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Responsiveness of Ship-owner's Demand for Port Services Relative to Changes in Port Pricing Regimes in Nigeria

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ABSTRACT

The study evaluated Ship-owner's Demand for Port Services Relative to Changes in Port Pricing Policy Regimes in Nigeria. Its objectives were, 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 Nigerian Port Authority (NPA) between 1977 and 2022. This was in realization of the fact that port charges have implications on port costs. It employed a quantitative research design methodology. 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 NPA between 1977 and 2022. The average rate of change quantitative tool and regression analysis were used to analyze the data obtained. It was found that an average rate of change coefficient of 34.719 ship traffic calls in Nigerian seaports relative to the trend of pilotage rates charged by the seaports over the period is 34.719. The results also show that there is significant influence of variations in pilotage rates charged by the Nigerian ports on the ship traffic calls in Nigerian seaports. The findings of the study further reveal that for each 1 naira variation (increase) in pilotage rates, the Gross Registered Tonnages (GRT)/shipping tonnage handled increased by an average rate of 1713332 GRTs. The implications of these results and findings is that shifts or changes in prices for port services significantly influence ship-owners port choice and port authorities should harness this relationship to achieve sustainable growth through use equilibrium pricing strategies.

Keywords: Ship owners, port services, port pricing policy, shipping industry

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Nijerya'daki Liman Fiyatlandırma Rejimlerindeki Değişikliklere Göre Gemi Sahiplerinin Liman Hizmetlerine Yönelik Taleplerinin Duyarlılığı

ÖZET

Bu çalışma, Nijerya'daki liman fiyatlandırma politikası rejimlerindeki değişimlere bağlı olarak armatörlerin liman hizmetlerine yönelik talebini değerlendirmiştir. Çalışmanın amacı, 1977–2022 yılları arasında Nijerya Liman Otoritesi (NPA) tarafından uygulanan kılavuzluk ücretlerindeki değişimlere bağlı olarak, Nijerya limanlarında armatörlerin liman hizmetleri talebindeki ortalama değişim oranı katsayısını tahmin etmektir. Bu amaç, liman ücretlerinin liman maliyetleri üzerinde etkilerinin bulunması gerçeğinden hareketle belirlenmiştir. Çalışmada nicel araştırma tasarımı benimsenmiştir. Armatörlerin liman hizmetleri talebine ilişkin bir gösterge olarak, çalışma kapsamında ele alınan 45 yıllık dönemde Nijerya limanlarında gerçekleşen gemi trafiği ve elleçlenen gemi tonajına ilişkin ikincil veriler NPA'dan temin edilmiştir. Ayrıca, 1977–2022 yılları arasında NPA tarafından uygulanan kılavuzluk ücretlerine ilişkin zaman serisi verileri de elde edilmiştir. Elde edilen veriler, ortalama değişim oranı analizi ve regresyon analizi kullanılarak değerlendirilmiştir. Araştırma bulguları, incelenen dönem boyunca Nijerya limanlarında kılavuzluk ücretlerindeki eğilimlere bağlı olarak gemi trafik çağrılarında 34,719'luk bir ortalama değişim oranı katsayısı olduğunu göstermektedir. Sonuçlar ayrıca, Nijerya limanlarında uygulanan kılavuzluk ücretlerindeki dalgalanmaların, limanlardaki gemi trafik çağrılarını anlamlı düzeyde etkilediğini ortaya koymaktadır. Çalışmanın diğer bir bulgusu ise, kılavuzluk ücretlerinde her 1 nairalık artışın, elleçlenen Gros Tonaj (GRT)/gemi tonajında ortalama 1.713.332 GRT artışla ilişkili olduğudur. Bu sonuçların ve bulguların temel çıkarımı, liman hizmetleri fiyatlarındaki değişimlerin armatörlerin liman tercihlerini önemli ölçüde etkilediğidir. Dolayısıyla liman otoriteleri, sürdürülebilir büyüme elde etmek amacıyla dengeleyici fiyatlandırma stratejileri kullanarak bu ilişkiyi etkin şekilde değerlendirmelidir.

