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Comparative study of two selected eastern port operational performance in Nigeria: Case of Rivers and Delta ports

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Abstract: *Purpose*: The main purpose of this paper is to compare the operational performance of two selected eastern ports in Nigeria: Rivers and Delta ports. *Methodology:* The paper uses secondary data from the Nigeria Port Authority (NPA) Portal from 2008 to 2013. The paper employs multiple regression models to analyze the data using SPSS and Statgraphics software packages. *Results:* The results show that Rivers Port has a higher operational efficiency than Delta Port, with an R-squared value of 81.34% and 79.47%, respectively. The results also reveal a significant relationship between cargo throughput and independent variables, such as vessel traffic, turnaround time, berth occupancy, and number of employees. *Theoretical contribution:* The paper contributes to the existing literature on port performance measurement and improvement by applying multiple regression models to assess the operational efficiency of two Nigerian ports. The paper also provides empirical evidence on the factors affecting port performance in a developing country context. *Practical implications:* The paper has practical implications for port authorities, maritime agencies, shipping companies, and the government. The paper suggests some policy recommendations to enhance the operational performance of the eastern ports, such as improving port infrastructure, pricing policy, and strategic competition.

Keywords: ports performance, turnaround, port, cargo throughput

1. Introduction

Maritime transport is one of the oldest forms of transport system in Nigeria. It is the main form of international transport system that has a significant economic impact in the history of Nigeria. Nigeria has various water bodies, such as the Atlantic Ocean, lagoons, and rivers. The water transport system has faced many constraints, making it difficult to use as a reliable means of transport because most cataracts and creeks are seasonal waterways that can only be navigated during the rainy seasons, while

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the inland waterways dry up in the dry season. Also, most waterways possess rocks, lowlands, hills, and rapid waterfalls, making navigation difficult (Igberi & Ogunniyi, 2013).

Ports are also points of convergence between two geographical domains of freight circulation. The port is a primary maritime gateway for global trade and a good tool for ascertaining a nation's economic development and health (Ogunsiji & Ogunsiji, 2011). For instance, Trujillo's observation states that there are 2,814 international ports catering for freight traffic worldwide, indicating the level of business activities associated with the maritime sector worldwide (Trujillo & Tovar, 2005).

Operational efficiency is associated with port performance. Physical qualities of items used, scale or scope of activities, levels of efforts expanded, and the efficiency in converting resources into port services capture the centre stage. Indicators like capital facilities expenditure per ton of cargo, revenue per ton of cargo, berth occupancy, number of gangs employed, and vessel turnaround time are used as avenues to measure recent operational performance against the previous year's performance and against competitor performance, to produce efficiency goals (Nwaogbe, Nwuzor, Onyema, Evans, & Eru, 2020).

There are several challenges facing the port. These challenges include poor infrastructure, shallow or poor drafts, and lack of multi-modal linkages in the port. It is essential to highlight how these issues can be solved to enhance growth and increase the port's productivity. Given Nigeria's maritime sector's state, infrastructure issues and excessive seaport fees require immediate correction. The ports in Nigeria are dealing with congestion within the environments of Tin Can and Apapa, as well as shallow entrances on the main highways going to the Eastern ports. Congestion at the port impacts shipping operations, leading to subpar performance, inefficient shipping operations, reduced vessel turnaround time, and long container stay times. Since most berths appear vacant, the average waiting time for ships at the Eastern seaports of Nigeria is at its absolute minimum. Despite being shorter than ships in wealthy nations, the average turnaround time for ships is still low. Compared to the number of calling ships, the berths are more numerous.

Rivers Port is located in the Gulf of Guinea, a transhipment hub for Niger and Chad. It has a 1300 m berthing line for accommodating 8 sea-going vessels simultaneously; it is equipped with 16 tanks of 3050-tonne capacity for storing oil and petroleum products, 7 stacking areas covering 12400 m^2 and 4 arcon sheds with 10500m^2 storage capacity. It also has a dockyard that carries out electrical, marine and engineering works.

The port of Warri lying between Lagos and Onne Port. It covers 1530000m^2 and is divided into the new Warri port and the old one dealing with RORO, containers, and general cargo. It has four container wharves and five general cargo berths covering 1600m with a draft of 8 metres. A 60000 m^2 yard is used for storing containers, and a 2500 m^2 paved area for keeping loose cargo.

This study uses a case study of two Eastern ports to assess port operation and performance in Nigeria. The objectives of this study are to examine the vessel's turnaround time in the study area, to assess the berth occupancy and number of employees in the study, to examine the cargo throughput in the study area, and to forecast the cargo throughput and vessel traffic in the study area.

