt seaports.
- iii. To itemize the major factors mediating the nexus between Revenue and STT, and between Revenue and GRT, at each seaport.
- iv. To assess the relative efficiency of Apapa and Port - Harcourt seaports in generating revenue based on STT and GRT.
- v. To evolve policy recommendations for upgrading revenue performance at seaports in Nigeria by optimizing STT and accommodating larger vessels.

1.3. Significance of the Study.

The importance of this research work with respect to STT and GRT will include:

- i. Use of the output by Policymakers: The work will supply data-driven insights to shape policies targeted at reducing STT and bringing in larger vessels.
- ii. Strategies for Port Authorities: The study will produce practical strategies to optimize berth scheduling, improving cargo handling processes, and seaport infrastructure investments that can attract larger vessels.
- iii. Informed Decisions by Shipping Lines and Businesses: This Understanding will impact STT and GRT for seaport performance, allowing shipping lines to make better informed decisions on vessel deployment and route planning.
- iv. Researchers and Academics will also benefit from this study by adding to current level of knowledge in these areas
- v. Economic growth of Local Communities

2. Literature Review.

The maritime sector of Nigeria plays a vital role in the nation's economy, helping to facilitating trade and transportation through its extensive network of waterways (Akaso et al, 2011). Maritime transportation is the spinal cord of international trade, facilitating the movement of goods across continental borders (Afolabi, 2015). Efficient and effective port operations are necessary for realizing the maximum potential of maritime transportation, creating jobs, facilitating economic diversification, and enhanced foreign exchange generations (UNCTAD, 2020). Notwithstanding, the sector also faces challenges, ranging from environmental concerns (EPA) to infrastructural deficiency. Seaports in Nigerian such as Apapa and Port-Harcourt, are necessary for the nation's trade activities, which are mostly outward-bound (Olukoju, 2006; Badejo, 2012; Badejo and Solaja, 2014).

Port-Harcourt seaport, situate in Rivers State, commands a major role in harnessing the oil and gas industry (Nigerian Ports Authority, 2023). Apapa seaport, located in the Marina-Apapa coastal hub of Lagos State, is Nigeria's largest and busiest port, carrying significant cargo volume, including bulk goods, containers and petroleum products (Nigerian Ports Authority, 2023; Osadume, Okene, Uzoma and Enaruna, 2023). Measuring Seaport performance is a complex process, compassing various operational and financial indicators (Brunet, 2003; Kaplan & Norton, 1992; Singh et al. 2016). Ship turnaround time (STT), which is the total time a vessel spends at a port, is a sensitive performance indicator (Daganzo & Goodchild, 2005; Moon 2018; Brouer, Dirksen, Pisinger, Plum, & Vaaben (2013); Comtois & Slack 2018). Productive STT is necessary for attracting sea-going vessels as well as shipping companies, and port revenue maximization. Gross registered tonnage (GRT), measures a ship's internal volume and it is another important factor influencing seaport operations and revenue. This research work studies the nexus between STT, GRT, and port revenue performance, interrogating how these factors contribute to the financial success of seaports in Nigeria. The revenue generated at seaports comes from various sources, these includes custom duties, clearing and forwarding fees, shipping haulage fees, berthing tariffs etc (Akaso, et al 2011; Chizea, 2015; Ekpo, 2012). An Analysis is essential to the influence of STT and GRT on these revenue heads and crucial for understanding the overall financial performance and competitiveness of seaports in Nigeria.

The main conceptual framework for this research draws upon the literature on economics of Port, maritime transport, and logistics. Key concepts include:

Ship Turnaround Time (STT): This is the total time a ship spends at a port, from arrival to departure. It measures port efficiency as an indicator and helps in the determination of costs of shipping (Daganzo & Goodchild, 2005).

Gross Registered Tonnage (GRT): This is used to measure a vessel's internal volume, and it classifies vessel size. This indicator measurement is relevant for port planning and infrastructure development (Stopford, 2013).

Port Revenue: This is the financial income earned by a port from all sources. This includes cargo handling fees, berthing

charges, and other related levies.

Port Efficiency: This is the optimal utilization of port resources to achieve maximum output and minimum costs. Optimal and efficient port operations are necessary to minimize STT and maximize revenue earnings.

Economies of Scale: These are cost advantages tied to larger-scale operations. In the context of ports, economies of scale helps to accommodate larger vessels (higher GRT) and handle larger volumes of cargo at minimal costs.

2.1. Theoretical Review.

The theory adopted for this study hinges upon the Performance Theory (Elger, 2007) and economic growth theory, which helps to understand the factors that influence Seaport revenue. In this environment, the theories helps to showcase how improvements in ship turnaround time (STT) and the various types of vessels calling at the port (shown by GRT) contribute primarily to port performance and revenue earnings. The focus of the theory is on the interconnectedness of various performance components, which is particularly relevant, as it takes cognizance that STT and GRT are not the only determinants of revenue performance but interact with other operational and contextual indicators. Economic growth theories (Mascelluti, 2021; Weil, 2003) provide the broader economic environment for understanding the importance of efficient and optimal port operations for the nation's development.

