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Research Article

A correlation of port users' patronage and tariff structure of Nigerian seaports: A study of Lagos Apapa port

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Abstract

The study evaluated the relationship between port tariff structure and user patronage of Apapa port from 1977 - 2021. Data sourced were secondary data from the Nigerian Ports Authority (NPA) annual reports and NPA simplified tariff structure 2021 providing time series data on ship dues, ship traffic volume, vessel gross registered tonnage, pilotage charge and harbor dues. Six hypotheses were formulated from the objectives of the study to answer the research questions and provide empirical evidence for the statistical results of the study. The study employed Pearson correlation and Simple Linear Regression Analysis to evaluate the relationship between variables. Models were developed which determined the relationships between each of the independent and dependent variables. The study revealed that user patronage of Apapa port has significant relationships with port tariff in terms of the ship dues, harbor dues, and pilotage charges paid to the NPA by ship-owners and/or their agents, accounting for the increasing number of ships regularly visiting the port. In conclusion, the study infers that there is significant relationship between port tariff and user patronage of Apapa port, Nigeria. The study recommends that tariff is an instrument of port pricing which also contributes to overall transport cost, therefore, designed and billed to encourage patronage of the port industry. It is noted that maritime trade competitiveness and the tariff system of a port are considerable factors for ship-owner in patronizing a local port industry.

1. Introduction

The competitiveness of ports was examined in several previous studies following different factors. Hsu et al. (2020) identified cargo volume as a crucial factor in liner carriers' port evaluation. Kaliszewski et al. (2020) surveyed global shipping lines on container port competitiveness. Also, De Souza et al. (2021) found ship calls and cargo concentration vital for port selection in Brazil. Fahim et al. (2022) highlighted the importance of service levels, network interconnectivity, and information systems in future port performance. Munim et al. (2022) assessed port competitiveness in Bangladesh using maritime connectivity and green port management factors. Baştuğ et al. (2022) emphasized port location for operators and operational efficiency for carriers as key factors.

Port tariffs are listed as one of the main competitive factors between ports. It is important for shipping companies' selection (De Sousa et al., 2021). Therefore, the relationship between port users' patronage and a tariff structure is a critical aspect of port management and operation. Ports serve as crucial nodes in global supply chains, facilitating the movement of goods and commodities between

regions and countries. The tariff structure of a port, which encompasses various charges and fees levied on port users for utilizing port services, plays a significant role in shaping port users' behavior and decisions. Understanding the relationship between port users' patronage and the tariff structure is essential for port authorities and policymakers to optimize port performance, enhance competitiveness, and ensure sustainable revenue generation. This relationship analysis seeks to explore how changes in the tariff structure influence port users' patronage levels, and vice versa, shedding light on important factors driving port utilization and financial viability. The examination of this relationship reveals that port stakeholders can make informed decisions regarding tariff adjustments, service offerings, and investment strategies to meet the needs of port users and achieve overall port objectives.

The relationship between port users' patronage and a tariff structure has been a subject of considerable research interest in the field of port management and maritime economics. Several studies have examined this relationship to understand the factors influencing port utilization and revenue generation.

Meersman et al. (2014) indicated that global port pricing structures are not uniform, with general cargo often yielding higher marginal revenues compared to bulk cargoes. In the context of South Africa's ports, vessel charges were found to be below the benchmarked mean, with necessary tariff revenues sourced from tariffs imposed on port tenants and cargo owners. These insights emphasize the importance of tailored tariff structures that consider cargo diversity and revenue streams for optimizing port authority revenues.

In addition, Gumede and Chasomeris (2018) conducted an examination and comparison of the 2013/2014 TNPA (Transnet National Ports Authority) tariff structure with that proposed by the Ports Regulator of South Africa. Their study evaluated and compared the dues for 254 different commodity cargos with the relevant sector base tariffs for the year. They provided a detailed analysis of how these tariffs differed between the two regulatory frameworks. This comparison underlined the variations in pricing strategies and their potential impacts on port operations, shipping companies, and overall trade efficiency. Their findings described how the tariff structures can influence port competitiveness and user patronage, and underscored the need for strategic tariff to enhance port attractiveness.

For port pricing, Achmadi et al. (2017) provided a proposal for port pricing, to establish a standardized cost structure to lower overall logistics expenses. Their approach investigated the intricate aspects of diverse port services tariffs. Furthermore, they examined the regulations of government of these tariffs, such as transparency and equality in pricing mechanisms. Recently, Andriotti et al. (2021) underlined in their study that tariff structures in the analyzed ports showed differences in prices and unit charges, and affected competitiveness analysis.