Anahtar Kelimeler: Armatörler, liman hizmetleri, liman fiyatlandırma politikaları, denizcilik sektörü

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 al., 2022b).

The implication is that the significance 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 et al., 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 et al., 2012; Bamidele & 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 et al., 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 et al., 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 et al., 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 & 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 study is distinct in its empirical focus on Nigeria's unique port pricing policy regimes and their direct influence on ship-owners' demand responsiveness over a 42-year period. Unlike previous research that often disaggregated port pricing impacts, this work leverages aggregated and generalized port data to reveal overall behavioural patterns of ship-owners, thereby offering locally grounded insights critical for policy reform and strategic planning in Nigeria's liberalized maritime economy. This is the central aim of this current study. The specific objectives of the study however are as stated below.

The specific objectives of the study are: "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" and "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”

The research questions of the study are: “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?” and “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 Literature Review

Meersman et al. (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 in 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 et al. (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 harbour, 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 Table 1 below.

Table 1: *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 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.

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 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) and, 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 and Anyasor, 2020; David et al, 2015).

According to (Oghojafor et al, 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 denote 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.

While the reviewed literature provides a comprehensive inventory of port charges and underscores the strategic role of port pricing in influencing ship-owner patronage, it largely adopts a descriptive rather

than a critical lens. A deeper analytical comparison reveals that while Meersman et al. (2003, 2014) and UNCTAD (1975) emphasize the theoretical underpinnings of pricing as a tool for market regulation, utility maximization, and competitive positioning, studies like Ndikom et al. (2017a) and Chioma (2011) remain prescriptive, focusing narrowly on the Nigerian port context without benchmarking against global best practices or efficiency-based pricing models such as marginal cost or Ramsey pricing. Moreover, while Nigerian port pricing appears to be largely cost-recovery driven and centrally administered by the NPA, global trends increasingly lean toward dynamic pricing models—where charges are adjusted in real-time based on port congestion, performance metrics, and service levels. The absence of value-based pricing or market-driven tariffs in Nigerian ports, as well as the rigidity imposed by compulsory pilotage policies, contrasts with reforms in ports like Durban, Tema, or Rotterdam, where pricing is strategically used to incentivize ship calls and modal shift. Furthermore, the literature underrepresents empirical studies that quantitatively assess the elasticity of ship-owner demand relative to price changes—an area where performance-based or demand-responsive pricing strategies could offer insight into optimizing revenue and traffic flow. Therefore, a critical gap persists in linking port pricing decisions in Nigeria to measurable impacts on port competitiveness, user satisfaction, and broader maritime logistics performance within West Africa.

3 Methodology

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 for 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:

$$SHP_{demand} = f(P_{rate})$$

Where:

$SHP_{tdemand}$ = 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 [t1----- t45] covering the 45-year period covered in the study can be estimated from the expression:

$$\frac{gSHP_{tdemand}}{gP_{rate}} = \frac{f(SHP_{tdemand1}) - f(SHP_{tdemand45})}{P_{rate1} - P_{rate45}} \quad (1)$$

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:

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

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

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_{demand}) and GRT of vessels handled (GRT_{demand}) over the period respectively.

Using the methods described above, the data obtained for the study was analysed 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.

3.2 Justification for Variable Selection and Limitation of Scope

The selection of ship traffic calls and gross registered tonnage (GRT) of vessels handled in Nigerian ports as proxies for ship-owners' demand for port services is methodologically sound and consistent with established maritime economics literature (e.g., Meersman et al., 2014; Nwokedi et al., 2023). Ship traffic calls represent the frequency and number of vessel entries into ports, providing a direct measure of the intensity of demand by ship-owners for port access and services. On the other hand, GRT reflects the cargo-carrying capacity of the vessels that use the port, thereby capturing the scale of demand in terms of volume. These variables are particularly useful in long-term port pricing studies as they are consistently recorded and can be disaggregated by port, vessel type, and time period.