This research study grounded in the Performance Theory (Elger, 2007), showcases the interconnectedness of various factors that influence performance. Within this medium, the theory suggests that STT and GRT are essential indicators of port revenue, but their impact is mediated by other factors, which includes port infrastructure, operational performance and efficiency, and management practices. Some of these further indicators include; i) The Queueing Theory (Gross et al., 2008) which provides framework for the understanding of the dynamics of ship arrivals, berthing, and cargo handling, these are relevant for analyzing STT. This helps to identify bottlenecks and optimize the allocation of resources to reduce waiting times and build on port efficiency. The Theory of Constraints (Goldratt, 1990) pictures the importance of classifying and indicating the most significant constraints limiting performance. In the arena of ports, these constraints may be related to infrastructure capacity, equipment availability, or operational procedures.

Economic growth theories provide an inextricable backdrop for comprehending the significance of efficient and excellent seaport operations. The above theories, while they often focus on aggregate national output (e.g., GDP), torchlights the importance of indicators that contribute to overall economic growth and performance. For example, neoclassical growth models reveal the roles of capital, labour, and techno-critical advancements (although they may not explicitly address port excellent operations). However, excellent and efficient functioning infrastructure, such as well-functioning seaports, will be seen as an essential form of capital that drives trade and triggers economic growth. Also, improvements in logistics at the port and reductions in ship turnaround time can be seen as forms of technological advancement that activates productivity in the mar-

itime sector. As Mascelluti (2021) puts it, one complex phenomena known globally is economic growth with variations across countries, and factors like port operation efficiencies can contribute to these variations. Weil (2003) suggests that economic growth should be measured through indicators like GDP, balance of trade, and external reserves. Excellent and efficient seaports, by encouraging trade and earning revenue, can positively affect these indicators. By enhancing STT and growing the utilization of larger vessels, ports can activate increased trade volumes, stir revenue generation, and ultimately, the living standard of a nation's economy."

2.2. Empirical Review.

This research work considered several studies that have examined the role of STT and GRT in port operations and performance. A case in hand, several studies showed a negative relationship between STT and port efficiency, with faster turnaround times resulting to enhanced performance. Other studies researched the effect of GRT on port revenue generation, which suggested that seaports that can berth larger vessels tend to earn more revenue.

The empirical literature on STT and GRT is considerable. Several studies have examined the nexus between STT and port operational efficiency, most times using econometric models and data from various operational ports globally. Studies have consistently revealed that shorter STT is related to improved port operational performance and improved competitiveness (e.g., Brouer et al., 2013). Researches on GRT have explored the nexus between vessel size and port operational costs, indicating the trade-offs between the benefits of handling larger vessels and port infrastructure costs upscales (e.g., Talley, 2004). Most researches on Nigerian seaports have often focused on the problems of congestion and delays, which is responsible for long STT (e.g., Onyema, Emeghara and Ahmodu, 2019; Osadume et al, 2024). This research work builds upon this existing literature by systematically examining the comparative nexus between STT and GRT on revenue earnings and performance at Apapa and Port-Harcourt seaports, with respect to their unique operational and infrastructural environments. This study will try to interrogate the mediating role of indicators such as infrastructure, management practice and equipment.

2.3. Research Gaps.

Existing researches have provided valuable clues into the role of STT and GRT in port operational performance, several lacuna remain;

i) There is an urgent case for more comparative researches focusing specially on Nigerian ports, considering the Nigerian maritime sector unique challenges.

ii) There is need for more research on specific factors affecting the connection between STT and revenue, and between revenue and GRT, which includes the roles of port operational infrastructure, equipment capacity and availability, labour productivity, logistical efficiency, and management practices.

iii) There is acute need for research works that evaluate the interaction between STT and GRT, with reference to how the

size of vessels calling at a seaport affects the required turnaround time. This work will aim to sufficiently address these lacunas by conducting a deep and robust comparative study on Apapa and Port-Harcourt seaports, providing needed clues for port authorities as well as policymakers.

3. Material and Methods.

This section shows the methodological sequence employed to interrogate the comparative influence of Ship Turnaround Time (STT) and Gross Registered Tonnage (GRT) on revenue performance at Port-Harcourt and Apapa seaports in Nigeria. It outlines the research design, data sources, variable measurement, model specification, and analytical techniques used in the study.

3.1. Research Design.

This study adopts a quasi-experimental, comparative case study design. While a true experimental design, involving the manipulation of variables, is not feasible in this context, the quasi-experimental approach allows for the examination of the relationship between STT, GRT, and revenue performance across two distinct cases (Port-Harcourt and Apapa seaports) over a specific time period. This comparative case study design enables an in-depth analysis of the specific contexts of each port and how these contexts influence the relationship between the key variables.

