Study on Influence of Harbour Dues on the Flow of Liquid Bulk Shipping Trade in Nigerian Port Terminals

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ABSTRACT

Understanding the extent to which and how harbour dues affect trade is essential for improving port efficiency and overall economic performance. This study aims to investigate the influence of harbour dues on the flow of liquid bulk shipping trade in Nigerian ports. The researcher adopted a qualitative research design and a critical literature review approach, utilizing historical (time series) data to conduct the analysis. Harbour dues were used as a proxy to represent the prices charged by the Nigerian Ports Authority (NPA) to shippers and ship operators for the use of port facilities. Additionally, the tonnage of liquid bulk trade handled at the ports, obtained from the NPA, served as a proxy for the trend in the flow of liquid bulk trade over the study period. The data covered the period between 1977 and 2021. To analyze the data, the study employed Ordinary Least Squares (OLS) regression analysis. The results revealed that the mean annual tonnage of liquid bulk (oil and gas) trade flow through the port harbours between 1977 and 2021 was approximately 88,352,706.57 tons, with a standard deviation of 62,936,605.79 tons. The average harbour dues per ton of liquid bulk trade handled during the same period were 333.21 naira, with a standard deviation of 310.66 naira. The findings indicated a strong positive correlation (approximately 82%) between the flow of liquid bulk trade through the ports and the harbour dues charged by the port authorities during the study period. The model representing the relationship between the flow of liquid bulk trade (as a measure of shippers' demand for port services) and the

rates charged by port authorities as harbour dues is expressed as follows: LBULKCARGOPUT=33546332.462+164476.109 · HARDUES. This implies that for every unit increase in harbour dues paid per ton by liquid bulk trade handled at the port terminals, there is an estimated increase of approximately 164,476.11 tons in the flow of liquid bulk trade through the port harbours. Furthermore, the results indicate that about 66% of the variation in the flow of liquid bulk trade handled at Nigerian ports during the study period can be explained by the harbour dues charged by the NPA to shippers of liquid bulk trade. The findings underscore the significant influence of harbour dues on the tonnage of liquid bulk trade shipped via Nigerian ports between 1977 and 2021.

Keywords: Harbour-dues, Liquid-bulk, Shipping-trade, Seaports, Nigeria.

1. Introduction

The maritime industry plays a critical and pivotal role in Nigeria's economy, particularly in the liquid bulk shipping trade, which primarily involves the transportation of seaborne crude oil and refined petroleum products. Understanding the extent to which and how harbour dues impact this trade is essential for improving port efficiency and overall economic performance. This is because the charges paid by operators of liquid bulk carriers as harbour due to port authorities and terminal operators significantly influence the port choices of ship operators and shippers. These charges have direct implications for the overall cost of port services, shaping the consumption experiences of shippers and ship operators, who are key stakeholders in the port sector. This study investigates the relationship between harbour dues and the dynamics of the liquid bulk shipping trade, with a focus on Nigerian ports while incorporating insights from relevant global contexts. In this study, harbour dues refer to the charges levied by port authorities and terminal operators on ship operators for all goods discharged or loaded, as well as for passengers embarking or disembarking within the harbour. These charges are imposed to cover the provision of facilities designed to ensure a secure harbour environment for anchoring vessels, enabling safe operations such as discharge, loading, embarkation, and disembarkation. Harbour dues are typically paid by ship operators, who may subsequently pass these costs on to shippers as part of the freight charges [1].

Several studies have shown that high harbour dues can significantly increase shipping costs, potentially deterring shipping lines from utilizing specific ports. For example, Bichou and Gray [2] examined the influence of port charges on shipping routes and logistics decisions, concluding that high charges often result in reduced shipping frequency and an overall decline in trade volumes. Similarly, Notteboom and Winkelmans [3] highlighted the importance of competitive

pricing in port operations, arguing that ports with lower dues are more likely to attract higher shipping activity. This observation is particularly pertinent to Nigeria, where competitive pressures from neighboring countries can significantly influence trade flows. The direct correlation between harbour dues and trade flow has been extensively examined in the literature, with notable implications for the liquid bulk shipping sector. For instance, Tavasszy and Van der Meer [4] analyzed port charges in Europe and found that increases in harbour dues frequently prompted a shift in trade to ports with more competitive pricing. This trend was especially evident in the liquid bulk sector, where shipping companies prioritized minimizing operational costs. In the context of Nigerian ports, Aderamo [5] identified high harbour dues as a key factor contributing to inefficiencies in the shipping process. These inefficiencies not only delayed the timely delivery of goods but also led to a decline in trade volumes. These findings collectively suggest that a reevaluation of harbour dues is necessary to enhance port competitiveness and facilitate smoother operations, particularly in the handling of liquid bulk trade. Addressing this issue could help mitigate inefficiencies, attract more shipping activity, and improve overall trade performance in Nigerian ports.

