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Evaluation of ship-owner's demand for port services relative to changes in port pricing policy regimes in Nigeria

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Abstract

The study evaluated the Ship-owner's Demand for Port Services Relative to Changes in Port Pricing Policy Regimes in Nigeria. Its specific objectives was among other thing to estimate the coefficient of average rate of change of ship-owner's demand for port services in Nigerian seaports relative to changes in pilotage rates charged by the Nigerian Port Authority (NPA) between 1977 and 2022. This was in realization of the fact that port charges have implications on port cost borne ship-owners and other categories of port users. It used the quantitative research design methods. It sourced secondary data from the NPA on the ship traffic call and shipping tonnages handled in the Nigerian ports over the 45 years covered in the study as proxies for ship-owners demand for port services. It also obtained time series data on pilotage rates charged by the ports between 1977 and 2022 from the NPA. The average rate of change quantitative tool and regression analysis were used to analyze the data obtained. It was found that, the average rate of change coefficient of ship traffic calls handled in the Nigerian seaports relative the trend of pilotage rates charged by the seaports over the period is 34.719. It results also show that there is significant influence of variations in pilotage rates charged by the Nigerian ports on the ship traffic calls handled in Nigerian seaports. The findings of the study further reveal that for each 1 naira variation (increase) pilotage rates charged by the NPA each year between 1977 and 2022, the GRT/shipping tonnage handled by the seaports increased by an average rate of 1713332 GRTs. Recommendations were proffered based on the study findings.

Keywords: Ship-Owners, Port-Services, Port Pricing Policy, Shipping-Industry.

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1. INTRODUCTION

Seaports represent maritime transport nodes, functioning as gateways into the national economies. As nodal points and links to multimodal transport networks within an economy, seaports play facilitative roles in the flow of local, coastal and international trade; thereby enhancing efficiency and effectiveness of the maritime logistics system (Nwokedi et al, 2022a). Since seaports connect other transportation systems and modes such as rail, land/road, air, pipeline, etc., to seashore/coastline for seamless exchange and transfer of both local, coastal and international trade traffic (both cargo and passenger traffic) among the modes, the cost of port usage to both shippers, ship-owners and ship operators is adjudged to be one of the component cost factors that influences commodity prices in both the local and international markets (Nwokedi et a 2022b).

The implication is that the significances of seaports in the shipping industry and national economies is evident in its seeming determinant effects in the overall transportation cost of seaborne trade, maritime logistics operations, lead time of processing trade and productivity/output. Prices charged by seaports for port services are usually outcomes of port pricing policy, which are used as tools for both revenue generation and for planning the long-term economic development and growth of the shipping industry cum port sector in particular, and the overall economy in general. Shippers, ship-operators, port agents and other allied groups

that happen to often times transact directly with the ports, bear the directly effects of port costs which are outcomes of port pricing policies and regimes (Ndikom et al, 2022). The rest of the individuals in the economy bear the multiplier effects of port pricing policies in the prices of manufactured and market commodities (Sodiq, Ndikom and Nwokedi, 2017).

Port pricing policy in the context of this study denotes the pricing instrument, framework and approaches employed by seaports, for example, the Nigerian ports, in fixing the rates, prices and financial costs that each identified categories of port users must pay in order to consume specified port services (Ndikom et al 2017a). In other words, to be offered specified services in any seaports for example, shippers and ship-owners pay various rates/prices which are established in the pricing policy of the ports. These prices represent costs of port usage to the shippers, ship-owners and ship operators, port agents and other groups of port users. Ports Authority in determining prices of port services produce a multiplicity of charges paid for various port services. Typical examples of prices for various port services determined in port pricing policies in Nigeria include; ship dues, pilotage rates, harbor dues, wharfage, berthage and mooring dues, towage charges, conservancy dues, light dues, etc (Ndikom et al, 2017b; NPA, 2019).

Government legislations, policies and order remain the instruments, tools and processes for midwifing and determining specific prices for various port services in Nigeria. Between 1977 and 2022 for example, the Nigerian port have operated about seven (7) port pricing policy regimes, which involves the amendment of existing port tariff, rates and charges and determining new one for the Nigerian port system. For example, the Nigeria Port Authorities tariff and rates regulations of 1977, 1987, 1999 and 2004 are major regulations detailing the tariff and prices of major port services that port users must pay (Oghojafor, Kuye and Alaneme, 2012; Bamidele and Oludele, 2017). It is viewed that price influences the profitability potentials of both the port service providers and the users.

It is also in line with the propositions of basic economic theories, that high port tariff which lead to high cost of port service consumption may negatively influence level of patronage to ports by the port users and subsequently affect port revenue and profitability potentials of both port authorities cum terminal operators and port users. This could ignite the need by port users to choose ports that offer more competitive prices in a perfect market setting. The withdrawal of patronage may subsequently lead to poor port performance with the long-term effect of lower productivity. By implication, suggests that the pricing policy of a given port has implications on the port users cost of operation, prices of imported goods and other goods transiting through the port, and the rate of inflation in the prices of goods in the local economy.