The importance of this study is to help make policies for the Nigerian port authority, maritime agencies, and shipping companies, with the government, students, and the general public as an eye opener to make sure there is an improvement in the operational activity. The result of this study will help the government solve the problem facing the Eastern port and fix it by reconstructing the road that links to the port, dredging, and making sure the channels are not silty. Doing so will enable more clients to patronize the Eastern port.

Hypothesis

H_1: There is no statistical relationship between cargo throughput and the number of employees
H_2 There is no statistical relationship between cargo throughput and turnaround time
H_3 There is no statistical relationship between cargo throughput and vessel traffic.
H_4 There is no statistical relationship between passenger throughput and vessel turnaround time

2. Literature review

Container ports or terminal operators need operational efficiency and effective management to gain global market competitiveness, Kim, Lee & Kim (2021); as world container ships grow, global shipping alliances reshuffle and become more extensive. Using scenario analysis, this study investigated the effects of integrated operations of the existing separate container terminals. The scenario analysis is attempted based on actual vessel arrival data on additional effects that Busan New Port can obtain from using the infrastructure pool by consolidating all five terminals. The results explain the benefits of terminal consolidation: the reduction of vessel waiting time, balanced utilization across terminals at the port, and increased overall profits for the actors (Kim, Lee & Kim, 2021).

Performance measurement and improvement are essential activities that ports use to enhance their competitive position in the global market. This study investigates this topic in container ports. This study explores the sensitivity of the performance enablers in Jaffar and Berry's port performance model (Jaffar & Berry, 2004). The performance measure used in this model for the container ports is the Twenty Equivalent Unit (TEU), and the port performance predictor variables were leadership commitment to excellence, modern technology, the efficiency of the terminal, port size, and the port hinterland. This study uses time series analysis to investigate the TEU change over five years (start of 1999 – end of 2003). The sample used in this study includes container ports in the Middle East, Far East and Europe. Based on the sample used, the paper suggests that port capacity and crane productivity are the most sensitive enablers affecting container ports' performance (Jaffar, Berry & Ridley, 2005).

Seaport operational efficiency is a critical factor for handling goods in the international supply chains (Otieno, Khin, Hualong & Banomyong, 2011) and is viewed to impact transportation and logistics, which play an essential role in trade exchange with other countries. It is crucial to evaluate the operational efficiency of seaports to reflect their status and reveal their position in this competitive environment. Moreover, knowing the impacts of the efficiency of seaports on the supply chain is vital for business survival. This study uses stochastic frontier and inefficiency models to analyze seaport operational efficiency and the Delphi technique to seek expert respondents' opinions on its characteristics. The research also uses structural equation modelling to build a model of seaport operational efficiency as a further step to examine the significance of the characteristics. The results of this study emphasize the need to improve seaport operational efficiency and indicate which characteristics should be given more attention (Otieno, Khin, Hualong, & Banomyong, 2011).

El Imran & Babounia studied four seaports, namely, Tanger Med, Algeciras Bay, Rotterdam and New York-New Jersey, to understand and evaluate their efficiency of operations and benchmark them. Port efficiency measures the input and output amount and their ratio. Port efficiency is not solely dependent on port performance. The port performance strategies of the case ports were studied, and efficiency variables were found through various literature. To analyze the input and output variables of the ports, efficiency software named Data Envelopment Analysis Program was used to find the most efficient ports. Then, the variables for the most efficient ports were benchmarked and ranked. A hypothetical port efficiency model has also been suggested for better efficiency of the ports.

3. Material and method

The study explored all aspects of port operations and port performance in Nigeria, after which the findings will be of great use for formulating new problems, theories, and ideas. Secondary data from the Nigeria Port Authority (NPA) Portal was employed. The study population covers Nigeria's maritime sector and port performance. Some variables are used in order to carry out practical work. The study will use port performance indicators such as cargo throughput, berth occupancy, vessel traffic, and number of employees for the performance analysis, covering 2008-2017.

3.1. Method of data analysis

To achieve the objectives and test the study's hypothesis, descriptive, multiple regression analysis and one-way analysis of variance (ANOVA) were used for the data analysis. Statistical Package for Social Science Windows version 26.0 (SPSS) software and Statgraphic version 16.0 software were used to analyze the data. Multiple regression models are stated as:

$$\hat{Y} = \alpha + \beta 1(\boldsymbol{x1}) + \beta 2(\boldsymbol{x2}) + \beta\boldsymbol{3}(\boldsymbol{x3}) + \cdots\ldots\ldots + \beta\boldsymbol{n}(\boldsymbol{xn}) + en$$

Where,

Y = dependent variable, $\boldsymbol{xn}$= independent variable, α = constant, $\beta\boldsymbol{n}$ = coefficient of x, en = error term.