In the port sector, port prices, dues, and charges serve as critical tools for influencing port-user patronage and demand for port services. In a competitive environment characterized by the presence of multiple ports and terminal operators, variations in harbour dues, for instance, can significantly impact the level of patronage by port users. This, in turn, alters the dynamics of shipping trade flows through specific ports and terminals. The effect is particularly pronounced in specialized trade types, such as the liquid bulk trade. In Nigeria, the current port pricing methods and approaches appear to inadequately account for the dynamic effects of harbour dues—alongside other port charges—on the decisions of liquid bulk cargo shippers and liquid bulk carrier operators to utilize local ports. This has direct implications for port productivity and efficiency. High harbour dues, for example, increase the cost of port usage and may lead to declining demand for port services. Conversely, optimal harbour dues can minimize the cost of port service consumption, thereby increasing demand for port services. Such optimization has the potential to positively influence the productivity and efficiency of Nigeria's port sector.

Nigeria, as one of Africa’s leading oil-producing nations, heavily relies on its seaports for the import and export of liquid bulk products. It is therefore expected that the structure of harbour dues will influence the cost framework faced by shipping companies, subsequently affecting their operational decisions, competitiveness, and trade patterns. The divergence in development and operational policy strategies between Nigeria’s port sector and those of more advanced global maritime nations underscores the need for a focused investigation into the relationship between liquid bulk trade and harbour dues as a component of port pricing. For instance, while Nigeria operates multiple liquid bulk (oil and gas) export terminals as well as numerous import terminals

across different geographical regions—with harbour dues charged for both terminal types—global maritime hubs such as China and Singapore predominantly handle liquid bulk import trade. This structural difference highlights the importance of examining how harbour dues influence trade efficiency and shipping practices, particularly in developing countries. Previous studies have pointed to the need for a more detailed understanding of how such fees impact trade efficiency and shipping operations in nations like Nigeria.

The Nigerian maritime industry is central to the country's economic development, particularly in the trade of liquid bulk commodities such as crude oil, refined petroleum products, and offshore drilling chemicals. Consequently, the imposition of harbour dues for the use of port facilities has significant implications for shipping operations and trade flows. This study is designed to examine the extent to which variations in harbour dues over the years have influenced the flow of liquid bulk shipping trade through Nigerian ports. Specifically, it seeks to provide empirical evidence on the relationship between the trends and rates of harbour dues and the dynamics of liquid bulk trade in Nigeria. The significance of this research lies in its potential contribution to understanding how harbour dues impact liquid bulk shipping trade traffic in Nigerian port terminals. This knowledge is crucial for improving operational efficiency and enhancing Nigeria's position in global trade. The study will also provide valuable insights for policy analysts and other stakeholders, facilitating the creation of a more competitive environment in the maritime sector. Ultimately, this research proposes an approach to investigating harbour dues that can inform the development of better policies and practices in Nigeria's maritime industry.

1.1 Objectives of the Study

The specific objectives of the study are identified below.

(i) To model relationship depicting the influence of harbor dues on the trend of oil and gas (liquid bulk) cargo shipped via the ports between 1977 and 2021.

(ii) To estimate the extent of variation in the flow of liquid bulk trade in Nigerian ports relative to variations in harbor dues by the port authorities over the period.

1.2 Research Question

(i) Is there a significant influence of harbour dues on the flow of liquid bulk trade in Nigeria ports?

(ii) Is the extent of variation in the flow of liquid bulk trade in Nigerian ports associated with variations in harbor dues charged in the ports significant?

1.3 Hypothesis

H_1: There is no significant influence of harbor dues on the flow of liquid bulk shipping trade in Nigerian ports between 1977 and 2021.

H_2: The extent of variation in the flow of liquid bulk trade in Nigerian ports relative to variations in harbour dues charged in the ports is not significant.