From the perspectives of the ship operators and ship-owners, beside ship dues, berthage and mooring charges; pilotage service is essentially a compulsory service that each vessel visiting Nigerian ports must compulsorily access from the Nigerian ports Authority (NPA). Pilotage rates represent one of the most significant port rates and charges that ship operators and ship-owners encounter/pay in Nigeria seaports (Ikpechukwu, Akin, and Enosoko, 2014). However, the perceptions of the ship-owners about the directions and fairness of the pilotage rates in Nigerian port in comparison with the rates prevailing in the nearest West and sub-Saharan African ports can influence ship operator's port choice. In a privatized port system such as Nigeria, the decision of a ship-owner to route their vessels to particular port terminals may be influenced by the prevailing port prices, including pilotage rates, which certainly have implications on the port cost and ship operating cost. This indicates that ship-owners and operators as major component port users may accept to pay high pilotage rates and subsequently transfer these high rates over the shippers who in turn transfer it to the final consumers of market commodities. This will subsequently reflect in the form of inflation in the prices of goods and services in the local markets (Olaogbebikan, Ikpechukwu, Akin and Enosoko, 2014; Ndikom et al 2017b). Individual ship operators may as well withdraw their patronage to port services in port terminals were pilotage rates for example and other port tariff are high, leading to poor port performance and output in the long-run.

To efficiently and effectively serve the needs of ship-owners and operators and ensure sustainability in port services delivery, port authorities and terminal operators must be able to use pricing policy as a tool by ensuring that pilotage rates and other port prices reflect value for money. In this way, port pricing policy should be used to plan rates and prices to remain within the competitive limits and block other competing port terminals and operators from using predatory lower rates and prices to gain competitive advantage. This is most important in the era of port privatization in Nigerian port sector, and the trade liberalization policy of the West African region. Competitive port prices that guarantee that ship operators are not unduly overcharged will serve as an attractive business strategy, that not only ensures that more ship operators use the ports with the most competitive prices, but also ensures sustainable patronage for port services in the long-run. Without this, a given port or terminal

operator in a truly competitive market setting may be rendered unproductive and perform very poorly in terms of ship traffic calls and shipping tonnage handled. These too have implications of port sector development (Ndikom, Buhari and Nwokedi, 2018).

The idea of port operations being provided at a cost and profit suggests the enthronement and/or ushering in of a competitive era, where price, quality and value of port service rendered becomes major variables that motivate shippers, ship owners and other categories of port user's port choice of port. Thus, the port pricing can serve as veritable tool to influence the directions of ship-owners patronage and loyalty to ports and ports services. The level and extent of ship-owners and operators patronage to port terminals may have consequences and implications on revenue generation, investment cost, capital cost recovery, profit generation, and development of competitive advantage in which port operators can gain higher patronage in the long-run (Bichou and Gray, 2004).

Since port pricing policy reflects the strategies, policy plan for determining prices and rates for port services offered to port users; as aforementioned, Nigeria has operated various port tariff and rates regulations in the years past. Increases in the port pilotage rates, ship dues and other elements of port prices and charges have been witnessed over the years. However, no available empirical studies have been able to investigate the responses of ship ship-owners to these variations in port charges over the years. It has become necessary that empirical knowledge be provided on to what extent ship operators have continued to patronize and/or demand for port services in Nigeria, relative to the various changes in port pricing policies and regimes. An understanding of the relationship between ship operators' demand for port services and the pilotage rates determined in Nigeria's port pricing policies over the years has become a necessary information for ensuring further development and growth in the Nigerian ports and shipping sector. This is the central aim of this current study. The specific objectives of the study however are as stated below.

1.1 Objectives of the Study

The specific objectives of the study are:

(i) To estimate the rate of change of ship traffic calls to Nigerian ports relative to pilotage rates charged by Nigerian ports as prices for providing pilotage services to ship-owners over the years

(ii) To evaluate the relationship showing the influences of variations in pilotage rates charged in Nigerian ports on the Gross Registered Tonnage (GRT)/ shipping tonnage handled in Nigerian ports and the trend of pilotage rates charged by Nigerian ports as prices for pilotage services rendered to ship-owners over the years.

1.2 Research questions

(i) What is the average rate of change of ship traffic calls handled in Nigerian ports relative to pilotage rates charged by Nigerian ports as prices for providing pilotage services over the years?

(ii) What is the extent of the effects of variation in pilotage rates charged in Nigerian seaports on shipping tonnage-Gross Registered Tonnage (GRT) of vessels handled in Nigerian ports.

2.0 Literature Review

Meersman, Vande Voorde and Vanelslander (2003) viewed pricing as a critical component of the foundations of economic transactions between port users, terminal operators and port authorities in the maritime industry. Price is this context connotes the money expended by port users (shippers and ship-owners) to access and consume port services. From the perspectives of the ship-owners and operators, ship dues, berthage cum mooring charges and pilotage rates represent major components of prices paid by ship-owners and operators for the consumption of specific port services in Nigeria (NPA, 2019). The concept of port pricing policy in the views of ship-owners and operators therefore connotes the process and plan available to a given port, for determining the amounts to be paid by ship-owners and operators as ship dues, towage, pilotage rates, berthage and mooring services for example.