Similarly, pilotage rates serve as an appropriate and stable proxy for port pricing policy in the Nigerian port context. This is because pilotage fees are uniformly regulated by the Nigerian Ports Authority (NPA) and are compulsory for all ocean-going vessels berthing in the country's ports, regardless of port location. Pilotage rates are thus less susceptible to discretionary pricing by terminal operators and more reflective of centralized pricing policy decisions over time, making them an ideal indicator to evaluate the effect of port pricing regimes on ship-owner behaviour.

However, the study acknowledges important limitations arising from the exclusion of macroeconomic and infrastructure-related variables. Macroeconomic factors such as national GDP, international trade volumes, and exchange rates significantly influence maritime trade flows and, by extension, port demand. Their omission may lead to omitted variable bias, thereby affecting the accuracy of the estimated relationship between pricing and demand. Additionally, port infrastructure quality—including berth capacity, dredging depth, ship turnaround time, and cargo handling efficiency—directly influences port attractiveness and vessel traffic. Without accounting for these factors, variations in ship traffic and GRT may be misattributed to pricing changes alone, thus limiting the explanatory power of the regression model. As a result, while the study offers valuable insight into the rate of change of demand relative to pricing policy, the findings must be interpreted with caution, particularly in the context of broader port competitiveness and investment planning.

To mitigate these limitations in future research, the study recommends the incorporation of multivariate analysis frameworks such as panel regression models, vector autoregression (VAR), or structural equation modelling (SEM), which allow for the simultaneous consideration of pricing, macroeconomic indicators, and port performance metrics. Such an approach would provide a more holistic understanding of the drivers of ship-owner demand for port services in Nigeria and across the West African maritime corridor and the researchers hope to implement another study by incorporating all the methodologies and methods described.

4 Results and Discussion

Table 2 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 (ship traffic calls). This is corroborates the findings of (Ndikom et al., 2018; Oghojafor et al., 2012). Figure 1 shows the trend line for ship traffic calls handled in the seaport and prevailing pilotage rates charged by the NPA over the period.

Table 2: *Typology of Port Charges and Rates Applicable to Specific Port services and Port user groups in Nigerian*

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	-

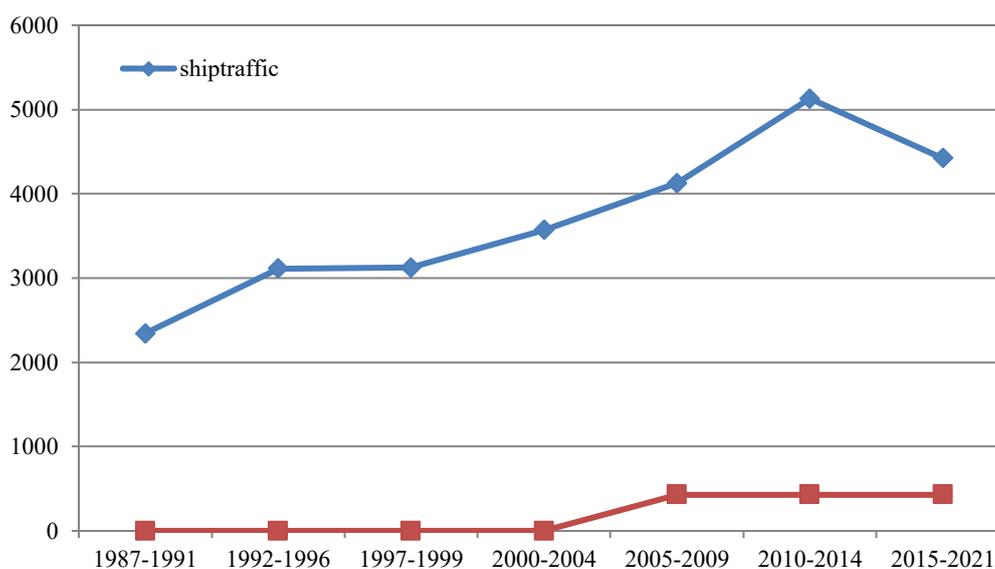


Figure 1: Trend line of ship traffic calls and pilotage rates charged in Nigerian Ports 1977-2022

Table 3 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.

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	.867 ^a	.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

a. Dependent Variable: ship traffic

The result on Table 3 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:

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

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 Figure 2 for the bar chart view of the relationship between pilotage rates and ship-owners patronage to ports in Nigeria.