For patronage, Okorie et al. (2015) proposed two hypotheses to examine the impact of value-adding services (VAS) on port users' utilization and retention. Hypothesis 1 suggested that the level of patronage of a port is influenced by the value-adding services offered by that port. Hypothesis 2 posited that a port's ability to retain users is associated with the value-adding services it provides. The study's results provided strong evidence of an associative relationship between VAS offers and port user's attraction. Furthermore, the findings indicated a significant association between the provision of VAS and the retention of port users.

Okorie et al. (2016) investigated the relationship between VAS and port users' patronage. The study found a positive correlation between the availability of VAS, such as logistics support and cargo handling facilities, and port utilization rates, highlighting the importance of service quality in attracting port users. In addition, the study determine relationship between user patronage and revenue generation based on tariff structure. The regression model displays the impacts of user patronage on revenue based on tariff structure of the port. Hence, there is a connection between VAS on revenue generation based on the tariff structure of the port. **Figure 1** describes how the offer of a VAS supports ports to enhance their user's attractiveness, thus justifying the higher tariffs and the increase of user

patronage. This relationship highlights the strategic importance of value-added services investment to maintain competitiveness and achieve sustainable growth. The VAS can support this relationship in different actions, as mentioned below:

- Boosted service quality within customer satisfaction and efficiency.
- Achieved cost-benefit according to competitive advantage.
- Increased throughput by volume growth and market expansion.
- Integrated operational collaborations by services, innovation, and technology.
- Simplified processes and risk management.
- Considered environmental and sustainability initiatives.

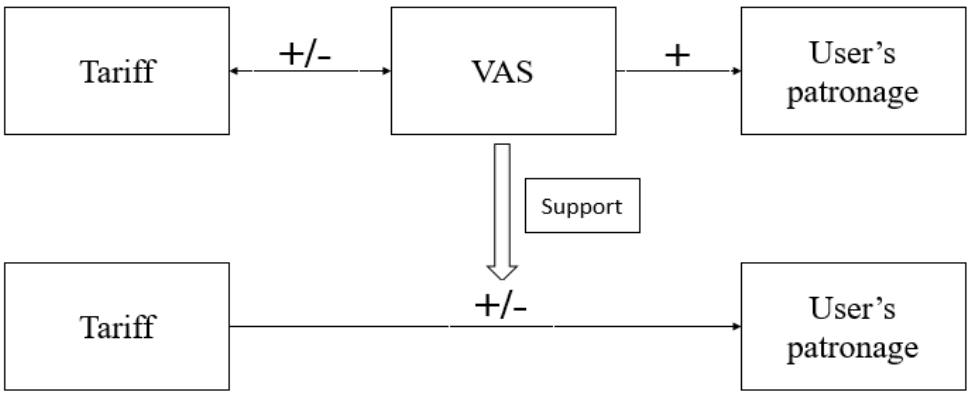

Figure 1 Relationship between tariff, VAS and port users.

Overall, the literature suggests a relationship between port users' patronage and tariff structure. Ports with competitive and transparent tariff systems tend to attract higher levels of patronage, leading to increased throughput volumes and revenue generation.

Nigerian seaports are important gateways to the national economy, as they facilitate the flow of international and coastal trade and enhance efficient logistics flow across all sectors of the national economic systems. They form an interface at the waterfront/seashore where all modes of transport systems interact, such as land, air, rail, and pipeline. These transport modes connect/meet; and the node/point at which the maritime transport mode is fed with traffic (cargo and passenger traffic) from other modes; and at the same time feeds other modes with traffic verse visa. This makes maritime transport unique from other modes of transport (Osis & Dele, 2023; Njite et al., 2015).

Nigerian ports can be grouped according to regions of their locations. Eastern ports include the Onne port, Rivers port, Calabar port, and Warri port, while the Western port are Apapa and Tin Can Island ports located in Lagos, the commercial city of Nigeria. The eastern ports are not as busy as the western ports of Apapa and Tin Can Island ports due to insecurity by the militant and other terrorist groups in the region. The Apapa port especially, being a premiere port, is well developed and equipped in the era of port concession and provides harbor for categories of vessel including container vessels. The location of the port in the commercial heart of Nigeria favors its regional and/or domestic competition among other ports in Nigeria. Apapa port contributes immensely to the economic growth and development of Nigeria through the vast nature of shipping activities influx of the port (Omoke et al., 2022). Apapa port among other Nigerian ports handles over 60 % of export and import shipping trades in Nigeria, hence, generating revenue and employment opportunities, directly and indirectly, for the populace of Nigeria (Irinyemi & Olorunfemi, 2018).