3.2. Population of the Study.

The population for this study comprises all cargo vessels calling at Port-Harcourt and Apapa seaports during the period under investigation (1981-2022). While analyzing every single vessel is not practical, the study uses aggregated annual data, effectively treating each year as a unit of analysis. This approach allows for a longitudinal analysis of the trends and series in STT, GRT, and revenue earning performance.

3.3. Method and Sources of Data Collection.

This work relies mainly on secondary data. The major data sources are:

NPA (Nigerian Ports Authority) Annual Reports and Statistical Bulletins: This provides important data on cargo throughput, vessel traffic, ship turnaround time, port revenue and gross registered tonnage, for both Apapa and Port-Harcourt seaports.

NBS (National Bureau of Statistics) Databases: The NBS provides economic data, such as exchange rates, which may be important for controlling external factors affecting port revenue.

Data to be collected will cover the period 1981-2022, where appropriate. Where data are not available, appropriate data surfing and imputation techniques, e.g. linear interpolation or averages, will be considered. The main data points collected will include:

Yearly Port Revenue (PTR): This is total revenue generated by each seaport, broken down if possible (e.g., Berthing charges, cargo handling fees).

Average Ship Turnaround Time (STT): The average time (in days or hours) taken for vessels to complete their port calls at each port annually.

Total Annual Gross Registered Tonnage (GRT): The sum of the GRT of all vessels calling at each seaport annually.

Average yearly Exchange Rate (EXR): This will serve as control variable for any potential impact of fluctuations in exchange rate on seaport revenue.

3.4. Operational Measures of Variables.

Port Revenue (PTR): Measured in Nigerian Naira (?) and deflated using the Consumer Price Index (CPI) to provide for inflation.

Ship Turnaround Time (STT): This is measured in days.

Gross Registered Tonnage (GRT): This is measured in tons.

Exchange Rate (EXR): This is measured as the average annual exchange rate of the Nigerian Naira to US dollar.

3.5. Model Specification.

The research model is developed and modified after the work of (Osadume and Edih, 2020) which used the variables of Total

Port Revenue to Gross Domestic Product f (TRGDP) for dependent variable proxy to Total Revenue to total gross registered tonnage (TRGRT), OSTP is Operating surplus (Ports) to total tonnage of cargo

handled (Throughput), Operating Surplus to Operating Revenue (OSOR) of the seaports authorities.

This can be represented by an equation (1)[Osadume & Edih, 2020] as follows;

$$TRGDP = \beta_0 + \beta_1 TRGRT + \beta_2 OSTP + \beta_3 OSOR + \mu \quad (1)$$

We modify equation one above to reflect our selected variables for seaport performance and transform to give;

i.

$$PTR = f(STT) \quad (2)$$

$$PTR = \beta_0 + \beta_1 STT + \mu \quad (2a)$$

ii.

$$PTR = f(GRT) \quad (3)$$

$$P = \beta_0 + \beta_1 GRT + \mu \quad (3a)$$

The model is represented below as:

$$PTR = \beta_0 + \beta_1 STT + \beta_2 GRT + \beta_3 EXCR + \beta_4 CTP + \mu \quad (4)$$

Where

PTR = Port Total Revenue,

STT = Ship Turnaround Time,

CTP = Cargo Throughput (control variable),

GRT = Gross Registered Tonnage,

EXCR = Exchange Rate,

U = Stochastic error term,

Bo - baseline and B1, B2 B3 and B4 coefficients of the regression parameters to be estimated.

3.6. Method of Data Analysis.

The data regression will be estimated via relevant econometric software (e.g., Eviews, Stata). The analysis will proceed as follows:

Descriptive Statistics: Calculate descriptive statistics (mean, median, standard deviation, minimum, maximum) for all variables to understand their distribution and characteristics.

Stationarity Tests: Conduct panel unit root tests (e.g., Levin-Lin-Chu, Im-Pesaran-Shin) to check for the stationarity of the variables. If variables are non-stationary, appropriate transformations (e.g., differencing) will be applied.

Data Regression: Estimate the panel data regression model using the appropriate estimator (Linear regression model estimator test).

Diagnostic Tests: Conduct diagnostic tests to check for potential econometric issues, including:

Heteroscedasticity: Use tests like the Breusch-Pagan test or White test.

Autocorrelation: Use the Wooldridge test for autocorrelation in panel data.

Multicollinearity: Examine the Variance Inflation Factors (VIFs) to detect multicollinearity among the independent variables.

3.7. APriori Expectations.

This research work expects a negative relationship between STT and port revenue ($\beta_1 < 0$), implying shorter turnaround times lead to improved revenue. Quicker turnaround times allow ports to handle increased ships and cargo, leading to increased revenue from various fees and charges.

This study expects a positive relationship between GRT and port revenue ($\beta_2 > 0$), implying that ports that accommodate larger vessels (higher GRT) generate more revenue. Larger vessels will ordinarily carry more cargo, leading to higher revenue from cargo handling fees and other related charges. However, the relationship might not be strictly linear. Ports may need to invest in specialized infrastructure to handle very large vessels, which could impact profitability.