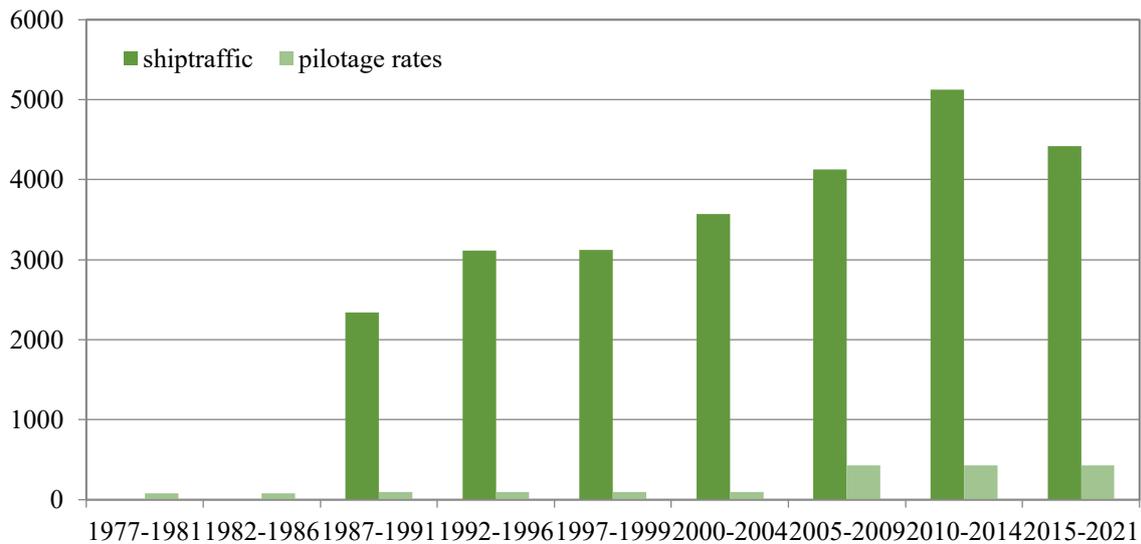


Figure 2: Pilotage rates and ship traffic size 1977-2022

Table 4 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 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.

Table 4: 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	-

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 et al., 2012).

The result on Table 5 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.

Table 5: 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

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) pilotage	35957592	18285704		1.966432	0.106409
	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.

4.1 Explaining the Positive Price-Demand Relationship through Derived Demand Theory and Port-User Behaviour

The observed positive relationship between pilotage rates and ship-owners' demand for port services, as reflected in both ship traffic calls and shipping tonnage (GRT), may appear contradictory to classical economic theory, which suggests that higher prices lead to lower demand. However, the concept of

derived demand offers a robust theoretical explanation for this result. In maritime transport economics, port services such as pilotage, mooring, and berthing are not demanded for their own sake but as intermediate inputs to the broader objective of facilitating international trade and cargo movement. Thus, the demand for port services is derived from the demand for shipping trade and logistics, which in turn is influenced by global trade volumes, export/import activities, and regional port connectivity. Even when port charges such as pilotage rates increase, ship-owners may continue to call at a port if the economic incentives tied to trade volumes, cargo availability, route efficiency, and hinterland access outweigh the increase in costs.

Moreover, port-user behaviour is often governed by a multi-criteria decision-making process, where pricing is only one of many factors considered. Others include service quality, port infrastructure, and frequency of vessel turnaround, regulatory stability, and market positioning. In the Nigerian context, where pilotage is compulsory and centrally administered by the Nigerian Ports Authority (NPA), ship-owners may have limited alternatives, thereby reducing the price elasticity of demand for such services. Additionally, the increase in pilotage rates over the study period may have coincided with broader growth in seaborne trade, oil exports, or port infrastructure investments, thus masking or neutralizing any negative pricing effect. This supports the argument that higher demand may be driven more by exogenous trade conditions and national cargo throughput than by pricing policy alone. Consequently, port pricing should not be analyzed in isolation but as one of several instruments used to manage port revenue, user behaviour, and competitiveness.