Studies by Ndikom et al (2018) and NPA reports (2019) established that while towage charges may not apply to all ships that call to the Nigerian ports, pilotage charges/rates form a significant compulsory component of the charges that ship-owners and operators must pay in order to access and use berthing facilities in Nigerian seaports. The Nigerian port authority (NPA) is responsible for setting these rates and tariff as prices to be paid by ship owners and operators while the terminal operators in a privatized port system and other contractors responsible to the NPA for example, operate on the basis of the ceiling rates and tariff already determined by the NPA for the use of privatized terminals (NPA, 2019).

Ogunsiji and Ogunsiji (2010) note that the major challenges with developing an optimal pricing policy/plan for ports in Nigeria is the lack of basis for and task of determining the right prices for port services. The right price denotes the price that can lead to prosperity and port performance improvement while also maximizing the utility derivable from the consumption of port services by users. Meersman,

Pettersen and Van de Voorde (2014) observes that pricing of ports is a significant factor in the port choice decisions by shippers and ship-owners; as a result it is a critical tool in port competition, especially for ports within the same trade regions where there is completion seaborne traffic. Since there exist variety of services offered by port and terminal operators, Nokuzola (2014) views that it becomes a matter of importance that port authorities tailor port prices and tariff to each element of services offered. This is because each service type takes an investment in infrastructure and/or superstructure to provide, thus prices must be ascribed to each service type to ensure the optimum performance of the port (Nokuzola (2014).

The Nigerian ports Authority (NPA, 2019) note that over the years, prevailing port pricing policies and regimes in Nigeria maintained among other things, compulsory pilotage policy, requiring that all vessels entering the berths in Nigerian ports must employ the services of NPA controlled Masters, to navigate the vessels into harbor, or berth and pay pilotage charges for such services using the prevailing rates. Beside the pilotage charges which are compulsory, other charges payable by the ship-owners and shippers for the use of specific port services in Nigeria are summarized in table1 below.

Given the that the payment of pilotage charges is compulsory for all ships calling to Nigerian seaports, studies by Ndikom et al (2017a) suggests that amendments to the current port pricing policy should ensure that pilotage be either not made a compulsory payment or that the prevailing rates be reduced to

Table1: Typology of Port Charges and Rates Applicable to Specific Port services and Port user groups in Nigerian

Typology of port charges	Description	Payable by:
Throughput Fee:	The throughput fee is a fee charged by the Port Authority for the volume of cargo inward and outward cargo traffic transiting through the concession terminal. The basis of measurement is in TEUS and Tons.	It is chargeable to and paid payable by the Terminal Operators (NPA, 2019).
Lease fee	fixed annual payment of a sum specified in the Agreement to be paid in twelve (12) equal installments or on annual basis in each operating year.	Terminal operators
Wharfage:	It is a charged assessed against goods of all description passing through wharf, whether they are general cargo, bagged cargo, liquid in bulk or in containers, dry cargo, unitized, ship's stores and bunker, animals and persons unless specifically exempted and shall be in addition to other charges.	This is charged to and payable by the shippers. The basis of measurement of wharfage is in Tons.
CARGO DUES:	According to Nigeria Ports Authority (NPA, 2019), Included under cargo dues and tariff are: a. Stevedoring: Including Overtime, Extra Services (Labour, Security and Tally Clerk), Delays weekend Charge, Optional Services and Facility Charge (for Containers) b. Harbour Dues c. Environmental Protection Levy.	Payable by the shippers and/or cargo owners.
BERTHING/MOORING DUES	It charge is a levy charged on vessel that make berthed in the port.	Payable by ship-owners
SHIP DUES	According to NPA(2019), ship dues is a charge, rate or tariff, paid to cover services offered to a vessel for her movement into and out of the Port including the use of Tug Boats.	Payable by ship-owners

CONSERVANCY c CHARGES	Conservancy charges is payable to the ports authority for the act of regulating and sustaining required standard of safety for ship in the waterways, through activities of Dredging, Sweeping, Lighting, Wreck removal, provision of Aids to Navigation and other activities necessary for safe movement of ships in and out of the ports (NPA, 2019)	Payable by ship-owners
PILOTAGE DUES	Pilotage is a charge payable by ship-owners for services rendered by a pilot on a ship entering, leaving or shifting in a Port. The NPA established compulsory pilotage districts necessitating the use of the ship master and the availability of the of a Nigerian Ports Authority's Pilot on the bridge shall to navigate the ship into the port harbours at a fee referred to as pilotage dues.	Paid by ship-owners
ANCHORAGE DUES	Anchorage is created within the pilotage district for the purpose of providing shelter for vessels calling at or departing from ports. The anchorage affords vessels and ports the opportunity to plan for the arrival/berthing of vessel as well as provide waiting places for them prior to outward movement (NPA, 2019).	Payable by ship-owners or operators

Source: Adapted from Nigerian Port authority Tariffs and rates.

attract higher ship-owners patronage for the Nigerian ports, in view of the current competition by most sub-Saharan African ports, to attain hub-port status in the region. The study argue that port pricing strategy can either be used as a tool to achieve higher patronage and ship calls to the Nigerian ports or discourage ship-owners from further patronizing the ports (Ndikom et al 2017a; Nwokedi et al, 2023). This underlines the need for an empirical study investigation to determine for example, to what extent variations in pilotage charges by Nigerian seaports over the years, has influenced demand for port services in Nigerian ports. The ship traffic calls and the shipping tonnage handled in Nigerian ports over the years can serve as veritable proxies for ship-owners demand for port services in Nigerian.