Where the dependent variables are:

Y1 = Cargo throughput (CARGO TP), $B_1 \dots B_4$ = coefficients for each independent variable
X_1, X_2, X_3, and X_4 are the research control variables, and they represent:
X_1= Vessel traffic (V-T)
X_2= Average turnaround time (AT)
X_3= Berth occupancy (BO)
X_4= Number of employees (NO)
ϵ=the model's error term (also known as the residuals).

4. Result and discussion

4.1. Results

4.1.1. Rivers Port Performance Analysis

Table 4.1: Analysis of variance of Rivers port performance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	6.7746E14	4	1.69365E14	5.45	0.0456
Residual	1.55407E14	5	3.10814E13		
Total (Corr.)	8.32867E14	9			

R-squared = 81.3407 percent
R-squared (adjusted for d.f.) = 66.4133 percent
Standard Error of Est. = 5.57507E6
Mean absolute error = 2.96389E6
Durbin-Watson statistic = 2.13008 (P=0.4692)
Lag 1 residual autocorrelation = -0.127968

Since the P-value in the ANOVA table is less than 0.05, there is a statistically significant relationship between the variables at the 95.0% confidence level.

The R-squared statistic indicates that the model as fitted explains 81.3407% of the variability in C_T. The adjusted R-squared statistic, which is more suitable for comparing models with different numbers of independent variables, is 66.4133%. The estimate's standard error shows the residuals' standard deviation to be 5.57507E6. This value can be used to construct prediction limits for new observations by selecting the Reports option from the text menu. The mean absolute error (MAE) of 2.96389E6 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is more significant than 0.05, there is no indication of serial autocorrelation in the residuals at the 95.0% confidence level (Nwaogbe et al., 2017).

In determining whether the model can be simplified, notice that the highest P-value on the independent variables is 0.4452, belonging to V_T. Since the P-value is greater or equal to 0.05, that term is not statistically significant at the 95.0% or higher confidence level. Consequently, it would be best to consider removing V_T from the model.

Table 4.2: Analysis of coefficient estimate of Rivers Port performance

Number of observations: 10

		Standard	T	
Parameter	**Estimate**	**Error**	**Statistic**	**P-Value**
CONSTANT	1.25282E8	4.8379E7	2.58959	0.0489
V_T	2105.95	2542.62	0.828262	0.4452
A_T	-1.93492E7	7.70761E6	-2.5104	0.0538
B_O	-811062.	279295.	-2.90396	0.0336
N_E	-122452.	108658.	-1.12695	0.3109

Where Dependent variable: C_T: Cargo Throughput

Independent variables: V_T is Vessel Traffic; A_T is Average Turnaround time; B_O is Berth Occupancy; and N_E is the Number of Employees.

The output shows the results of fitting a multiple linear regression model to describe the relationship between C_T and 4 independent variables. The equation of the fitted model is

C_T = 1.25282E8 + 2105.95*V_T - 1.93492E7*A_T - 811062.*B_O - 122452.*N_E

Table 4.3: 95.0% confidence intervals for coefficient estimates

Parameter	Estimate	Standard Error	Lower Limit	Upper Limit
CONSTANT	1.25282E8	4.8379E7	919404.	2.49645E8
V_T	2105.95	2542.62	-4430.07	8641.98
A_T	-1.93492E7	7.70761E6	-3.91623E7	463906.
B_O	-811062.	279295.	-1.52902E6	-93108.5
N_E	-122452.	108658.	-401765.	156862.

Table 4.3 shows 95.0% confidence intervals for the coefficients in the model. Confidence intervals show how precisely the coefficients can be estimated, given the available data and the present noise.

Table 4.4: Correlation matrix for coefficient estimates

	CONSTANT	V_T	A_T	B_O	N_E
CONSTANT	1.0000	-0.4622	-0.8306	-0.7115	-0.9380
V_T	-0.4622	1.0000	0.4531	0.1163	0.3774
A_T	-0.8306	0.4531	1.0000	0.3308	0.6144
B_O	-0.7115	0.1163	0.3308	1.0000	0.7274
N_E	-0.9380	0.3774	0.6144	0.7274	1.0000

Table 4.4 shows estimated correlations between the coefficients in the fitted model. These correlations can Sbe used to detect the presence of serious multicollinearity, i.e., correlation amongst the predictor variables.

In this case, 2 correlations with absolute values greater than 0.5 (not including the constant term) exist.