4.2 Limitations

While the results of the study reveal a statistically significant and positive relationship between pilotage rates and ship-owners' demand for port services, several limitations must be acknowledged, which constrain the generalizability and interpretation of the findings. First, the scope of the study is limited to the sole use of pilotage rates as the proxy for port pricing policy as it relates to ship-owners, excluding other port charges such as berthage, mooring, towage, conservancy, and ship dues that collectively influence the total cost of accessing port services. This narrow focus may not capture the full spectrum of cost considerations influencing ship-owners' port choice behaviour.

Second, macroeconomic and trade-related variables such as GDP growth, exchange rates, oil price fluctuations, trade liberalization policies, and international shipping cycles were not integrated into the analysis. These exogenous factors can significantly influence the volume of trade and, by extension, ship traffic and GRT handled, thereby confounding the effect attributed solely to pilotage rate variations.

Fourth, the study uses aggregated annual data, which may smooth out short-term fluctuations, peak-period effects, or policy shocks that could yield a more nuanced understanding of ship-owners' sensitivity to price changes. This aggregation may also limit the ability to capture seasonal or cyclical patterns in port service demand. The assumption of a linear and unidirectional relationship between pilotage rates and ship-owners' demand may oversimplify the complex, non-linear interactions between port users and service providers. Elasticity of demand may vary across vessel sizes, cargo types, and trade routes, which were not disaggregated in the study.

These limitations suggest that while the findings provide important insights into long-term pricing trends and demand behaviour in Nigerian ports, caution must be exercised in attributing causality. Future research should employ multivariate, panel, or structural models that integrate broader economic, policy, and operational variables to enhance the robustness and applicability of the findings.

5 Conclusions

Variations in pilotage rates charged by the Nigerian Ports Authority for ship husbandry operations in Nigerian ports have significant influence on ship-owner's demand for port services in Nigeria. The findings indicate that the increasing trend in pilotage rates charged by the NPA between 1977 and 2022 corresponded with consequent increases in ship traffic calls and shipping tonnages handled in the ports. Therefore, port pricing policy has a significant impact on ship-owners' patronage of port services in Nigeria.

Integrate Empirical Price-Demand Analytics into Port Pricing Policy Formulation: The Nigerian Ports Authority (NPA) should adopt evidence-based frameworks by incorporating historical data and demand elasticity coefficients into port pricing models. This will enable the authority to set pilotage rates that optimize both revenue generation and port user satisfaction, while avoiding arbitrary or politically driven pricing decisions.

Implement a Dynamic and Performance-Based Pricing Framework: A flexible pilotage pricing mechanism should be adopted, in which rates are periodically reviewed and adjusted based on key performance indicators (KPIs) such as port throughput, congestion levels, vessel turnaround time, and utilization rates. This aligns pricing with performance and encourages more efficient port operations.

Adopt Differential Pricing Based on Vessel Characteristics and Traffic Volumes: To attract a diverse range of vessel types, the NPA should introduce a tiered pilotage rate structure that differentiates between vessel size, frequency of calls, and operational risk. For example, volume-based discounts or loyalty incentives for frequent callers can encourage long-term patronage without undermining cost recovery.

Use Pricing as a Strategic Tool to Compete with Regional Ports: Given Nigeria's ambition to become a maritime hub in West and Central Africa, pilotage and other port service charges should be strategically benchmarked against competing ports in Ghana, Togo, and Cameroon. This will help Nigerian ports remain competitive in attracting transshipment and long-haul vessel traffic.

Incorporate Stakeholder Engagement in Pricing Policy Development: Port pricing reviews should involve structured consultations with key stakeholders, including ship-owners, terminal operators, maritime unions, and logistics providers. This collaborative approach ensures buy-in, transparency, and a shared understanding of the rationale behind pricing decisions.

Invest Pilotage Revenues in Port Infrastructure and Service Upgrades: To sustain the positive demand response identified in the study, revenue generated from pilotage charges should be transparently reinvested into improving pilotage safety, training of pilot masters, vessel traffic systems (VTS), and dredging of port access channels. This will reinforce confidence among ship-owners and enhance service delivery.