In response to the question on what should constitute the objectives of the NPA in establishing prices for specific port services, the United Nations Conference on Trade and commerce (UNCTAD 1975) identified that from the service suppliers and/or port authorities perspectives, port pricing policy should have capacity to ensure the satisfaction of three key objectives of which include:

i. Create a proper re-allocation of benefits,
ii. Facilitate the comparison between charges and costs, and
iii. Contribute to the improved utilization of port facilities (UNCTAD, 1975).

By implication, rates of pilotage charges as prices for port services consumed by ship-owners should be competitive enough not to discourage ship-owners and operators from patronizing Nigerian port terminals. This is evident in the aforementioned third objective of port pricing according to UNCTAD (1975). Comparison between port charges and costs aims at ensuring that prices charged for consumption of port services are derivatives of the cost of services production, such that investment cost per unit of service is recoverable from the price per unit of service consumed by ship-owners and other port users. This enshrines competitiveness among ports and ensures that utility is maximized from the perspectives of the port users. It is this competitive pricing that promotes the efficient use of port facilities (UNCTAD, 1975). According to Bamidele et al (2017), other objectives which port pricing policy must pursue include the reduction of total costs of logistics and transport, increasing patronage for port services, and optimizing port output and revenue.

Meersman et al (2014) note that the processes, strategies and procedures for arriving at an established port pricing plan and/or changing an existing port pricing plan is complex. This is because the price is viewed as constituted of several other variables such

as the cost of service production, the profit margin and value added tax for example. Thus, port charges and tariff as prices for the paid by port users must be structured to include these individual sub-components and more, depending on the overall pricing objective of the port authority and/or operator. It must however be designed to be implemented for a long term and to achieve not only current pricing objectives but also future pricing objectives (Chioma, 2011). The United Nations Conference on Trade (UNCTAD, 1975) established some basic approaches, strategies and factors of importance towards determining port tariff/ price structure. UNCTAD (1975) opines that to establish an optimal port tariff structure, ports should:

(a) Clarify the relationship between port facilities and users: This enables the easy identification of who the port users are and the facilities and services that each class of port users use in order that price can be structured according to users' needs while a clearly established framework for the relationship between the charges and the "who pays" factor, ensures that fairness and flexibility is ensured in the adoption of a pricing structure (UNCTAD, 1975).

(b) Ensure that the challenge of double payment is prevented: Duplicity of port charges and tariff should be eliminated in order to ensure that port users are not made to make double payment for units port services consumed.

(c) Adopt price mechanisms as a tool to prevent port congestion: In the views of UNCTAD (1975), port facilities that incurred no cost inputs is recommended to be exempted from charges. However, in situations that port congestion occurs as a result free or low port charges, leading to saturation of traffic flow and subsequent imposition of congestion cost; UNCTAD notes that in such situations, congestion could be prevented by introducing congestion prevention charges.

(d) Simplification of port tariffs: It is important that ports not confuse port users with multiple and complex conflicting charges. This is the reason for the need and demand that tariff structure be simplified. Approaches to achieve simplification include reducing the number of charges and/or reducing the number of variables in the basis for each charge (UNCTAD, 1975).

In addition to the above, studies by Chioma (2011) note that some port pricing strategies such as Performance-based pricing which is an approach employed in determining optimal port prices relative to the performance of the port in ship traffic calls for example, will help in ensuring that ship-owners are not discouraged from patronizing port services. In performance-based pricing, port tariff is increased when the level of port utilization is above the optimum, and it is decreased when the level of port utilization is below the optimum. When levels of utilization are extremely high, congestion builds up, this makes using the facility very expensive in terms of delay costs (UNCTAD, 1975; Hercules, 2002).

Studies by Osis and Dele (2003), Njelita and Anyasor (2020) agree that port user satisfaction is vital in a port's capacity to attract new ship operators, ship-owners and shippers to retain existing ones. Osis and Dele (2000), view port user satisfaction as the perceptions of port users (ship-owners and shippers) that port services consumed by them provided the desired and right level of utility. By implication, price of port services in conjunction with the actual services consumed by port users, influence the perceptions and judgment of ship-owners and shippers about the level utility derived from consumption of port services. This can subsequently affect demand and patronage for port services. By implication, the ship-owners as consumers of port services pays prices in exchange for the port services received and expect to derive utility equivalent to the value of the price paid (Njelita, Anyasor, 2020; David, Joyce, Haragopal, Rahul and Jean-Pierre, 2015).