Table 4.5: Unusual residuals

Row	Y	Predicted Y	Residual	Studentized Residual
3	2.38328E7	2.50497E7	-1.21696E6	-3.52
8	2.63148E7	1.70098E7	9.30504E6	3.46

Table 4.5 presents unusual residuals, showcasing all observations where the Studentized residuals exceed an absolute value of 2. These residuals gauge the extent to which each observed C_T value deviates from a model constructed using all data except for that specific observation. Within this context, there exist 2 Studentized residuals that surpass a significance of 3. It is advised to thoroughly examine observations exceeding 3 to ascertain if they qualify as outliers. Such outliers may need removal from the model and require separate handling.

Figure 4.6 shows the straight line of cargo throughput as predicted and observed.

Figure 4.6: Plot of C-T, Rivers port

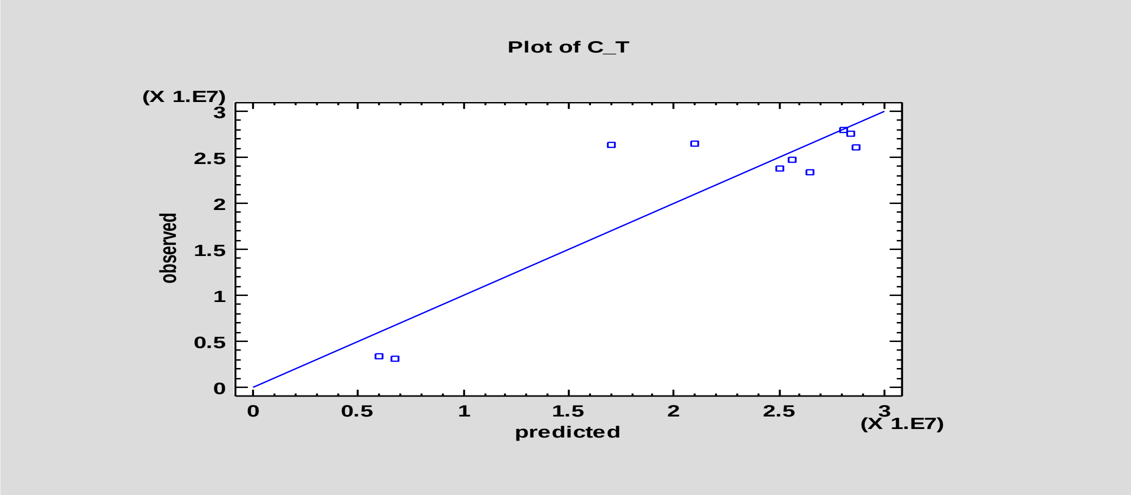

Figure 4.7 shows the standardized cargo throughput predicted residual plot.