2. Literature Review

The shipping of liquid bulk cargo is a critical component of Nigeria's maritime trade and understanding how harbour dues impact this sector is essential for improving port efficiency and ensuring robust economic performance. This literature review critically examines prominent empirical studies on the relationship between harbour dues and shipping trade dynamics within Nigerian ports, while also drawing insights from relevant global contexts. Meersman, Vande Voorde, and Vanelslander [6] emphasize that pricing is a fundamental element underpinning the economic interactions between port users, terminal operators, and port authorities in the maritime industry. Price is defined as the monetary value expected or paid in exchange for goods or services. In the context of port services, price refers to the financial payment made by consumers for the use of a unit of port service. Harbour dues, charged by port authorities and terminal operators, are a subset of port prices that ship operators and shippers pay for specific port services. These dues are determined by port pricing policies and play a significant role in shaping port operations and trade flows.

Oghojafor, Kuye, and Alaneme [7] investigated the challenges faced by Nigerian ports prior to the 2006 concession program and evaluated the extent to which the initiative improved port performance and met user demands. Using secondary data on key performance indicators related to port usage by shippers and ship owners, the study employed content analysis to draw conclusions. The findings revealed that, while the concession program increased government revenue from port operations, it failed to adequately address user demands for improved services. Persistent issues, such as rising port charges, high operational costs, prolonged cargo dwell times, and extended ship turnaround times, remain significant barriers. The authors recommended that port authorities enhance service quality to justify increasing rates and improve user satisfaction.

Hercules [8] explored the interplay of competition, excess capacity, and pricing strategies for port infrastructure. The study highlighted the ongoing debate among stakeholders regarding optimal pricing approaches that balance user satisfaction with the need for investors to recover development costs profitably. Hercules argued that aligning port infrastructure investments with broader economic development goals is essential for resolving pricing controversies. The study advocated for marginal cost pricing as an effective strategy to promote cost recovery, ensure fair competition among ports, and maintain user satisfaction, presenting it as a superior alternative to traditional pricing methods.

Emenike, Amamilo, and Ajayi [9] assessed vessel traffic and customer patronage at the Rivers Seaport in Port Harcourt, Nigeria. Using both primary and secondary data, the study analyzed factors influencing port usage, including cost, cargo-handling efficiency, berthing space availability, and government policies. The findings revealed that high costs associated with port usage, including clearing charges, were critical barriers deterring ship owners and shippers from fully utilizing the port. The authors recommended streamlining and reducing various charges and taxes to alleviate the financial burden on port users and encourage greater patronage. Meersman, Pettersen Strandenes, and Van de Voorde [10] examined port pricing principles, structures, and models, highlighting the pivotal role of pricing levels and transparency in shaping shippers' decisions regarding supply chain and transport mode selection. The study found that many global ports rely on linear pricing models that lack modern strategies such as price differentiation and revenue management. These limitations result in suboptimal pricing practices that fail to maximize port profitability or enable users to derive maximum utility from port services.

Recent advancements in port technology and digitalization, such as blockchain technology, artificial intelligence (AI), the Internet of Things (IoT), and port automation, have significantly enhanced terminal operations and reduced port costs for container trade in many global ports [11]. However, it remains unclear how these technological innovations have influenced port costs, pricing, and harbour dues for liquid bulk terminals in Nigeria. Melnyk, Shcherbina, Mykhailova, Obnyavko, and Korobko [12] observed that the adoption of greener energy technologies for ship propulsion systems has led to a modest decline in the traffic of fossil fuel-powered vessels. Yet, the impact of these changes on harbour dues for the liquid bulk trade in Nigeria's port sector remains insufficiently explored.

Nokuzola [13] investigated port pricing methodologies in South Africa, emphasizing the critical role of robust port infrastructure in sustaining the country's economic vitality. The study highlighted that the efficiency of port infrastructure and the associated pricing mechanisms are key determinants of economic performance. High tariffs in South African ports were found to contribute to inflationary pressures on domestic commodity prices. Nokuzola [13] argued that factors such as the structure of port management, the elasticity of demand for port services, and the sources of port funding significantly influence pricing methodologies. Comparative studies from other developing countries provide additional insights into how harbour dues affect shipping trade.