The importance of the seaport and port operations to the economy of the nation cannot be over emphasized, as it exerts the dominant influence on maritime operations and logistics in terms of cost,

productivity/output, time, efficiency, and effectiveness of operations, and similar nodes and entities in the global supply chain network (Hlali & Wanis, 2020). Aside from the trade facilitation role of ports, in which they serve the needs of the general shippers and freight forwarders, shipping companies and ship owners, haulage operators, and oil and gas companies, among numerous other categories of port users, ports also function as revenue generation agencies of governments/states; at least, for the purpose of generating enough revenue that is sufficient to make the port economically self-reliant to run on its own without external financial supports (Sodiq et al., 2017; Adiele & Opara, 2014).

Seaport efficiency has a role in trade facilitation and serves the needs of the different groups of port users; ports make investments and financial commitments into infrastructural provision, service improvement, and operations, as well as provide port services to users (Hlali et al., 2023). The current era of port privatization and concession, more than any other time, exposed the need for port authorities and operators to commercialize operations and services aimed at enabling public regulators and private operators to provide the best of services at a cost and profit (Bamidele & Oludele, 2017). This idea of port operations being provided at a cost and profit suggests the enthronement and the ushering in of a competitive era, where price, quality, and value of port services rendered become major variables that motivate shippers, ship owners, and other categories of a port user's choice of port and/or terminal of call (Eze et al., 2015; Varki & Colgate, 2019). Thus, the concept of port pricing becomes a veritable tool for determination of prices which users of port services must pay for services consumed. At the same time, price becomes a greater veritable tool for revenue generation, investment cost/capital cost recovery, profit generation, and development of competitive advantage cum achievement of higher patronage from port users, by port authorities and operators alike (Bichou & Gray, 2014).

Given the various port tariff and rates regulations in Nigeria over the years that has culminated in increases in port prices, charges, and dues in Nigeria, it has become important to investigate the reactions of shippers, ship-owners, and different categories of port users to these changes in port pricing regimes; charges and rates, as well as measuring the relationships between changes in port pricing and patronage by port users. It is important to understand how the port pricing regime changes relate with the demand for port services by ship-owners and shippers in Nigeria over the periods, and this study is unique as it bridges the gap in the literature to provide relevant information on the relationship between changes in port tariff structures and patronage of port users over periods. The aim of this study is to determine the relationship between changes in port tariff structures and patronage of port users in Nigeria. The specific objectives of the study are: first, to determine the relationship between port tariff and ship traffic volume of Apapa Port from 1977 - 2021. Second, to determine the relationship between port tariff and gross registered tonnage of Apapa Port from 1977 - 2021.

Hypotheses

H_{o1}: There is no significant relationship between ship dues and ship traffic volume of Apapa Port from 1977 - 2021.

H_{o2}: There is no significant relationship between ship dues and gross registered tonnage of Apapa port from 1977 - 2021.

H_{o3}: There is no significant relationship between pilotage charge and ship traffic volume of Apapa port from 1977 - 2021.

H_{o4}: There is no significant relationship between pilotage charge and gross registered tonnage of Apapa port from 1977 - 2021.

H_{o5}: There is no significant relationship between harbor dues and ship traffic volume of Apapa port from 1977 - 2021.

H_{o6}: There is no significant relationship between harbor dues and gross registered tonnage of Apapa port from 1977 - 2021.

2. Materials and methods

The study considered the variables which have financial implications on the patronage and operations of the port which are estimable, quantifiable, and have available data. Thus, the variables selected for the study were the dependent variables (ship due; pilotage charge and harbor due), which were selected to represent some of the basic tariff factors of the port, while the independent variables (ship traffic and vessel gross registered tonnage), among others, were selected to represent Port Users' Patronage. Ship due are charges levied by the Statutory Port Authority on vessels using a terminal. Pilotage charge is for the service of the pilot. Harbor due is for the use of the harbor resources. It is the payment a shipowner makes for the use of port harbor facilities. Ship traffic explains the number of vessel calls to a port in a particular year, whereas vessel tonnage determines the overall weight of the vessels in tons, signifying the quantity of load transported, which also forms the basis on which most port revenues are collected.