Figure 4.7: Residual plot Rivers port

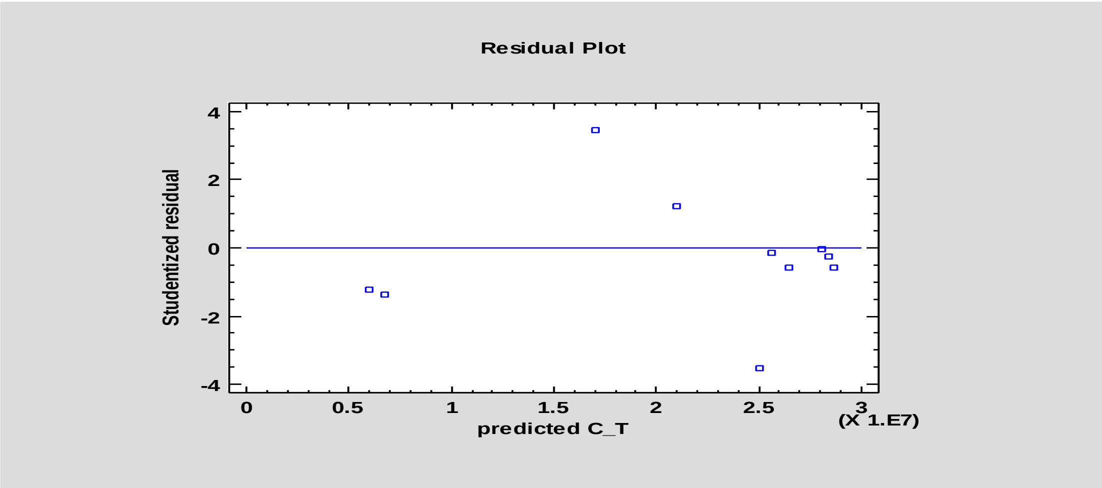

Figure 4.8: Predicted values plot Rivers port

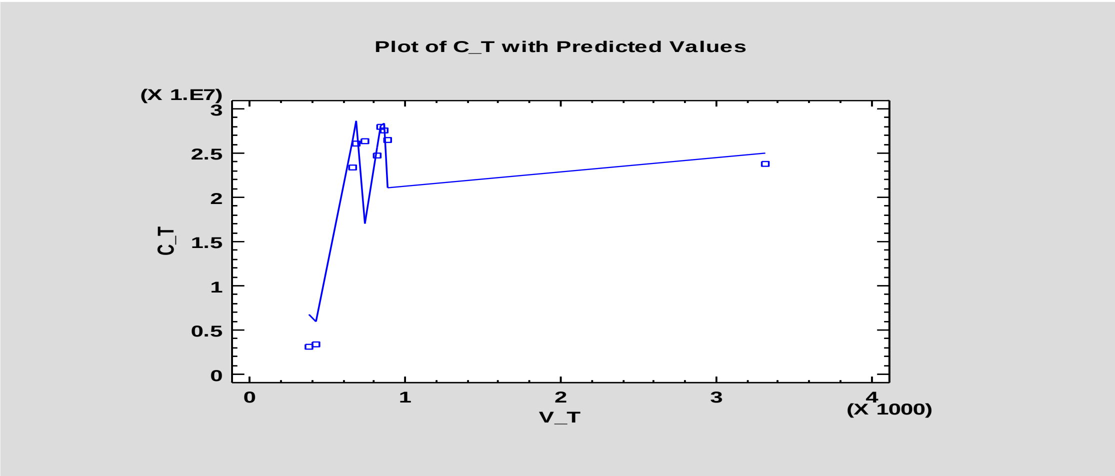

Figure 4.8 above shows the predicted values of the cargo throughput plot with predicted values.

4.2. Analysis of Delta port performance

Table 4.6: Analysis of variance for Delta port performance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	1.41185E13	4	3.52962E12	4.84	0.0571
Residual	3.64801E12	5	7.29602E11		
Total (Corr.)	1.77665E13	9			

R-squared = 79.4669 percent
R-squared (adjusted for d.f.) = 63.0405 percent
Standard Error of Est. = 854167.
Mean absolute error = 422624.
Durbin-Watson statistic = 2.15507 (P=0.3019)
Lag 1 residual autocorrelation = -0.0860918

Since the P-value in the ANOVA table is greater or equal to 0.05, there is no statistically significant relationship between the variables at the 95.0% or higher confidence level.

The R-squared statistic indicates that the model as fitted explains 79.4669% of the variability in C_T. The adjusted R-squared statistic, which is more suitable for comparing models with different numbers of independent variables, is 63.0405%. The estimate's standard error shows the residuals' standard deviation to be 854167. This value can be used to construct prediction limits for new observations by selecting the Reports option from the text menu. The mean absolute error (MAE) is 422624, the residuals' average value. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is more significant than 0.05, there is no indication of serial autocorrelation in the residuals at the 95.0% confidence level.

When assessing the potential simplification of the model, it's important to note that the highest P-value among the independent variables is 0.7034, attributed to N_E. Given that this P-value is greater than or equal to 0.05, the variable N_E lacks statistical significance at a 95.0% or higher confidence level. Therefore, it is advisable to contemplate removing the variable N_E from the model.

Table 4.7: Coefficient standard

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	1.62549E7	2.90754E6	5.59062	0.0025
V_T	1579.75	924.304	1.70912	0.1481
A_T	-1.09103E6	705591.	-1.54626	0.1827
B_O	54635.1	27856.7	1.96129	0.1071
N_E	-2281.08	5656.22	-0.403287	0.7034

Dependent variable: C_T Independent variables: V_T; A_T; B_O and N_E
Number of observations: 10

The output in Table 4.7 shows the results of fitting a multiple linear regression model to describe the relationship between C_T and 4 independent variables. The equation of the fitted model is

C_T = 1.62549E7 + 1579.75*V_T - 1.09103E6*A_T + 54635.1*B_O - 2281.08*N_E

Table 4.8: 95.0% confidence intervals for coefficient estimates

Parameter	Estimate	Standard Error	Lower Limit	Upper Limit
CONSTANT	1.62549E7	2.90754E6	8.78085E6	2.3729E7
V_T	1579.75	924.304	-796.256	3955.75
A_T	-1.09103E6	705591.	-2.90481E6	722757.
B_O	54635.1	27856.7	-16973.0	126243.
N_E	-2281.08	5656.22	-16820.9	12258.7

Table 4.8 shows 95.0% confidence intervals for the coefficients in the model. Confidence intervals show how precisely the coefficients can be estimated, given the available data and the present noise.