Establish a Pricing Impact Monitoring Unit within the NPA: The NPA should establish a dedicated Pricing Impact Monitoring and Evaluation (PIME) Unit responsible for tracking the short- and long-term effects of price changes on ship calls, port throughput, and revenue. This unit can generate periodic reports to guide pricing adjustments and policy refinements.

6 Declarations

6.1 Study Limitations

The study considered the responses of ship-owners demand for port services relative to changes in port pricing regimes in Nigeria. It didn't extent to investigate shipper's response to changes port pricing regimes. The is limited to evaluating the rate of change of ship-owners demand for port services relative to the extent of variations in port pricing regimes between 1977 and 2022. The data used in the study was obtained from the Nigerian Ports Authority (NPA) covering the period between 1977 and 2022. Therefore, the extent of accuracy of the research findings is limited to the extent of accuracy of the data obtained from the NPA and used in the study.

6.2 Acknowledgements

We humbly acknowledge the support of the Department of Maritime Technology and Logistics, Federal University of Technology, Owerri, Nigeria for granting the researchers the much needed moral and intellectual support needed to conclude the study as component of the a PhD Thesis in 2022.

6.3 Funding Source

No financial support was received for this research.

6.4 Competing Interests

There is no conflict of interest in this study.

6.5 Authors' Contributions

Theophilus Chinonyerem NWOKEDI: Developing ideas for the article, planning the materials and methods to reach the results, taking responsibility for the explanation and presentation of the results.

Nathaniel Nsen FUNIAL: Taking responsibility for the literature review during the research, taking responsibility for the creation of the literature review.

John Folayan OJUTALAYO: Taking responsibility for the experiments, organizing and reporting the data.

Chigozie Odumodu UZOMA: Taking responsibility for the literature review during the research.

Okoroji LAZARUS: Taking responsibility for the literature review during the research, taking responsibility for the creation of the reference list.

7 Human and Animal Related Study

7.1 Ethical Approval

The Post Graduate Board of the Department of Maritime Technology, Federal University of Technology Owerri, approved the work as part of a Post Graduate research Thesis.

7.2 Informed Consent

Informed consent form was obtained from all participants for the study that they agreed to participate in the study.

References

- Bamidele B., & Oludele M.S. (2017) The Nigerian seaports and development (1900-2015): Historical perspectives and dynamics. *International Journal of Development and Sustainability*, Volume 6(9): Pp: 1007-1024
- Bichou, K., & Gray, R. (2004) A logistics and supply chain management approach to port performance measurement. *Maritime Policy and Management*,31(1)Pp. 47-67.
- Chioma Y.J. (2011) Freight Traffic at Nigerian Seaport: Problems and Prospects. *The Social Sciences* Vol.6(4) Pp.: 250-258.
- David N, Joyce N., Haragopal P., Rahul P., & Jean-Pierre V. R. (2015) Consumer patronage and willingness-to-pay at different levels of restaurant attributes: A study from Kenya. *Research in Hospitality Management* 2015, 5(2): 171–180
- Emenike G. C., Amamilo A. C., & Ajayi E. O.(2018) Assessment of Vessel Traffic and Customers Patronage at the Rivers Seaport, Port Harcourt, Rivers State, Nigeria. *Nature and Science* 2018;16(11)Ppp.: 22-29
- Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics*. 5th eds. New York, McGraw-Hill/Irwin.
- Hercules H (2002) Competition, Excess Capacity, and the Pricing of Port Infrastructure. *International Journal of Maritime Economics* 2002 (4) Pp.: 323-347.
- Meersman H., Van de Voorde E., & Vanelslander T. (2003) Port Pricing: Considerations on Economic Principles and Marginal Costs. *European Journal of Transport and Infrastructure Research* 3 (4), pp. 371-386
- Meersman H., Pettersen S. S., & Van de Voorde E. (2014) Port Pricing: Principles, Structure and Models. Working Paper at the Department of Economics, Institutt for Samfunnsøkonomi, Norway.
- Nigeria Ports Authority (NPA, 2019) Nigeria Ports Authority Tariff Regulation. Working Document of the Nigeria Ports Authority (NPA).
- Njelita, C. I., & Anyasor, O. M. (2020) Customer Loyalty and Patronage of Quick Service Restaurant in Nigeria. *British Journal of Marketing Studies (BJMS)* Vol. 8(2) Pp.:54-76.
- Nokuzola E.M. (2014) Towards efficient port pricing: a specific look into South African tariff methodology. A dissertation submitted for the Award of Master of Science Degree in Shipping Management and Logistics at the World Maritime University, Malmo, Sweden.
- Nwokedi T. C., Ndikom O.B., Nnadi K.U., & Onyaeachi C. (2023) Modeling shipping accidents economic loss and the compensation in Nigeria. *Maritime Technology and Research* 2023; 5(2): 260960. <https://doi.org/10.33175/mtr.2023.260960>
- Nwokedi Theophilus C, Osondu-Okoro C. G., Mbachu J. C., Gbasibo L. A., Nwolozi C. N., & Onwusoh A. F. (2022) Funding Alternatives for Speed Boat Operations in Inland Waterways Transport Sub-Sector in Rivers State Nigeria: A Comparative Study. *Hmlyan Jr Eco Bus Mgn*; 3(2) 116-122.