In addition, Nigerian tariff structure is a policy which has gone through reforms over time to observe the economic system and competitiveness of the maritime industry within the West African sub region; however, external factors, such as GDP and exchange rate, play roles in determining the tariff structure. Nevertheless, the study focused on considering the tariff structures and the behavior of shipping trade (port user patronage) with respect to the tariff structures. The tariff structures take note of the GDP and exchange rate, which is quite unstable and cannot be fathomed. Hence, the study excludes other external factors, because Nigeria is a country with an unstable economy. Therefore, the study is not ignorant of the external factors, but these were not focused on to be the considering factors to determine port user patronage, knowing that port tariff structure policy has already put those factors into consideration as the instability of the Nigerian economics and the rate of inflations. Nigeria is also an importation, rather than an exportation, country.

The research employed time series approach in the collection of data and the use of ordinary least square (OLS) regression models in establishing the relationship between port tariff system/pricing policy and port users' patronage in Nigeria, as well as the responsiveness of port users to increase (changes) in port dues and charges over the years in Nigeria. It also used the Pearson correlation to study the relationship between the variables.

Regression analysis is a statistical investigation of the relationship between a dependent variable, Y, and one or more independent variable(s) X or Xs, and the use of the modelled relationship to predict, control or optimize the value of the dependent variable Y. The relationship is formulated in an equation to express the value of Y in terms of the corresponding values of X or the Xs, and to enable future values of Y to be predicted in terms of the observed values of X to be controlled or optimized by manipulating the values of Xs. The independent variables Xs are called explanatory variables, or controlled variables, while the dependent variables Y are called response variables. Simple linear regression analysis were suitable for this work. In addition, the variables (dependent and independent) were cointegrated.

Linear regression was chosen for this study, due to its suitability for analyzing the relationship between two or more variables. Moreover, the multiple regression undertakes measurement for variables, the residuals and variance normality, and the error terms are independent and without linearity. Many previous studies in the seaport sector used the regression to analyze different problems, such as Hlali (2023), Ducruet & Itoh (2022), and Russo et al. (2022); the key gain of the regression model is to estimate a single dependent variable according to one variable or numerous independent variables.

In this case, linear regression allows for the examination of how changes in port dues and charges affect port users' patronage over time. By using OLS regression, the study could estimate the coefficients of the independent variables (port dues and charges) and assess their significance in predicting the dependent variable (port users' patronage). In addition, linear regression provided insights into the direction and strength of the relationship between these variables, enabling

researchers to make informed conclusions about the responsiveness of port users to changes in port tariffs.

The regression equation of such time series dataset may be represented as follows:

$$Y_t = \beta o + \beta_I X_I + \varepsilon_t$$

where
t = number of years/ periods/observations
Y = the dependent variables (ship due; pilotage charge and harbor due)
X= the independent variable (ship traffic and vessel gross registered tonnage)
βo= constant or the intercept of the graph
β_I = slope of the graph
ε_t, = random error term.

For such, ordinary least square (OLS) estimation method can be used to estimate the coefficients βo and β_I, and the normal hypotheses testing method using OLS holds valid. β_I measures the effect of the explanatory variable on the dependent variable. X_1 is the value of the variable in period t.

Using the simple regression model approach and OLS estimation, the relationship showing the impacts of port dues/charges (ship dues, pilotage charge, harbor dues) and the proxies for port users' patronage of Nigeria ports (ship traffic and vessel gross registered tonnage) were modeled and the hypotheses tested. The relationship between the port dues/charges and the shippers demand for port services were examined by using the OLS method.

$$Y_{shiptraffic} = \beta o + \beta_1 X_{shipdue} + \varepsilon \quad (1)$$

$$Y_{grt} = \beta o + \beta_1 X_{shipdue} + \varepsilon \quad (2)$$

$$Y_{shiptraffic} = \beta o + \beta_1 X_{pilotagecharge} + \varepsilon \quad (3)$$

$$Y_{grt} = \beta o + \beta_1 X_{pilotagecharge} + \varepsilon \quad (4)$$

$$Y_{shiptraffic} = \beta o + \beta_1 X_{habourdues} + \varepsilon \quad (5)$$

$$Y_{grt} = \beta o + \beta_1 X_{habourdues} + \varepsilon \quad (6)$$

The research selected 95 % confidence interval or 5 % threshold of significance (0.05) for this investigation. It follows from this that a variable's P-value needs to be less than 0.05 (P-value < 0.05), hence, with a P-value < 0.05, alternative hypothesis was accepted, and null hypothesis was rejected. It indicates that there is an impact if the null hypothesis is disproved.

3. Results

Table 1 represents the Pearson correlations between the variables. The correlation is highly significant between all variables at 1 and 5 % level.

The data presented in **Table 2**, below, were data collected on ship dues, pilotage charges, and harbor dues from NPA simplified tariff and ship traffic volume and vessel tonnage of Apapa port from NPA annual statistical data. The study covers the duration 1977 - 2021.