Table 4.9: Correlation matrix for coefficient estimates

	CONSTANT	V_T	A_T	B_O	N_E
CONSTANT	1.0000	-0.7952	0.3829	-0.5379	-0.7836
V_T	-0.7952	1.0000	-0.4904	0.5094	0.6262
A_T	0.3829	-0.4904	1.0000	-0.8806	-0.8072
B_O	-0.5379	0.5094	-0.8806	1.0000	0.7619
N_E	-0.7836	0.6262	-0.8072	0.7619	1.0000

Table 4.9 shows estimated correlations between the coefficients in the fitted model. These correlations can be used to detect the presence of serious multicollinearity, i.e., correlation amongst the predictor variables. In this case, there are 5 correlations with absolute values greater than 0.5 (not including the constant term).

Table 4.10: Unusual residuals

		Predicted		Studentized
Row	Y	Y	Residual	Residual
1	1.28079E7	1.30494E7	-241430.	-2.59
3	1.44616E7	1.41983E7	263351.	2.66
7	1.75008E7	1.59846E7	1.51625E6	3.73

Table 4.10 displays unusual residuals, cataloguing all observations where the Studentized residuals exceed an absolute value 2. These residuals quantify the deviation of each observed C_T value from a model constructed using all available data except for that specific observation. In this instance, 3 Studentized residuals surpass a significance of 2, with one exceeding 3. It is advisable to meticulously examine observations greater than 3 to ascertain if they qualify as outliers. Such outliers may warrant removal from the model and necessitate separate handling.

Figure 4.4: Plot of C-T Delta port

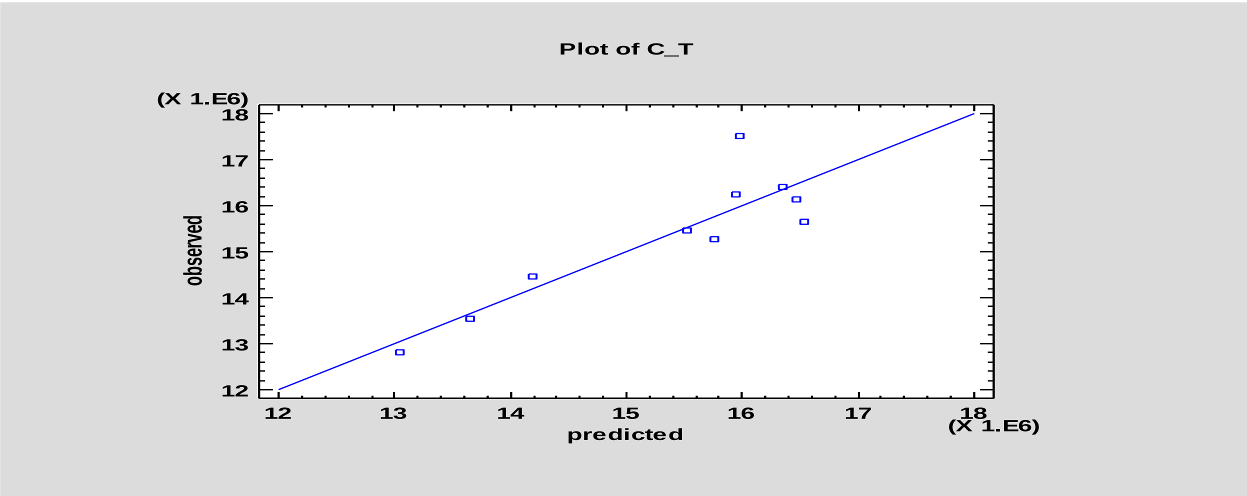

Figure 4.4 shows the straight-line plot of the cargo throughput predicted.