For instance, Bichou and Gray [2] analyzed the impact of port charges on shipping routes and logistics decisions. Their findings revealed that high port charges generally reduce the frequency of shipping trips and result in a decline in overall trade volumes. Similarly, Notteboom and Winkelmans [3] emphasized the importance of competitive pricing for port operations, noting that ships are more likely to be drawn to ports with lower dues. This observation is particularly relevant

in the Nigerian context, where competitive dynamics across borders significantly influence trade flows. Tavasszy and Van der Meer [4] examined principal port charges in Europe and identified a trend where increases in harbour dues often redirect trade to more competitively priced ports. This phenomenon is particularly evident in the liquid bulk sector, where shipping companies prioritize minimizing operating costs. Aderamo [5] studied Nigerian ports and identified high harbour dues as a major impediment to shipping efficiency, leading to delays in delivery and reduced trade volumes. He recommended revisiting harbour dues to facilitate smoother operations and enhance trade efficiency.

Harrison and Sutherland [14] explored the challenges faced by West African ports and identified excessively high harbour dues as one of the most pervasive barriers to trade. They concluded that port authorities could stimulate trade by restructuring fees to make ports more attractive and cost competitive. Similarly, Olivier and Huyssteen [15] focused on the South African context and demonstrated that reducing harbour dues had a positive impact on the flow of bulk commodities through the country's ports. Their findings underscore the potential of policy reforms targeting harbour dues to significantly increase trade volumes. In addition, UNCTAD [16] reported on the effects of port governance reforms in developing countries, highlighting that transparent and equitable fee structures enhance port competitiveness. The report suggested that Nigerian ports could benefit from similar reforms to attract more liquid bulk shipping. Jenkins [17] further emphasized the need for comprehensive policy frameworks addressing harbour dues in relation to overall port efficiency. Jenkins argued that a strategic approach to managing these fees could lead to increased trade volumes and economic growth.

In summary, the empirical literature establishes a clear link between harbour dues and the flow of liquid bulk shipping trade. High harbour dues often increase shipping costs, leading to reduced trade volumes and diminished port competitiveness. Studies from Nigeria and other developing countries consistently highlight the need for policy reforms aimed at reducing harbour dues to enhance port competitiveness and stimulate economic growth. This study aims to build on this body of knowledge by collecting and analyzing empirical data specific to Nigerian ports to further substantiate these findings.

3. Data and Methods

The researcher adopted a qualitative research design and employed a critical literature review approach, utilizing historical (time-series) data to conduct the study. The research focused on the Nigerian port logistics sub-sector, with particular emphasis on the major seaports managed by the Nigerian Ports Authority (NPA). Data on harbour dues and rates charged uniformly across all Nigerian seaports by the NPA were obtained directly from the organization. Harbour dues were used as a proxy to represent the prices charged by the NPA to shippers and ship operators for the

use of the ports. Additionally, data on liquid bulk trade throughput—measured as the tonnage of liquid bulk cargo handled at the ports—was also obtained from the NPA. This throughput data served as a proxy for the trends in the flow of liquid bulk trade through the ports during the study period. The dataset covered the years from 1977 to 2021 and reflected the harbour dues as outlined in the NPA's tariff and rate regulations. The data obtained was analyzed using regression analysis to estimate the extent of variations in harbour dues and their relationship with the demand for port services by ship operators and shipowners in Nigeria over the study period. The specific model specifications used for the analysis are presented below:

$$\boldsymbol{LBULKCARGOPUT = \beta_0 + \beta_1 HARDUES + \mathcal{E}} \quad (1)$$

Where:

LBULKCARGOPUT = throughput of liquid bulk cargo/trade handled in the ports over the period.

HARDUES = harbour dues charged by the NPA as prices for handling liquid bulk trade

Normal hypotheses testing method for OLS estimation using t-test is used to determine the significance of the impacts/relationships.

4. Results and Discussion of Findings

The result on table1 shows that the mean tonnage of liquid bulk (oil and gas) trade flow through the port harbours per annum between 1977 and 2021 is 88352706.571tons with standard deviation of 62936605.79 while the average/mean harbor dues/rates per ton of liquid bulk trade handled in the port harbours between 1977 and 2021 is 333.21 naira with standard deviation of 310.66003.