Table 1 Pearson correlation.

	Av_harbor_ dues	Av_vessel_ tonnage	Av_ship_ due	Av_pilotage_ charge	Av_ship_ traffic
Av_harbor_dues	1	0.840*	0.775*	0.817*	0.824*
Av_vessel_tonnage	0.840*	1	0.900*	0.900*	0.995**
Av_ship_due	0.775*	0.900*	1	0.952**	0.857*
Av_pilotage_charge	0.817*	0.900*	0.952**	1	0.857*
Av_ship_traffic	0.824*	0.995**	0.857*	0.857*	1

*Correlation is significant at the 0.05 level.
**Correlation is significant at the 0.01 level.

Table 2 Study variables.

Year	Av. Ship Dues ($ in Mil)	Av. Pilotage Charges ($ in Mil)	Av. Harbor Dues ($ in Mil)	Av. Ship Traffic Volume	Av. Vessel Tonnage (ton)
1977 - 1981	0.39	6.33	0.6942	n.a.	n.a.
1982 - 1986	0.39	6.33	0.6942	n.a.	n.a.
1987 - 1991	0.78	27.44	0.6942	2,344	7,166,622
1997 - 1999	0.78	27.44	1.6583	3,123	32,911,941
2000 - 2004	0.78	27.44	774.14	3,569	55,162,705
2005 - 2009	280.8	71.28	774.14	4,126	88,305,368
2010 - 2014	280.8	71.28	774.14	5,130	125,814,815
2015 - 2021	280.8	71.28	774.14	4,422	100,997,264

Source: Computed by Authors from various materials; NPA simplified tariff 1977, 1987, and 2004, and NPA annual statistical report 1977 - 2021.

Table 3, below, provides descriptive statistics on data collected for the study. The table shows that the mean ship dues were $80.6743 per ship, with Std. Deviation of $136.71200. This infers that the mean annual ship dues per ship call to the port were $80.6743, and the standard deviation of $136.71200 explains the rate at which ship dues could vary or spread across the years of study. The mean vessel tonnage of the port is 44,194,493.0000 tons, with Std. Deviation of 1,980.16804 tons. This shows that total vessel tonnage received was 2,613.1429 annually from 1977 - 2021, signifying the patronage of ship-owners to the port, while standard deviation of 1,980.16804 explains the dispersion at which these tonnages vary annually or spread through the years. The mean pilotage charge was $33.9343/ship with 27.20271 Std. Deviation, implying that the mean annual pilotage charge was $33.9343/ship calls, which could vary or spread through the years at the rate of $27.20271. The mean ship traffic volume for periods was 2,613.1429 vessels, with Std. Deviation of 1,980.16804. This shows that a total of 2,613 ships calls were handled by the port annually from 1977 - 2021, signifying the patronage of ship-owners to the port, while standard deviation of 1,980.16804 explains

the rate or intervals at which the ships visiting the port varies annually. Lastly, the table displays that the mean harbor dues were $332.3087 per ship visit to the port, which spread across the years with Std. Deviation of $413.29548. In addition, the sample size with five variables is sufficient for the adopted linear regression model during a period of 44 years (Mumtaz et al., 2020).

Table 3 Descriptive statistics of ship traffic and ship dues.

	Mean	Std. Deviation	N
av_ship_dues	80.6743	136.71200	44
av_vessel_tonnage	44,194,493.0000	48,532,830.06482	44
av_pilotage_charges	33.9343	27.20271	44
av_ship_traffic	2,613.1429	1,980.16804	44
av_harbor_dues	332.3087	413.29548	44

Table 4, below, displays the model summary of the regression analysis of ship traffic volume and ship dues. The table shows that a dependent variable (ship traffic) correlates positively with an independent variable (ship dues) at 69.6 %, which shows a high percentage correlation, as indicated in the summary table R value of 0.696. The R square value of 0.484 indicates that 48.4 % of the changes in the dependent variable were well explained by the independent variable. This is because there are some other factors that determines the ship due, which were not considered in this study.

Table 4 Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.696[a]	0.484	0.381	1,557.62587

[a]Predictors: (Constant), av_ship_dues

The model summary **Table 5** of the regression analysis shows the connection between ship traffic volume and pilotage charges. The dependent variable is given as the average ship traffic volume, and the independent variable as the average pilotage charge. The dependent and independent variables are related at 88.8 %, which implies a high percentage positive correlation indicated in the summary table R value of 0.888. The percentage changes in the dependent variable might be attributed to changes in the independent variable, shown by the R square as 0.788, inferring that the independent variable accounts for 78.8 % of the fluctuations in the dependent variable.