Figure 4.5: Residual plot Delta port

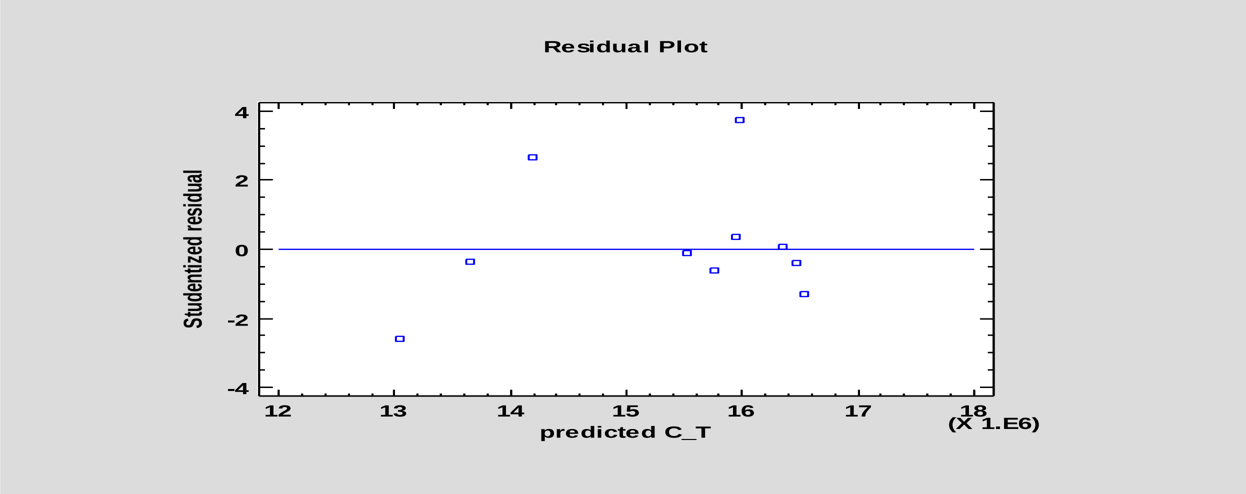

Figure 4.5 shows a residual plot predicted for cargo throughput.

Figure 4.6: C-T Predicted values plot, Delta port

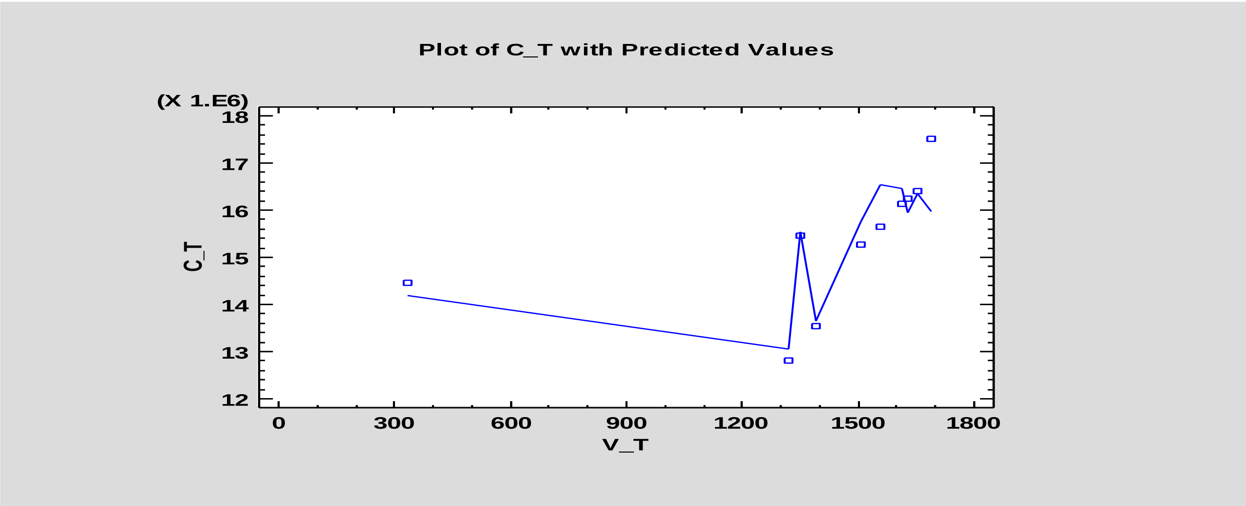

Figure 4.6 shows the predicted value plot for Delta port.

5. Discussion

The study evaluates a comparative study of some selected eastern port operational performance in Nigeria: RIVERS and DELTA PORT case. The study evaluated some hypotheses, including the relationship between cargo throughput and the number of employees, cargo throughput and turnaround time, and cargo throughput and vessel traffic. The entire hypothesis was tested with multiple regression analysis. The RIVERS port performance hypothesis indicates that since the ANOVA table's P-value is less than 0.05, there is a statistically significant relationship between the variables at the 95.0% confidence level. (R=81.34%, F=5.45, P=0.0456) The multiple R of 81.34% indicate the relationship between the cargo throughput, number of employees, turnaround time, and vessel traffic, which are demonstrated as the variables; thus, based on the ANOVA table, the F value of 9 degrees is 5.45F and its significant value is 0.0456, Wanke, Nwaogbe & Chen 2017). The DELTA port performance hypothesis indicates that since the ANOVA table's P-value is greater than 0.05, there is no fully absolute statistically significant relationship between the variables at the % confidence level. (R=79.46%, F=4.84 P=0.0571) The multiple R of 79.46% indicates the relationship between the cargo throughput, number of employees, turnaround time, and vessel traffic, which are demonstrated as the variables; thus, based on the ANOVA table, the F value of 9 degrees is 4.84F, and its significant value is 0.0571 (Nwaogbe et al., 2020).