According to (Oghojafor, Kuye, Alaneme, 2012), the level of satisfaction derived from the consumption of port services, the perception of the users with regards to nature of the port charges (high charges or low charges) in relation to the utility derivable from the consumption of the services can influence the port users' demand for service via the port and invariably their patronage. Ship-owners patronage for port services manifest in various forms such as:

Ship traffic statistics/count: This is a term used to denotes the number of vessels that called to a port over a period of time, usually one year. Ship/vessel traffic statistics is an indicator of the count and level of ship-owners and/or ship agents of demand for port services and patronage to ports. Number of ships that called to a port over a period influences basically the amount of revenue collectable as pilotage revenue, ship dues, etc.

Gross Registered Tonnage (GRT) of vessels handled in ports: The GRT represent the gross shipping tonnages of vessels handled by the port over the period covered in the study. This also influences port revenue generated through pilotage rates and ship dues.

3.0 Data and Methods

The study is designed to evaluate the rate of change of ship-owners demand for port services relative to the extent of variations in port pricing policies and regime between 1977 and 2022. It also assessed the relationship between ship-owners demand for port services and port pricing policy in Nigeria from 1977 to 2021. It used quantitative research design method

in which time series secondary data on ship traffic calls to Nigeria ports and the shipping tonnage or Gross Registered Tonnage (GRT) of vessels handled in the Nigerian ports over the period was used as proxies for ship-owner's demand for port services, while the prevailing pilotage rates charged by port authority over the period was used as proxy to represent port pricing policy. The study used the data collected from all the four major seaports in Lagos, Onne seaport, Port-Harcourt port and Warri ports which handled more than 90% of the Nation's ocean going vessels, as a case study to implement the research. The decision to obtain the historical data on the identified variables is to use it to assess the quantitative relationship between the ship-owner's demand for port services relative to the variations in pilotage rates over the years as well as estimate the rate of change coefficients of ship-owner's demand for port services to variations in pilotage rates that prevailed in the Nigerian port sector over the years.

As aforementioned, the study sourced secondary data on ship traffic calls and shipping tonnage (GRT) handled in Nigerian ports and the pilotage rates from the Nigerian Ports Authority reports. The derivative function or Rate of Change Analysis (RCA) quantitative tool and regression analysis were used to determine the average rate of change coefficient of ship-owner's demand for port services associated with changes in pilotage rates charged by the NPA. It was also used to determine the relationship showing the extent of influence of pilotage rates charged by the port authority on the ship-owner's demand for port services in Nigeria.

3.1 Derivative of Functions and Rate of Change Analysis

The first objective of the study which seeks to determine the coefficient of the average rate of change of ship-owner's demand foe port services associated with variations in pilotage rates over the time (period) of implementation of the port pricing policies in Nigerian ports. This objective was addressed using the derivative of functions or rate of change method. The study estimated the coefficient of the average rate of change of ship-owner's demand for port services relative to variations in the time (periods) of implementation of the port pricing policies that created variations in pilotage rates between 1977 and 2022.

We assume that the ship-owner's demand for port services measured by the ship traffic handled in the ports is dependent of the prevailing level of pilotage rates or charges charged by the ports. Thus the mathematical expression holds:

$SHP_{demand} = f(_{Prate})$

Where:

$SHPt_{demand}$ = demand for port services

P_{rate} = pilotage rates charged by the port authority

The implication is that a change in pilotage rates will determine of influence the direction of ship-owners demand for port services. Basically, the average rate of change relative to variations in pilotage rates from the interval [t_1------- t_{45}] covering the 45-year period covered in the study can be estimated from the expression:

$$\frac{gSHP_{tdemand}}{gP_{rate}} = \frac{f(SHP_{tdemand_1}) - f(SHP_{tdemand45})}{P_{rate_1} - P_{rate45}} \quad (1)$$

Where:

g = delta/symbol for change.

1 --- 45 represent the first year and final/last year of the 45 years period covered in the study.

$SHP_{tdemand1}$ and $SHP_{tdemand45}$ = ship traffic calls to the port representing ship-owner's demand for port services in the first and final year over the period covered in eh study.

P_{rate1} and P_{rate45} = pilotage rates charged by port authority in the first and final year over the period covered in the study.

Similarly, since the GRT of vessels handled in the seaport can also serve as a metric for measuring ship-owner and operators demand for port services, the rate of change in the GRT of vessels handled relative to variations in pilotage rates charged by the port authority over the period can be estimated as:

$$\frac{gGRT_1}{gP_{rate}} = \frac{f(GRT_1) - f(GRT_{45})}{P_{rate1} - P_{rate45}} \quad (2)$$

According Gujarati and Porter (2009); Nwokedi et al (2023), the ordinary least square (OLS) estimation methods can also be used to determine the average rate of change (RCA) coefficients where the denominator of the function in equations (1) and (2) above becomes the is the independent variable. That is for each regression function, [P_(rate1)- P_(rate45)] is used as the independent variable to estimate the average rate of change coefficient of ship-owner's demand for port services relative to variations in pilotage rates charged in Nigeria ports over the period covered in the study as the coefficient of regression. Using the method we write that:

$SHP_{tdemand} = \beta_0 + \beta_1 PILOTAGE_{rates} + e$ (3)

$GRT_{demand} = \beta_0 + \beta_2 PILOTAGE_{rates} + e$ (4)

Where:

β_0 = regression constant

β_1 and β_2 = regression coefficients = average rate of charge coefficients of demand for port services measured by ship traffic calls to the ports ($SHP_{tdemand}$) and GRT of vessels handled(GRT_{demand}) over the period respectively.