Table 5 Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.888[a]	0.788	0.746	997.58233

[a]Predictors: (Constant), av_pilotage_charges

The model summary **Table 6** of the regression study shows the percentage connection between pilotage charges and gross registered tonnage of Apapa port as 93.1 %, indicating a positive correlation. The R square indicates how much of the variances in the dependent variable can be

attributed to the independent variable, which is given as 0.868, suggesting that the independent variable may account for 86.8 % of the fluctuations in the dependent variable.

Table 6 Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.931[a]	0.868	0.841	19,351,865.56747

[a]Predictors: (Constant), av_pilotage_charges

The model summary **Table 7** provides the correlation between average ship traffic and average harbor dues given at 78.5 % correlation, indicated in the summary table as R value of 0.785. This shows that the correlation is strong and positive, and R square value of 0.617 accounts for 61.7 % of the fluctuations in in the independent variable.

Table 7 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.785[a]	0.617	0.540	1,342.71178

[a]Predictors: (Constant), av_harbor_dues

Table 8 is the model summary on average vessel tonnage and average harbor dues. The R value of 0.878 in the model summary table indicates an 87.8 % correlation between the independent and dependent variables. The R square indicates how much of the variances in the dependent variable can be attributed to the independent variable. With R square of 0.772 from the table, it can be inferred that the independent variable accounts for 77.2 % of the fluctuations in the dependent variable.

Table 8 Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.878[a]	0.772	0.726	25,406,600.05930

[a]Predictors: (Constant), av_harbor_dues

Testing $\mathbf{H_{o1}}$: There is no significant relationship between ship dues and ship traffic volume of Apapa Port from 1977 - 2021.

Table 9 below shows the coefficients output of the regression analysis. The table establishes a relationship between dependent and independent variables. It tells of the strength of the link or the importance of the variables in the model, and the percentage to which they affect the dependent variable is observed in the table below. The outcome contributes to the explanation of the study test of hypothesis (Ho1). The table p-value of 0.082 shows that the vessel traffic has no significant impact on ship dues of Apapa ports. The significant is measured at 95 % significance level. Therefore, the research hypothesis was accepted, implying that the relationship between ship dues and ship traffic volume in Apapa port from 1977 - 2021 is not statistically significant.

The study establishes the model relationship between average ship traffic and average ship dues by stating the Eq. (7) of the model using the coefficient of regression lines, given in **Table 9**.

$$\text{Ship dues} = 1{,}799.905 + 10.081X_{\text{shiptraffic.}} \quad (7)$$

The model shows that, within the periods of study, the average ship dues of Apapa were approximately $1,800, and every one unit increase in ship traffic volume would only provide an additional $10 increase in average ship dues of Apapa port, which can be rated at 69.6 %. However, the study infers that this increase is not statistically significant.

Table 9 Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0 % Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1,799.905	698.147		2.578	0.050	5.261	3,594.549
	av_ship_dues	10.081	4.651	0.696	2.167	0.082	-1.876	22.037

[a]Dependent Variable: av_ship_traffic

Source: SPSS 22 output (2023)

Testing $\mathbf{H_{o2}}$: There is no significant relationship between ship dues and gross registered tonnage of Apapa port from 1977 - 2021.

The coefficient **Table 10** shows the strength of relationship of independent and dependent variables. The p value in the table is 0.008, which indicates that, at 95 % significant level, the p value is less than 0.05, which is significant. This suggests that the dependent variable (vessel tonnage) of Apapa port significantly relates with the independent variable (ship dues). Therefore, the research hypothesis is rejected, and the alternative is accepted, informing that there is a significant correlation between ship dues and the gross registered tonnage of the Apapa port from 1977 and 2021. The impacts of independent variable are rated at 88.5 %. The effect of average ship tonnage on average ship dues is stated using the model Eq. (8) of regression lines, given in **Table 10**.

$$\text{Ship dues} = \$18{,}841{,}588.802 + \$314{,}262.518X_{\text{shiptonnage.}} \quad (8)$$

The model shows that, within the periods of study, the average ship dues of Apapa were approximately $18,841,589, and every unit increase in ship tonnage would provide an additional $314,263 increase in average ship dues of Apapa port. The study infers that this increase is statistically significant.

Table 10 Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0 % Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	18,841,588.802	11,083,559.059		1.700	0.150	-9,649,606.790	47,332,784.394
	av_ship_dues	314,262.518	73,843.662	0.885	4.256	0.008	124,441.342	504,083.695

[a]Dependent Variable: av_vessel_tonnage

Testing $\mathbf{H_{o3}}$: There is no significant relationship between pilotage charge and ship traffic volume of Apapa port from 1977 - 2021.