- Nwokedi T. C., Ibe C. C. Mbachu J. C., & Okafor C. O., (2022). Modeling influences of Container Freight Ocean Shipping and Road Haulage Costs to Last-mile Trade Corridors on Price Inflation Trend in West Africa, 12(4) 71-78. Retrieved from <http://jms.eleyon.org/index.php/jms/>
- Ndikom, O. B., Okoroji L.I., B. S. O., Mbachu J. C., & Nwokedi T. C. (2022) Comparative analysis of foreign and coastal trade cargo handling charges in SIFAX seaport terminals, Nigeria. *Advances in Transportation and Logistics* Volume 2, (1) 2-9.
- Ndikom O.B., Nwokedi, Buhari & Okeke (2017a) An Appraisal of Demurrage Policies and Charges of Maritime Operators in Nigerian Seaport Terminals: the Shipping Industry and Economic Implications. *Naše more* 64(3) pp. 90-99. DOI 10.17818/NM/2017/3.3
- Ndikom O. B., Buhari S.O., Nwokedi T.C., & Okeke O.K. (2017b) The challenges of cargo clearance at the Nigerian ports. (A service provider and shippers perspectives). *Journal of Maritime Research* Vol XIV. No. I (2014) 38–43
- Ndikom O. B., Nwokedi T. C., & Buhari S.O. (2018) Cargo clearance and congestion challenges in Nigeria ports: A case for integration of Emerging River Ports and ICDs into Hub Port Trade Corridors. *Ijagun Journal of Social and management Sciences*. Vol. 5(1) 27-43
- Oghojafor B. E. A. Kuye O. L., & Alaneme G. C. (2012) Concession as a Strategic Tool for Ports Efficiency: An Assessment of the Nigerian Ports. *American Journal of Business and Management* Vo. 1(4) Pp. 214-222.
- Ogunsiji, A. S. & Ogunsiji, O. O. (2010) Consummate precision of strategic management approach on transport logistics and physical distribution for port performance efficiency: A case study of Nigerian Ports. *Journal of Emerging Trends in Economics and Management Sciences*,1(2), 96-101.
- Olaogbebikan J. E., Ikpechukwu N. F., Akin O., & Enosko O. (2014) Performance Evaluation of Nigerian Ports: Pre and Post Concession Eras. *Civil and Environmental Research* Vol.6 (.2) P.: 1-13.
- Sodiq O.B., Ndikom O.B., & Nwokedi T.C. (2017) An assessment of the relationship among cargo-throughput, vessel Turn-around time and port-revenue in Nigeria (A study of Lagos port complex). *Journal of Advance Research in Business, Management and Accounting* Vol.3 (7)Pp. 1-13.
- United Nations Conference on Trade and Development (UNCTAD, 1975) Port Pricing. A Report and Working Document by the UNCTAD secretariat. Document number: TD/B/C.4/110/Rev.1.



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