Table 2: Average rate of change ship traffic handled in the Port relative to variations in pilotage rates charged by port authority between 1977 and 2022

Variable(s)	Mean	Std. Deviation	Average rate of change coefficient
Ship traffic calls (ship-owner's demand for port services)	3689.5714	938.10924	34.719
Pilotage rates (port charges) per 0.3 meters.	46.2286	23.43347	-

Source: Author's calculation

Using the methods described above, the data obtained for the study was analyzed and normal hypotheses testing method for OLS estimation using t-test was used to determine the significance of the impacts of pilotage rates charged by port authority on ship-owners and operators demand for port services between 1977 and 2022.

4.0 Results and Discussion of Findings

Table 2 above shows the result of the study showing the rate of change of ship traffic calls to the seaport as a metric for ship-owner's demand for port services between 1977 and 2022 relative to variations pilotage rates charged by the port over the period. The result indicates that the mean number of ships handled in the port per annum between 1977 and 2022 is 3689.5714 with standard deviation of 938.109 while the mean amount charged as pilotage rate by the port authority per over the period is 46.229 naira per 0.3 meters of pilotage services rendered to each vessels, with standard deviation of 23.4335. The implication is that each year between 1977 and 2022, each vessel that called to the Nigerian ports paid an average of 46.229 naira per 0.3 meters of pilotage services rendered by the Nigerian ports authority. The average rate of change coefficient of ship traffic calls to the Nigerian seaport relative the trend of pilotage rates charged by the seaport over the period is 34.719. This indicates that for each 1 naira variation (increase) pilotage rates charged by the NPA each year between 1977 and 2022, ship calls to the Nigerian seaport increased by an average rate of 34.719 vessels. This is contrary to the principles of basic economics that increases in price will cause decreases in demand for services. But since demand for port services is derived demand, factors other than port prices also influence and are considered by ship-owners in port choice. However, the result have implications in the revenue generating potentials of the port such that, with variations in pilotage rates charged by port authorities, ship-owners demand for port services or ship call to the port also varies as shown in the result, subsequently, port revenue varies in line with and in the same direction with ship-owner's demand for port services

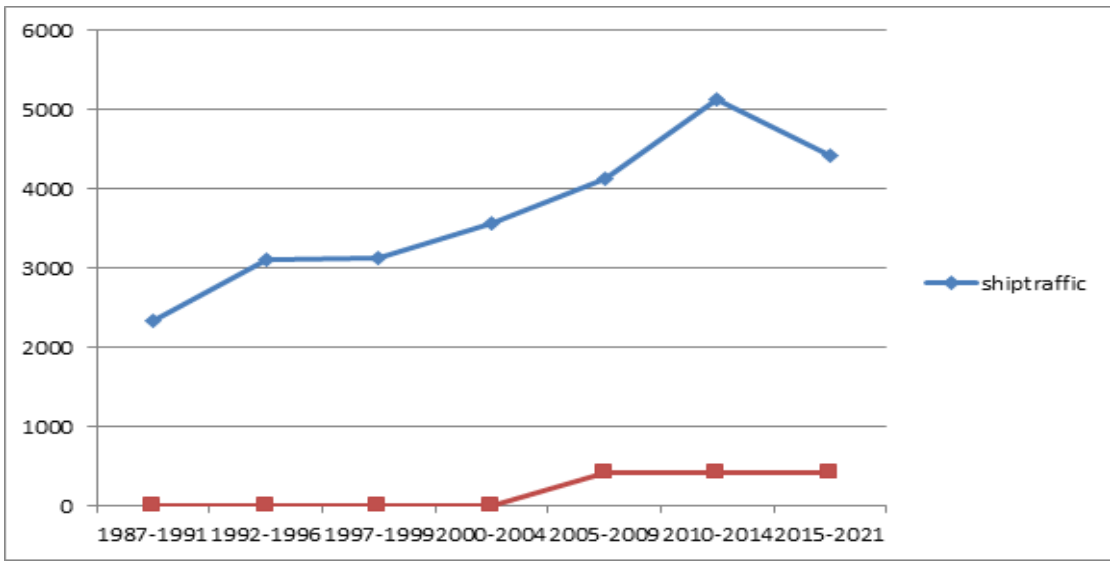

Figure 4.1: Trend line of ship traffic calls and pilotage rates charged in Nigerian Ports 1977-2022
Source: Prepared by author.

Table 3: Relationship between ship Traffic handled in Nigeria Ports and Pilotage rates Charged between 1977 and 2022

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.867a	.752	.703	511.61380

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2084.559	455.160		4.580	.006
	pilotage	34.719	8.913	.867	3.895	.011

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3037.2500	4559.3335	3689.5714	813.58776	45
Residual	-693.25000	570.66669	.00000	467.03737	45
Std. Predicted Value	-.802	1.069	.000	1.000	45
Std. Residual	-1.355	1.115	.000	.913	45

Source: Authors calculation. a. Dependent Variable: shiptraffic

(ship traffic calls). This is corroborates the findings of (Ndikom et al, 2018; Oghojafor, Kuye, Alaneme, 2012). Figure1 below shows the trend line for ship traffic calls handled in the seaport and prevailing pilotage rates charged by the NPA over the period.