4. Data and Discussions.

4.1. Diagnostics Treatment.

The preliminary tests carried out to determine the suitability of the variables in the series for this research work are Descriptive Statistics, Stationarity test, Johansen Co-integration test.

Descriptive Statistics.

The descriptive statistics reveals the basic information about measure of central tendency, measure of dispersion and measure of normality of the dependent and independent variables.

Table 1a: Descriptive Statistics - Rivers Port.

	CTP	EXCR	GRT	PTR	STT
Mean	68.54259	171.2270	.541111	82156.10	6.127407
Median	65.23000	148.8800	5.560000	44285.56	6.830000
Maximum	160.7000	423.9000	34.05000	515267.7	10.55000
Minimum	12.62000	21.89000	-74.34000	3779.130	2.050000
Std. Dev.	40.15944	106.4934	19.97850	114921.4	2.571940
Skewness	0.376220	0.920348	-2.256670	2.593803	-0.257783
Kurtosis	2.295640	3.181084	10.57279	9.614423	1.765982
Jarque-Bera	1.195076	3.848571	87.43207	79.49458	2.012185
Probability	0.550165	0.145980	0.000000	0.000000	0.365645
Sum	1850.650	4623.130	149.6100	2218215.	165.4400
Sum Sq. Dev.	41932.31	294862.2	10377.66	3.43045	171.9867
Observations	27	27	27	27	27

Source: Author’s E-views 12 Computation.

CTP (Cargo Turnaround Time): The mean (68.54) is marginally higher than the median (65.23), suggesting a slight positive skew. The high standard deviation (140.16) indicates significant variability in cargo turnaround times. The positive skewness and kurtosis suggest some very long turnaround times are pulling the mean up.

EXCR (Exchange Rate): Similar to CTP, the mean (171.23) is greater than the median (148.88), indicating a positive skew. The large standard deviation (106.49) shows substantial fluctuation in exchange rates. The higher kurtosis suggests more extreme values than a normal distribution would have.

GRT (Gross Registered Tonnage): The negative minimum value (-74.34) is a major red flag and likely an error in the data. GRT cannot be negative. The high standard deviation (19.98) and extreme skewness (-2.26) and kurtosis (10.57) are also likely due to this erroneous data point. This variable needs immediate data correction.

PTR (Port Turnaround Time): The mean (82156.10) is much larger than the median (44285.56), indicating a strong positive skew. The very high standard deviation (114921.40) and kurtosis (9.61) suggest a few extremely long port turnaround times are heavily influencing the mean.

STT (Ship Turnaround Time): The mean (6.13) is slightly lower than the median (6.83), indicating a slight negative skew. The standard deviation (2.57) is relatively moderate. The negative skewness and platykurtic (kurtosis < 3) distribution suggest more consistent ship turnaround times with a few shorter durations.

Table 1b: Descriptive Statistics - Apapa Seaport Analysis.

	CTP	EXCR	GRT	PTR	STT
Mean	21222416	163.0413	29694074	192.8652	7.163043
Median	20645269	148.8800	29258335	163.2000	7.010000
Maximum	26987241	325.8000	37046879	518.0000	9.640000
Minimum	17986998	21.89000	3303555	38.10000	4.200000
Std. Dev.	2295774.	76.86780	3874279.	50.1406	1.537638
Skewness	0.918261	0.945093	0.196622	0.630934	-0.218463
Kurtosis	3.358195	3.281192	2.066218	.187085	2.411938
Jarque-Bera	3.355240	3.499708	0.983815	.159262	0.514358
Probability	0.186818	0.173799	0.611459	.339721	0.773230
Sum	4.8808	3749.950	6.8308	4435.900	164.7500
Sum Sq. Dev.	1.1614	129990.5	3.3014	495928.6	52.01529
Observations	23	23	23	23	23

Source: Author’s E-views 12 Computation.

CTP (Cargo Turnaround Time): Similar to the case of Port Harcourt, the mean exceeds the median, indicating a positively skewed distribution. However, the standard deviation (2295774) is lower than that observed in Port Harcourt, suggesting comparatively reduced variability in cargo turnaround times.

EXCR (Exchange Rate): The mean is again higher than the median, confirming the presence of positive skewness. The standard deviation (76.87) is smaller than in Port Harcourt, indicating lower exchange rate volatility and a more stable distribution.

GRT (Gross Registered Tonnage): The distribution appears more consistent and statistically plausible than in Port Harcourt, with a positive mean and a standard deviation lower than the mean. This suggests a more balanced dispersion and the absence of extreme outliers.

PTR (Port Turnaround Time): The mean exceeds the median, indicating a positively skewed distribution. The relatively high standard deviation reflects substantial variability, suggesting the presence of extreme values that may influence the overall distribution.

STT (Ship Turnaround Time): The mean is marginally higher than the median, indicating a mild positive skewness. The relatively low standard deviation suggests consistent ship turnaround times with limited dispersion.