Table 11 shows the strength of correlation between independent and dependent variables. The p value in the table is 0.008, which indicates that, at 95 % significant level, the p value is less than 0.05, which is significant. This suggests that the dependent variable significantly relates with the independent variable. Therefore, the research hypothesis is rejected, and the alternative is accepted,

informing that there is a significant correlation between pilotage charge and ship traffic volume of Apapa port from 1977 - 2021.

The study establishes the relationship between average pilotage charges and average ship traffic by stating the model Eq. (9) using the coefficient of regression lines, given in **Table 11**.

$$\text{Pilotage charge} = 419.686 + 64.638X_{\text{shiptraffic.}} \quad (9)$$

The model shows that, within the periods of study, the average pilotage charge of Apapa was approximately $420, and a unit increase in ship traffic volume would provide an additional $65 increase in average pilotage charge of Apapa port, with this impact being valued at 88.8 %. The study infers that this increase is statistically significant.

Table 11 Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0 % Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	419.686	632.672		0.663	0.536	-1,206.650	2,046.021
	av_pilotage_charges	64.638	14.971	0.888	4.317	0.008	26.153	103.123

[a]Dependent Variable: av_ship_traffic

Source: SPSS 22 output (2023)

H_{o4}: There is no significant relationship between pilotage charge and gross registered tonnage of Apapa port from 1977 - 2021.

Table 12 indicates p-value of 0.002, which implies that the strength of the relationship between independent variable (pilotage fees) and dependent variable (vessel tonnage) are significant. Therefore, the alternative hypothesis is accepted, that there is significant relationship between pilotage fees and vessel tonnage of Apapa port. The study modelled the relationship between average ship tonnage and average pilotage charge by stating the Eq. (10) of the model using the coefficient of regression lines, given in **Table 12**.

$$\text{Pilotage charge} = -12{,}195{,}053.584 + 1{,}661{,}727.819X_{\text{shiptonnage.}} \quad (10)$$

The model shows that the average pilotage charge of Apapa was approximately $ -12,195,054, and any unit increase in ship tonnage would provide an additional $1,661,728 increase to the average pilotage charge of Apapa port. The effect of dependent variable on independent is evaluated at 93.1 %. The study infers that this increase is statistically significant. Therefore, the research hypothesis is rejected, and the alternative accepted.

Table 12 Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0 % Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-12,195,053.5	12,273,056.4		-0.994	0.366	-4,374,3949.5	19,353,842.4
	av_pilotage_charges	1,661,727.8	290,425.6	0.931	5.722	0.002	915,164.8	2,408,290.7

[a]Dependent Variable: av_vessel_tonnage

H_{o5}: There is no significant relationship between harbor dues and ship traffic volume of Apapa port from 1977 - 2021.

Table 13 shows that the P-value is 0.036, signifying significance at 95 %, which implies that there is significant in the relationship between the harbor dues and ship traffic of Apapa port; hence, the alternative hypothesis is accepted. The study establishes the relationship between average ship traffic and average harbour dues by stating the model Eq. (11) using the coefficient of regression lines.

$$\text{harbor dues} = 1{,}363 + 3.763X_{\text{shiptraffic.}} \quad (11)$$

The model shows that, within the periods of study, the average harbor dues of Apapa were approximately $1,363, and any unit increase in ship traffic volume would provide an additional $3.763 increase in average harbor dues of Apapa port. The study infers that this increase is statistically significant, and creates an impact evaluated at 78.5 % on the dependent variable. Hence, the alternative hypothesis is accepted.

Table 13 Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0 % Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1,362.684	672.168		2.027	0.098	-365.180	3,090.548
	av_harbor_dues	3.763	1.326	0.785	2.837	0.036	0.354	7.172

[a]Dependent Variable: av_ship_traffic

H_{o6}: There is no significant relationship between harbor dues and gross registered tonnage of Apapa port from 1977 - 2021.

The p-value for the coefficient **Table 14** is 0.009 at a significance of 95 %. Therefore, harbor dues have significant relationship with vessel tonnage of Apapa port, Nigeria. Therefore, the null hypothesis is rejected. The study also establishes the relationship between average ship tonnage and average harbor dues by stating the model Eq. (12) using the coefficient of regression lines.

$$\text{harbor dues} = 9{,}916{,}057.274 + 103{,}152.387X_{\text{shiptonnage.}} \quad (12)$$

The model displays that the average harbor dues of Apapa were approximately $9,916,057, and any unit increase in ship tonnage would provide an additional $103,152 increase of average harbor dues of Apapa port. The study infers that this increase is statistically significant and rated at 87.8 %.