Table1. Influence of Harbour Dues on the Flow of Liquid Bulk (Oil and Gas) Trade in Nigerian Ports

	Mean	Std. Deviation	N
oilandgasfreight	88352706.5714	62936605.79111	7
harbourduesoil	333.2178	310.66003	7

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.812[a]	.659	.591	40252197.40216

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		

1	(Constant)	33546332.462	23283965.283		1.441	.209
	harbourduesoil	164476.109	52896.701	.812	3.109	.027

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	33728620.0000	129320768.0000	88352706.5714	51096153.00672	7
Residual	-30760752.0000	58734644.0000	.00000	36745060.84386	7
Std. Predicted Value	-1.069	.802	.000	1.000	7
Std. Residual	-.764	1.459	.000	.913	7

Source: By Authors. Dependent Variable: oilandgasfreight

The coefficient of correlation (R) measuring the relationship between the tonnage of liquid bulk trade flow and the harbour rates/dues charged over the study period is 0.82. This indicates a strong positive correlation of approximately 82% between the flow of liquid bulk trade through the ports and the harbour dues charged by port authorities during the period. The model representing the relationship between the flow of liquid bulk trade (as a proxy for shippers' demand for port services) and the rates charged by port authorities (harbour dues) over the study period is presented below:

$$\boldsymbol{LBULKCARGOPUT = 33546332.462 + 164476.109HARDUES} \quad (2)$$

This finding implies that a unit increase in harbour dues paid per ton of liquid bulk trade handled at port terminals results in an approximate increase of 164,476.11 tons in the flow of liquid bulk trade through the port harbours. In other words, rising harbour dues and charges in Nigerian ports over the study period were associated with a corresponding increase in the volume of liquid bulk trade handled. This suggests that shippers of liquid bulk cargo increased the tonnage of their shipments despite the rising harbour dues during the period. Consequently, this trend likely led to an increased number of liquid bulk carriers calling at the ports.

However, the increased cost of port usage associated with higher harbour dues may have inflationary effects on the market prices of liquid bulk commodities in local markets. This is because shippers and ship operators typically pass on the additional port costs and freight charges to final consumers in the form of higher prices. The coefficient of determination (R^2), which measures the explanatory power of the model and the extent of variation in liquid bulk trade flow relative to changes in harbour dues, is 0.66. This indicates that approximately 66% of the variations

in the flow of liquid bulk trade handled at Nigerian ports during the study period can be attributed to changes in harbour dues charged by the Nigerian Ports Authority (NPA). In essence, the increasing trend in harbour dues charged by the NPA accounted for about 66% of the changes in the flow of liquid bulk trade through the ports. These findings suggest that variations in harbour dues have a direct and positive influence on the dynamics of liquid bulk cargo flow through Nigerian ports. Such trends have significant implications for the productivity and efficiency of the ports.

4.1 Test of Hypothesis

Table 2 below presents the results of the significance of the relationship between harbour dues and the flow of liquid bulk trade in Nigerian ports.

Table 2. Test of hypotheses H_{01}: There is no significant influence of harbor dues on the flow of liquid bulk shipping trade in Nigerian ports between 1977 and 2021.

Hypotheses	t-score	t-table	p-value	Sig. (P-value<0.05)	Decision
H_{01}	3.109	2.26	0.027	Yes	Reject H_{01}

Source: Authors calculation

The test of hypothesis H1, as presented in Table 3, examines the influence of harbour dues on the tonnage of liquid bulk trade cargo shipped through the port between 1977 and 2021. The results show a t-score of 3.109, a critical t-value (t-table) of 2.26, and a p-value of 0.027 at an alpha level of 0.05. Since the p-value (0.027) is less than the significance level of 0.05 (0.027 < 0.05), the study rejects the null hypothesis (H1) and accepts the alternative hypothesis. Based on these findings, the study concludes that harbour dues have a statistically significant influence on the tonnage of liquid bulk cargo shipped through the port during the period from 1977 to 2021.

Table 3. Test of Hypothesis H_{02}: The extent of variation in the flow of liquid bulk trade in Nigerian ports relative to variations in harbour dues charged in the ports is not significant.

Hypotheses	Expected variation (ev%)	Observed variation (ov%)	Sig. (ov>50%)	Decision: Reject if ov>50%
H_{02}	100.00	66.00	Yes	Reject H_{02}

Source: By Authors.