Table 3 above shows the result of the study used in developing the empirical model of relationship between ship traffic calls handled in Nigerian ports and pilotage rates charged by the seaports over the period.

The result on table3 shows parameters for developing the equation of the relationship showing the influence of trend of pilotage rates charged by Nigerian seaports on ship traffic calls handled in the ports 1977 and 2022. The result indicates that the coefficient of correlation R indication the degree of correlation between ship traffic handled in the seaport and trend of pilotage rates charged by the NPA over the period is 0.87; which shows 87% very high positive correlation between the ship-owner's demand for port services measured by the ship traffic handled by the seaports and the pilotage rates charged over the period.

The model of relationship showing the impacts of variations in pilotage rates charged by the NPA on ship-owner's demand for port services measured by ship traffic calls to the ports over the period is:

$$SHIP_{tdemand}=2085.559+34.72PILOTAGE_{rates} \quad (5)$$

The result confirms that there exist a directly positive relationship between ship traffic handled in the ports and variations in pilotage rates charged by the NPA over the period. It corroborates the findings of the rate of change analysis in the previous section which indicates that with a unit increase in pilotage rates charged by the NPA over the period, ship traffic handled in the ports (ship-owner's demand for port services) increased by 34.72 ships per annum. By implication, increasing pilotage rates and charges paid in the Nigeria ports witnessed increasing patronage to ports by ship-owners. This confirms that port pricing policy is a veritable instrument for planning the directions of port revenue performance.

The coefficient of determination R-square which measures the explanatory power of the model is 0.75. This indicates that about 75% variation in number of ships handled in Nigerian ports over the period is explained by variations in pilotage rates charged by the NPA to ship-owners over the period.

The result also shows a t-score of 3.895 and p-value of 0.011 at alpha-value of 0.05. Since the p-value is less than the alpha-value (0.011<0.05,); we conclude that there is significant influence of variations in pilotage rates charged by the Nigerian ports on the ship traffic calls handled in Nigerian seaports. See figure2 below for the bar chart view of the relationship between pilotage rates and ship-owners patronage to ports in Nigeria.

Table4 above shows the result of the study showing the rate of change of GRT of vessels handled in Nigerian ports as a measure for ship-owner's demand for port services between 1977 and 2022 relative to

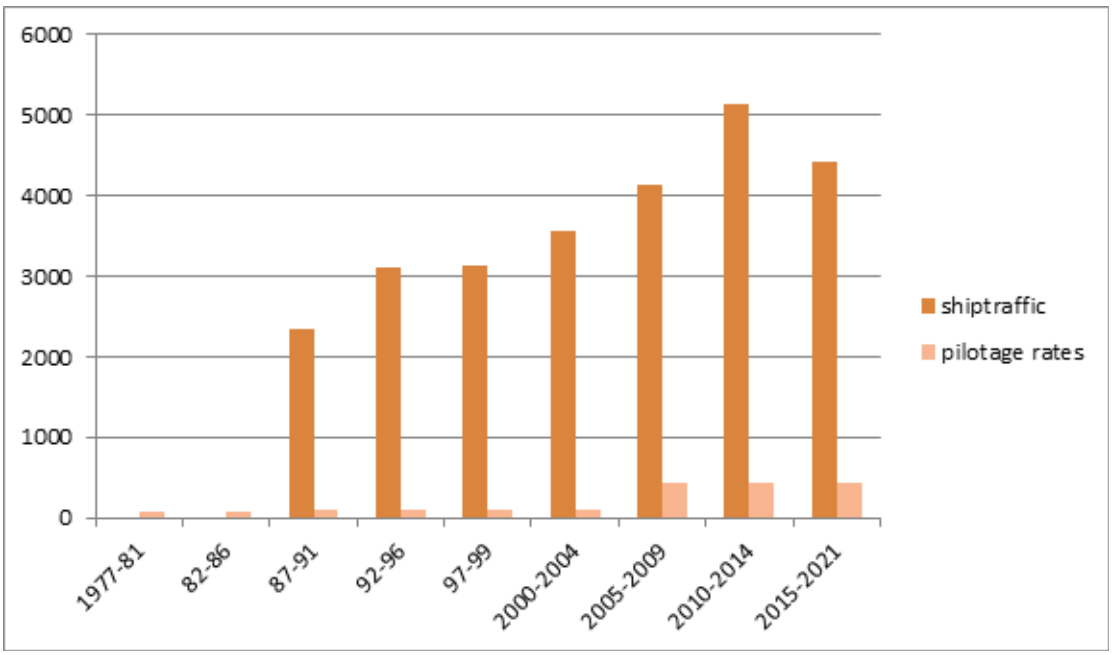

Figure2: Pilotage rates and ship traffic size 1977-2022

Source: Authors calculation.

variations pilotage rates charged by the port sector over the period. The result indicates that the mean Gross Registered Tonnage (GRT) of ships handled in the port per annum between 1977 and 2022 is 80249679 tons with standard deviation of 30145644 while the mean amount charged as pilotage rate by the port authority per over the period is 46.229 naira per 0.3 meters of pilotage services rendered to each vessels, with standard deviation of 23.4335.