Table 14 Coefficients[a].

	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	9,916,057.274	12,718,675.742		0.780	0.471	-22,778,339.562	42,610,454.109
av_harbor_dues	103152.387	25,096.333	0.878	4.110	0.009	38,640.209	167,664.566

[a]Dependent Variable: av_vessel_tonnage

4. Discussion

The study infers that the relationships between port patronage and tariff structures of the Nigerian ports are significant. Implying that tariff structure of the seaports are such would inspire shipping companies' patronage of the Nigerian ports. This agrees with the work of Yi et al. (2019) on how to promote customer loyalty of Chinese Mobile Operators, in a case study of China Mobile, stating that cost is a competitive instrument to win customers' loyalty. This study further shows that increased patronage of the port is as a result of moderate port pricing, and that more patronage earns the ports more revenues. The study acknowledges that increasing patronage of the ports is due to the moderate rate of the tariff structure, hence, the tariffs of the port are well related to ship traffic and tonnage of the port from 1977 - 2021.

Notwithstanding this, the findings of this study are further evidenced by the work of Minh et al. (2023), which examined the effect of changes in the number of shipping lines on port charges and profits of New Zealand ports and found that the decrease in the number of shipping lines were as a result of increasing handling charges, and also that shipping lines moved more cargos to ports with comparatively low costs. The Nigerian Ports Authority, NPA, has a relief tariff structure on consignments by as much as 30 per cent for service providers operating at the Eastern Ports of the country, and 10 % discount on vessels berthing at Eastern Ports, to increase patronage (Andrew, 2023).

In addition, the study shows the role that government and port authority could play to improve port competitiveness and attractiveness. Investment in modern and efficient infrastructure reduces ship turnaround times. This makes ports more appealing to international shipping lines. Also, establishing competitive pricing policies attracts more traffic. Setting tariff rates that are attractive to port users while ensuring profitability is essential. This is similar to the results of the study of De Sousa et al. (2021), who investigated tariff policies and economic management practices at Brazilian public ports. They found significant variations in tariff application, financial management, and cost management procedures, despite regulatory standardization efforts. Moreover, policies and regulatory frameworks facilitate trade and investment, and create a stable environment for port growth.

5. Conclusions

The study investigated the effect of port user patronage on port tariff earning of Apapa seaport, Nigeria. The study measured the tariffs systems in pilotage services, ship dues, and harbor dues in relation to ship traffic volume and ship tonnage for the periods 1977 - 2021. In general, the study reveals the significance of port user patronage on tariff earning of Apapa port, Nigeria. Models were developed which show the relationships between each of the dependent variables and independent variables. The study shows that user patronage of Apapa port has significant impacts on port tariff earning of the port industry. Increase in ship dues, harbor dues, and pilotage charges paid by ship-owners and/or their agent between 1977 and 2021 increased patronage of the potential ship-owners and shippers regularly visiting the port.

The study makes a contribution to knowledge by providing a regression model that shows the relationship between port tariff variables and customer patronage of Apapa port, Nigeria, which no other study has provided. In conclusion, this study on the Nigerian port highlights several findings about the relationship between port patronage and tariff structures. First, the study concludes that there is a significant relationship between the tariff structures of the Nigerian port and the patronage by shipping companies. Moderate port pricing has been identified as a critical factor influencing the increased use of Apapa port. Second, it is observed that, the more patronage a port receives, the more revenue it earns. This underlines the importance of competitive pricing to attract shipping companies and increase port traffic. Third, the study analyzed data from 1977 to 2021, and indicated a reliable relationship between moderate tariff rates and increased ship traffic and tonnage. Fourth, the findings align with other international studies, such as Yi et al. (2019), which highlighted that competitive

pricing is a key strategy to win customer loyalty in the context of Chinese mobile operators. Similarly, Minh et al. (2023) demonstrated that increased port charges can lead to a decrease in the number of shipping lines using a port, thereby supporting the notion that lower costs attract more traffic. Fifth, the study mentions the Nigerian Ports Authority's (NPA) initiatives to provide tariff relief, such as a 30 % reduction on consignments for service providers at the Eastern Ports, and a 10 % discount on vessels berthing at these ports. These measures are aimed at boosting port patronage. Sixth, the results suggest that maintaining moderate and competitive tariff structures is crucial for attracting more ships and increasing the overall revenues of the Nigerian ports. This has implications for policy decisions regarding port management and pricing strategies.

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