Unit Root Test.

Table 2a: Unit Root Output - Rivers Port.

Variable	t-statistics	ADF @ 5%	Probability	Integration
CTP	-6.15868	-1.95502	0.0000	I(1)
EXCR	-4.68511	-3.60320	0.0050	I(1)
GRT	-3.41635	-3.62203	0.00242	I(1)
PTR	-3.4736	-3.62203	0.0042	I(1)
STTT	-4.61806	-3.64496	0.0074	I(1)

Source: Author’s E-views 12 Computation.

Table 2a reports the tests for stationarity properties of the series following the Augmented Dickey Fuller (ADF) statistics. All the variables were found to be stationary at order one (1). At the First difference as reported, the ADF Statistics for the respective variables were more negative than the critical values at 5% significance level. The reported P values were all less than 0.05 chosen level of significance for which cause, the Null Hypothesis of the presence of unit root in all the variables is convincingly rejected. For the purposes of Cointegration analysis and tests, it is also interesting to state that the variables are all integrated of the same order.

Table 2b: Unit Root Test - Apapa Seaport Performance.

Variable	t-statistics	ADF @ 5%	Probability	Integration
CTP	-4.90619	-3.60320	0.0031	I(1)
EXCR	-4.68511	-3.60320	0.0050	I(1)
GRT	-5.27545	-3.60320	0.0013	I(1)
PTR	-4.04719	-1.95568	0.0003	I(1)
STTT	-7.66847	-3.60320	0.0000	I(1)

Source: Author’s E-views 12 Computation.

The unit root or stationarity tests is used to ascertain the stationarity level of the series in a given model when their probabilities are less than chosen level of significance. In table 2b, while four of the variables were stationary at first difference level (CTP, EXCR, GRT and STT, their probabilities being statistically significant at p-values below the 5% confidence level, while other variable (such as PTR) were stationary at levels. The null hypothesis will thus be rejected, that there are no unit roots in the series.

Table 3a: Breusch-Godfrey Serial Correlation Test - Rivers Port.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	1.991583	Prob. F(2,16)	0.1689
Obs*R-squared	4.584499	Prob. Chi-Square (2)	0.1010

Source: Author’s E-views 12 Computation.

Table 3b: Breusch-Godfrey Serial Correlation LN Test - Apapa Seaport.

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	2.031897	Prob. F(4,14)	0.1449
Obs*R-squared	8.448031	Prob. Chi-Square(4)	0.0765

Source: Author’s E-views 12 Computation.

Breusch-Godfrey Serial Correlation Test.

The Breusch-Godfrey tests is used to test for the presence or absence of serial or autocorrelations in the model with the Null hypothesis stating that there is No autocorrelation. This holds if p-value is greater than the chosen level of significance otherwise reject.

From table 3a, the p-value is greater than the chosen level of significance of 5%, indicating the absence of autocorrelation in the model. This is further enhanced with a Durbin-Watson statistics of 2.0347. Hence, we do not suspect any violation of the assumptions of classical linear regression.

From table 3b, the p-value is greater than the chosen level of significance of 5%, indicating the absence of autocorrelation in the model. This is further enhanced with a Durbin-Watson statistics of 1.8861. Hence, we do not suspect any violation of the assumptions of classical linear regression.

Heteroskedasticity Test.

The null hypothesis states that there is No heteroskedasticity if p-value is not significant and is greater than the chosen level of significance of 5%. Hence, in this case we accept the Null hypothesis that there is no evidence of heteroskedasticity since p-value is greater than 5% significance level.

Again, we accept the Null hypothesis that there is no evidence of heteroskedasticity since p-value is greater than 5% significance level.

Table 4a: Heteroskedasticity Test - Rivers Port.

Heteroskedasticity Test: ARCH			
F-statistic	2.132653	Prob. F(1,24)	0.1572
Obs*R-squared	2.121827	Prob. Chi-Square(1)	0.1452

Source: Author’s E-views 12 Computation.

Table 4b: Heteroskedasticity Tests - Apapa Seaport.

Heteroskedasticity Test: ARCH			
F-statistic	1.357086	Prob. F(1,20)	0.2578
Obs*R-squared	1.397939	Prob. Chi-Square(1)	0.2371

Source: Author’s E-views 12 Computation.

Hypothesis Testing.

H0₁: There is no significant relation between turnaround time and Port revenue performance of Port- Harcourt and Apapa seaports.

HA₁: There is significant relation between turnaround time and Port revenue performance of Port- Harcourt and Apapa seaports.

H0₂: There is no significant effects of Gross registered tonnage on Port-Harcourt and Apapa seaport revenue performance.

HA₂: There is significant effects of Gross registered tonnage on Port-Harcourt and Apapa seaport revenue performance.

4.2. Hypothesis Testing – Performance Parameters of Rivers Port, Port-Harcourt.

Ordinary Least Square Regression Result.