The implication is that for an average of 80249679 shipping tonnage (GRT) handled in the port per annum between 1977 and 2022, ship-owner's expended an average of 46.229 naira per 0.3 meters of pilotage services rendered by the Nigerian ports authority. The average rate of change coefficient of ship tonnage handled in the Nigerian seaports relative the trend of pilotage rates charged by the NPA over the period is 1713332. This indicates that for each 1 naira variation (increase) pilotage rates charged by the NPA each year between 1977 and 2022, the GRT/shipping tonnage handled by the seaports increased by an average rate of 1713332 GRTs. Again, the result have implications in the revenue generating potentials of the port such that, with variations in pilotage rates charged by port authorities, GRT/shipping tonnage handled by the ports also varies as shown in the result. By implication, port revenue will vary in line with and in the same direction with GRT/shipping tonnage tendered by the ship-owner's to the ports. This findings corroborates the findings of (Ndikom et al, 2018; Oghojafor, Kuye, Alaneme, 2012).

The result on table5 shows parameters for developing the equation of the relationship showing the influence of trend of pilotage rates charged by Nigerian seaports on shipping tonnages (GRT) handled in the ports 1977 and 2022. The result indicates that the coefficient of correlation R which indicates taht the degree of correlation between shipping tonnages (GRT) handled in the seaports and trend of pilotage rates charged by the NPA over the period is 0.769213; which shows about 77% very high positive correlation between the shipping tonnages handled in the seaports as a proxy for ship-owner's demand for port services and the pilotage rates charged over the period.

Table4: Coefficient of Average rate of change of GRT of Vessels handled in the Port relative to variations in pilotage rates charged by port authority between 1977 and 2022

Variable(s)	Mean	Std. Deviation	Average rate of change coefficient
GRT handled (ship-owner's demand for port services)	80249679	30145644	1713332
Pilotage rates (port charges)	46.2286	23.43347	-

Source: Author's calculation

Table5: Influences of Pilotage rates Charged by the NPA on Shipping Tonnage (GRT) Handled in Nigerian Ports

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.76921	0.591689	0.510027	21101377

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	35957592	18285704		1.966432	0.106409
	pilotage	1713332	636510.4	.967	2.691759	0.043208

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.05E+08	88305368	80249679	30145644	45
Residual	-1.7E+07	1973.1460	.00000	13.53411	45
Std. Predicted Value	77130.27	2.069	.000	1.200	45
Std. Residual	-2.134	1.315	.000	.633	45

The equation of relationship showing the influences of the variations in in pilotage rates charged by the NPA on the shipping tonnage (GRT) handled in the seaports over the period is:

$$GRT_{demand}=35957592+1713332PILOTAGE_{rates} \quad (6)$$

The result indicates that there variations in pilotage rates charged by the NPA over the period had direct positive influences on the shipping tonnages (GRT) handled in the ports over the period covered in the study. The findings of the study confirms that a unit increase for example in the pilotage rates charged by the ports led to about 1713332 increase in shipping tonnage (GRT) handled by the ports per annum over the period. The implication that in the Nigerian port sector, increasing trend in pilotage rates charged by the NPA between 1977 and 2022 witnessed increasing trend in the shipping tonnage (GRT) handled by the ports over the same period. This confirms that port pricing policy is a veritable instrument for planning the directions of port revenue performance and thus corroborates the findings of Ndikom et al (2018).

The coefficient of determination R-square which measures the explanatory power of the model is 0.592. This indicates that about 59% variation in the shipping tonnages (GRT) handled in the Nigerian ports over the period is explained by variations in pilotage rates charged by the NPA to ship-owners over the period. The result also shows a t-score of 0.043208 and p-value of 0.0431 at alpha-value of 0.05. Since the p-value is less than the alpha-value (0.0431<0.05,); we conclude that there is significant influence of variations in pilotage rates charged by the Nigerian ports on the shipping tonnages handled in Nigerian ports over the years.

5.0 Conclusion

In line with the objectives and findings of the study, variations in pilotage rates charged by the Nigerian Ports authority for ship husbandry operations in Nigerian ports have significant influence of ship-owner's demand for port services in Nigeria. In line with the findings of the study, increasing trend in pilotage rates charged by the NPA between 1997 and 2022 saw consequent increases in ship traffic calls and shipping tonnages handled in the ports over the period. Therefore, there is a significant impact of port pricing policy on both ship-owners patronage to port services in Nigeria.

6.0 Recommendations

It is recommended that the empirical relationship between pilotage rates charged by the NPA and ship-owner's demand for shipping services (ship traffic calls and GRT shipping tonnage) should be component part of the tools and instruments for developing sustainable port pricing plan/policy in Nigeria.

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