6. Conclusion

This paper has compared the operational efficiency of two eastern ports in Nigeria: Rivers and Delta ports, using multiple regression models and secondary data from the NPA Portal. The paper has found that Rivers port has a higher operational efficiency than Delta port, with an R-squared value of 81.34% and 79.47%, respectively. The paper has also identified some factors that affect port performance, such as vessel traffic, turnaround time, berth occupancy, and number of employees. These findings have implications for the maritime transport sector and the port industry in Nigeria, as they provide insights into the current state and challenges of the eastern ports, as well as the potential areas for improvement.

The paper has addressed the four hypotheses stated in the introduction, and has confirmed that cargo throughput has a positive and significant relationship with the independent variables, except for the number of employees. The paper has also provided confidence intervals, correlation matrices, residual plots, and predicted values for the coefficient estimates, which enhance the validity and reliability of the results.

However, the paper has some limitations that should be acknowledged and addressed in future research. First, the paper has used secondary data from the NPA Portal, which may not be accurate or complete, as the data collection and reporting methods may vary across ports and years. Second, the paper has focused on only two eastern ports, which may not be representative of the entire port industry in Nigeria. Third, the paper has used a linear regression model, which may not capture the non-linear and complex relationships between the dependent and independent variables. Fourth, the paper has not considered other factors that may influence port performance, such as port governance, environmental factors, or customer satisfaction.

Therefore, future research should use primary data from port operators and stakeholders, which may provide more accurate and comprehensive information on port performance. Future research should also include more ports from different regions and countries, which may allow for a comparative and benchmarking analysis of port performance. Future research should also employ more advanced and robust statistical methods, such as non-linear regression, panel data analysis, or structural equation modeling, which may account for the heterogeneity and endogeneity of the data. Future research should also incorporate more variables that may affect port performance, such as port governance, environmental factors, or customer satisfaction, which may provide a more holistic and multidimensional perspective on port performance.

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Conflicts of interest

The authors declare no conflict of interest.

Data availability

Some or all data and models that support the findings of this study are available from the corresponding author upon reasonable request.

Citation information

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References

El Imran, O., & Babounia, A. (2018). Benchmark and competitive analysis of port performances model: Algeciras Bay, Rotterdam, New York-New Jersey and Tangier Med. *Eur. J. Log. Purch. Supply Chain Manag*, *6*, 28-48.

Igberi, C.O. & Ogunniyi, M.B. (2013). Has maritime transport sector impacted on the growth of Nigeria's economy?. *Journal of business and economics*, 4(8), 722.

Jaffar, W. & Berry, G. (2004). Performance improvement in port authorities: The case of Dubai ports authority. *Proc of Performance Measurement and Management: Public and Private,* eds. A. Neely, M. Kennerley & A. Walters, Cranfield School of Management: Cranfield, pp. 499-506.

Jaffar, W. D., Berry, G. A., & Ridley, I. (2005). Performance management in port authorities. *WIT transactions on the built environment*, *79*, 269-278.

Kim, G., Lee, E., & Kim, B. (2022). Strategic port management by consolidating container terminals. *The Asian Journal of Shipping and Logistics*, *38*(1), 19-24. https://doi.org/10.1016/j.ajsl.2021.11.003

Nwaogbe, O. R., Nwuzor, O. A., Onyema, H. K., Evans, C., & Eru, J. (2020). An evaluation of port operations performance in Nigeria: case of Calabar free port. *Transport & Logistics*, *20*(48).

Nwaogbe, O. R., Pius, A., Abduljelil, A., & Alharahsheh, H. H. (2019). An empirical study of Nigerian seaports operational performance. *Transport & Logistics: The International Journal*, *20*(48), 73-87.

Ogunsiji, A. S., & Ogunsiji, O. O. (2011). Comparative ports performance efficiency measurement in developing nations: A matching framework analysis (M FA) Approach. *European Journal of Social Sciences*, *18*(4), 625-631.

Trujillo, L., & Tovar, B. (2007). The European port industry: An analysis of its economic efficiency. *Maritime Economics & Logistics*, *9*(2), 148-171. https://doi.org/10.1057/palgrave.mel.9100177

Wanke, P., Nwaogbe, O. R., & Chen, Z. (2018). Efficiency in Nigerian ports: handling imprecise data with a two-stage fuzzy approach. *Maritime Policy & Management*, *45*(5), 699-715. https://doi.org/10.1080/03088839.2017.1410588

Yang, H., Lin, K., Kennedy, O. R., & Ruth, B. (2011). Seaport operational efficiency: An evaluation of five Asian ports using stochastic frontier production function model. *Journal of Service Science and Management*, *4*(03), 391-399. https://doi.org/10.4236/jssm.2011.43045

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