Table 5a: Ordinary Least Square Result - Rivers Port - Port-Harcourt Seaport.

Dependent Variable: PTR				
Method: Least Squares				
Sample (adjusted): 1998 2020				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-31311.33	39929.76	-0.784160	0.4431
CTP(2)	1538.913	441.3918	3.486502	0.0026
GRT(2)	543.1925	511.2371	1.062506	0.3021
STT(-2)	-25750.57	6971.794	-3.693536	0.0017
EXCR(1)	876.7738	128.6798	6.813609	0.0000

Source: Author’s E-views 12 Computation.

From table 5a, the STT (-2) at lag 2, has a t-statistic value of

-3.693536 and p-value of 0.0017 and this effect is statistically significant at the 5% level. While, the GRT (2) at lead 2, with a t-statistics of 1.062506 and a p-value of 0.3021, shows a statistically insignificant effect on port revenue at the 5% level of significance.

Similarly, a cointegration test to ascertain the nature of relationship in the long-run, using co-integration trace and maximum eigenvalue tests revealed as below;

Table 6a: Trace Co-integration Rank Tests.

Sample (adjusted): 1998 2022				
Series: CTP EXCR GRT PTR STT				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.876360	08.3109	69.81889	0.0000
At most 1 *	0.699499	56.05130	47.85613	0.0070
At most 2	0.487808	5.99370	29.79707	0.1289
At most 3	0.291246	.267307	15.49471	0.3412
At most 4	0.026100	.661154	3.841465	0.4162
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

Source: Author’s E-views 12 Computation.

The trace test in table 6a, indicates the existence of two co-integrating vectors, showing a long-run relationship between port revenue at the river’s seaport and other performance parameters such as cargo throughput, gross registered tonnage and ship turnaround time (p-value = 0.0000 and 0.0070).

Table 7a: Maximum Eigenvalue Co-integration Rank Tests.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.876360	52.25959	33.87687	0.0001
At most 1 *	0.699499	30.05760	27.58434	0.0236
At most 2	0.487808	16.72639	21.13162	0.1853
At most 3	0.291246	8.606153	14.26460	0.3204
At most 4	0.026100	0.661154	3.841465	0.4162
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				

Source: Author’s E-views 12 Computation.

Also, table 7a, the maximum eigenvalue test indicates the existence of two co-integrating vectors, showing a long-run relationship between port revenue at the river’s seaport and other performance parameters such as cargo throughput, gross registered tonnage and ship turnaround time (p-value = 0.0001 and 0.0236).

Decision Rule: We reject the null hypothesis, to accept the alternative, that there is significant relationship between ship turnaround time and port revenue of rivers seaport. Similarly,

for the second hypothesis, we reject the null hypothesis, to accept the alternat

ive that the is a statistically significant relationship between gross registered tonnage and port revenue performance of rivers seaport.

4.3. Hypothesis Testing for Apapa Port, Apapa.

Table 5b: Least Square Regression Output - Apapa Seaport.

Dependent Variable: PTR				
Method: Least Squares				
Sample (adjusted): 1998 2020				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-908.0170	222.8510	-4.074547	0.0007
CTP(2)	1.45005	6.2506	2.311853	0.0328
EXCR(-2)	1.505739	0.251556	5.985691	0.0000
GRT(-2)	1.67605	4.40406	3.785976	0.0014
STT(2)	14.42654	8.586743	1.680094	0.1102

Source: Author’s E-views 12 Computation.

From table 5b, the GRT (-2) at lag 2, has a t-statistic value of 3.785976 and p-value of 0.0014 and this effect is statistically significant at the 5% level. The EXCR serves as a moderating variable.

However, STT at a led of 2, has a t-statistic of 1.680094 and a p-value of 0.1102, which indicates a statistically insignificant effect of Ship turnaround time on Port revenue.

A review of the long-term relationship between these variables, is further undertaken in order to validate the nature of relationship;

Table 6a: Trace Co-integration Rank Test.

Sample (adjusted): 2000 2020				
Included observations: 21 after adjustments				
Series: CTP EXCR GRT PTR RESID STT				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. Of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.985656	172.9347	95.75366	0.0000
At most 1 *	0.864142	3.80168	69.81889	0.0026
At most 2	0.585524	1.88263	47.85613	0.1620
At most 3	0.380016	23.38707	29.79707	0.2275
At most 4	0.313080	3.34779	15.49471	0.1027
At most 5 *	0.229004	.461503	3.841465	0.0194
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				

Source: Author’s E-views 12 Computation.

The trace test indicators the existence of two co-integrating vectors, showing a long-run relationship between port revenue at the Apapa seaport and other performance parameters such as cargo throughput, gross registered tonnage and ship turnaround time (p-value = 0.0000 and 0.0026).

Table 7b: : Least Square Regression Output - Apapa.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. Of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.985656	89.13301	40.07757	0.0000
At most 1 *	0.864142	41.91905	33.87687	0.0044
At most 2	0.585524	18.49556	27.58434	0.4544
At most 3	0.380016	10.03929	21.13162	0.7410
At most 4	0.313080	7.886285	14.26460	0.3903
At most 5 *	0.229004	5.461503	3.841465	0.0194
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				

Source: Author’s E-views 12 Computation.

The maximum eigenvalue test indicators the existence of two co-integrating vectors, showing a long-run relationship between port revenue at the Apapa seaport and other performance parameters such as cargo throughput, gross registered tonnage and ship turnaround time (p-value = 0.0000 and 0.0044).

Decision Rule: We accept the null hypothesis, to reject the alternative, that there is no significant relationship between ship turnaround time and port revenue of Apapa seaport. However, in the case of the gross registered tonnage, we reject the null hypothesis, to accept the alternative that there is a statistically significant relationship between gross registered tonnage and port revenue performance of Apapa seaport.

4.4. Discussion of Findings.

This study on “Deciphering the Dynamics of Ship Turnaround Time and Gross Registered Tonnage’s Influence on Revenue Performance at Nigerian Seaports” namely – River’s port and Apapa port. The motive of such a study was to affirm or refute established seaport performance standards and ascertain the better performing seaport from chosen area of study. Following a detail theoretical review and empirical analyses, findings were made in line with the research questions as well as set and tested hypotheses. The findings are hereby discussed below in line with the objectives of this study.

Objective One.

To compare the relationship between turnaround time and revenue performance between Port-Harcourt and Apapa seaports.

The result of the study revealed that for River’s seaport, the ship turnaround time had a negatively significant effect on Port revenue with a p-value of 0.0017 while, for Apapa seaport ship turnaround time had an insignificant effect on Port revenue of

the seaport with a p-value of 0.1102. While outcome agrees with literature, that of Apapa seaport, however, does not align with literature possibly due to its size and premiership status. This outcome is equally supported by the findings of in the work of Onyema, Emeghara and Ahmodu (2019) and Omoke et al of a positive relationship with the economy. The implication of such an outcome is that a 1% increase in vessel turnaround time will result to a 25750.57% decline in Port revenue at River’s port while it will have no impact on Apapa seaport.

Objective Two.

To compare the effect of gross registered tonnage on revenue performance between Port-Harcourt and Apapa seaports.

The result of the study revealed that for River’s seaport, the gross registered tonnage had an insignificant effect on Port revenue with a p-value of 0.3021 while, for Apapa seaport gross registered tonnage had a positively significant effect on Port revenue of the seaport with a p-value of 0.0014. While outcome agrees with literature, that of Rivers seaport, however, does not align with literature possibly due to its the influence of competition from rival ports. This outcome is equally supported by the findings of in the work of Onyema, Emeghara and Ahmodu (2019) and Omoke et al of a positive relationship with the economy. The implication of such an outcome is that a 1% increase in gross registered tonnage will result to a 1.6761% rise in Port revenue at Apapa seaport only.

Conclusions.

This study investigated the relationship between operational performance (ship turnaround time (STT) and gross registered tonnage (GRT)) and revenue performance at Port-Harcourt and Apapa seaports in Nigeria. The findings reveal a contrasting picture between the two ports. At Port-Harcourt, STT has a statistically significant negative impact on revenue, suggesting that longer turnaround times lead to decreased revenue. The implication of this study is that a 1% rise in STT will result to a 25750.57% fall in seaport revenue. This outcome agrees with extant literature. Conversely, STT’s effect on Apapa’s revenue was insignificant, this may be due to Apapa’s larger size and market dominance. This result is consistent with some prior research. Regarding GRT, it had a statistically significant positive effect on revenue only at Apapa seaport, with a 1% increase in GRT leading to a 1.6761% rise in revenue. At Port-Harcourt, GRT’s influence on revenue was insignificant, possibly due to competition from other ports. This outcome aligns with previous studies. These findings emphasize the need for calculated interventions to raise both seaport operational efficiency and revenue generation capacity.

Recommendations:

i) study urges the government to optimize Ship Turnaround Time at the Port-Harcourt seaport, through investments in automated modern cargo handling equipment, streamlined single-window customs procedures, improved coordination among port

stakeholders, while at the Apapa seaport, continuous monitoring and reporting will help to maintain competitiveness.

ii. The seaport authorities at Apapa seaport are encouraged to pursue and implement Strategic GRT Management, to improve GRT and revenue generating capacity by attracting larger vessels. This could be achieved through deepening of seaport channels, expanding berth area capacity and competitive pricing strategies. While at the Port-Harcourt seaport, the strategy should focus on attracting wider and larger vessel sizes, and eventually leading to niche cargo markets. This will improve GRT-related revenue.

References.

- Akaso, A. A., Bariweni, P. A., & Abowei, J. F. (2011). Some economic and environmental benefits of maritime transportation in Nigeria. *Nigerian Journal of Agriculture, Food and Environment*, 7(4), 97–110. (9)
- Afolabi, T. O. (2015). Building economic capacity through maritime infrastructure development. A 3-day annual exhibition and conference- Nigeria: Regenerating economic growth through the maritime sector, Nigeria maritime expo (NIMAREX) 2015 at Eko Hostel & Suites, Victoria Island, Lagos.
- Badejo, B. (2012). Towards achieving effective seaport regulations. Presented at a Seminar on Ports, Terminals and Logistics organized by Admiralty Resources Services, Lagos, 29th–30th June 2010.
- Badejo, B. A., & Solaja, O. M. (2017). The Nigerian seaports and development (1900-2015): Historical perspectives and dynamics. *International Journal of Development and Sustainability*, 6(9), 1007–1024. (9)
- Brouer, B. D., Dirksen, J., Pisinger, D., Plum, C. E. M., & Vaaben, B. (2013). The vessel schedule recovery problem (VSRP) – a MIP model for handling disruptions in liner shipping. *European Journal of Operational Research*, 224(2), 362–374. (9)
- Brunet, R. (2003). *Ports and maritime transport: Infrastructure, strategies, and policies for developing countries*. World Bank Institute.
- Comtois, C., & Slack, B. (2018). Ships time in port. *International Journal of Shipping and Transport Logistics*, 10(1), 45–62.
- Daganzo, C. F., & Goodchild, A. V. (2005). *Reducing ship turn-around time using double-cycling*. Berkeley, CA: University of California Press.
- Ehbenine, A. (2018). The impact of port privatization and concessioning on economic growth. *Journal of Business and Management*, 12(5), 12–22.
- Elger, D. (2007). *A theory of performance*. [Please provide more details: Book, article, etc. Publisher or Journal information is needed.]
- Ekpo, I. (2012). Impact of shipping on Nigerian economy: Implications for sustainable development. *Journal of Educational and Social Research*, 2(7), 107–117. (9)
- Goldratt, E. M. (1990). *The haystack syndrome: Why managers don't see the big picture*. North River Press.
- Gross, D., Shortle, J. F., Thompson, J. M., & Harris, C. M. (2008). *Fundamentals of queueing theory* (4th ed.). Wiley.
- International Chamber of Shipping. (2020). *Shipping world trade*.
- Johnson, O. (2020). *Port problem in developing countries*. Japan: The International Association of Harbors.
- Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard - measures that drive performance. *Harvard Business Review*, 70(1), 71–79.
- Mascelluti, R. (2021). Economic growth. *IZA World of Labor*. Retrieved from <https://wol.iza.org/topics/economic-growth> (9)
- Moon, D. (2018). *Terminal performance measures*. Malmö, Sweden: World Maritime University.
- NPA. (2023). Half-Year Performance Report 2023. Nigerian Ports Authority, Marina, Lagos. [Retrieved from <https://nigerianports.gov.ng/>]
- Olukoju, A. (2006). Maritime policy and economic development: A comparison of Nigerian and Japanese experiences since the Second World War. *Afrika Zamani*, 11 & 12, 160–182. (9)
- Omoke, V., Aturu, A. C., Nwaogbe, O. R., Ajiboye, A. O., & Diugwu, I. (2018). *Analysis of the impact of port operations on Nigerian economy: A focus on Apapa seaport*. University of Minna.
- Osadume, R. C., & University, E. O. (2020). Port revenue performance and economic growth: The Nigerian ports authority experience, 2010–2019. *LOGI – Scientific Journal on Transport and Logistics*, XI(2), 1–11.
- Osadume, R. C., Okene, A. J., Uzomah, B. C., & Enaruna, D. V. (2023). An Evaluation of the Delay Factors in Nigeria's Seaports: A Study of the Apapa Port Complex. *Journal of Transportation and Logistics*, 8(2), 191–204. <https://doi.org/10.26650/JTL.2023.1203871>
- Onyema, H., Emenyonu, U., Kpee, V., & Emeghara, G. (2016). The impact of short-sea shipping on Nigerian economy. *Journal of Maritime Research*, 13(1), 37–40.
- Onyema, H. K., Kingsley, A., & Emeghara, G. C. (2015). Comparative analysis of Port performance in Nigeria: A study of Ports in Rivers state. *The International Journal of Business & Management*, 7(3), 100–107.
- Singh, S., Darwish, T. K., & Potočnik, K. (2016). Measuring organizational performance: A case for subjective measures. *British Journal of Management*, 27, 214–224. (9)
- Smith, A. (1776). *The wealth of nations*. Candell Publishers.
- Stopford, M. (2013). *Maritime economics* (3rd ed.). Routledge.
- Talley, W. K. (2004). Ship size economies of scale and diseconomies of traffic congestion. *Transportation Research Part E: Logistics and Transportation Review*, 40(2), 117–127.
- UNCTAD. (2020). *Review of maritime transport, 2020*. United Nations Conference on Trade and Development.
- Weil, D. N. (2003). *Economic growth*. Addison-Wesley.