The implication is that variations in the trends and rates of harbour dues charged by port authorities and terminal operators for handling liquid bulk trade in Nigerian ports will result in corresponding changes in the tonnage of liquid bulk trade passing through these ports. The test of hypothesis H2, as presented in Table 4.2, examines the extent to which variations in the tonnage

of liquid bulk trade handled by the ports are influenced by changes in the trend of harbour dues charged by port operators over the study period.

The results indicate that the observed variation in the tonnage of liquid bulk trade handled during the period is 66.0%. Since the observed variation exceeds 50% (66.0\% > 50\%), the study rejects the null hypothesis (H2) and accepts the alternative hypothesis. This confirms that there is a significant change in the flow of liquid bulk trade through the ports relative to changes in the trend of harbour dues. These findings align with the earlier conclusions of the study, which suggest that variations in the trend and rates of harbour dues charged by port authorities and terminal operators for handling liquid bulk trade in Nigerian ports directly influence the tonnage of liquid bulk trade passing through these ports.

5. Conclusion

Harbour dues charged by port and terminal operators for liquid bulk trade (cargo) have a significant influence on the tonnage of liquid bulk trade shipped through the ports between 1977 and 2021. Approximately 66% of the variations in the tonnage of liquid bulk trade handled at the ports can be attributed to changes in the trend of harbour dues charged by Nigerian ports during this period.

References

[1] Nigeria Ports Authority (NPA). Nigeria Ports Authority tariff regulation. Working document of the Nigeria Ports Authority (NPA), 2019.

[2] Bichou, K. and Gray, R. A logistics and supply chain management approach to port performance measurement. Maritime Policy and Management, 2004, 31(1), 47–67.

[3] Notteboom, T. and Winkelmans, W. Structural changes in logistics: Implications for port authorities. Maritime Economics and Logistics, 2001, 3(2), 139–154.

[4] Tavasszy, L.A. and Van der Meer, H. The impact of port charges on cargo flows: The case of Europe. Transport Policy, 2006, 13(5), 317–329.

[5] Aderamo, A.J. Impact of port charges on trade flow: Evidence from Nigeria. Journal of Transportation Research, 2011, 24(2), 123–140.

[6] Meersman, H., Van de Voorde, E. and Vanelslander, T. Port pricing: Considerations on economic principles and marginal costs. European Journal of Transport and Infrastructure Research, 2003, 3(4), 371–386.

[7] Oghojafor, B.E.A., Kuye, O.L. and Alaneme, G.C. Concession as a strategic tool for ports efficiency: An assessment of the Nigerian ports. American Journal of Business and Management, 2012, 1(4), 214–222.

[8] Hercules, H. Competition, excess capacity, and the pricing of port infrastructure. International Journal of Maritime Economics, 2002, 4(4), 323–347.

[9] Emenike, G.C., Amamilo, A.C. and Ajayi, E.O. Assessment of vessel traffic and customers' patronage at the Rivers Seaport, Port Harcourt, Rivers State, Nigeria. Nature and Science, 2018, 16(11), 22–29.

[10] Meersman, H., Pettersen, S.S. and Van de Voorde, E. Port pricing: Principles, structure and models. Working Paper, Department of Economics, Institutt for Samfunnsøkonomi, Norway, 2014.

[11] Maria-Isabel, G., Yasmin-Alexandra, V. and Diana-Mercedes, V. Smart, green, and sustainable: Unveiling technological trajectories in maritime port operations. IEEE Access, 2017, 99–112. DOI: https://doi.org/10.1109/ACCESS.2024.3376431

[12] Melnyk, O.M., Shcherbina, O.V., Mykhailova, L.V., Obnyavko, T.S. and Korobko, T.O. Focused research on technological innovations in the shipping industry: Review and prospects. Transport Development, 2023, 16(1), 159–174. DOI: https://doi.org/10.33082/td2023.1-16.13

[13] Nokuzola, E.M. Towards efficient port pricing: A specific look into South African tariff methodology [Master's dissertation]. World Maritime University, Malmö, Sweden, 2014.

[14] Harrison, R. and Sutherland, J. Shipping and port dues: Implications for trade in West Africa. African Journal of Logistics, 2014, 12(3), 145–162.

[15] Olivier, R. and Huyssteen, D. Harbour dues and bulk commodities in South Africa. South African Journal of Transport, 2013, 21(1), 87–102.

[16] United Nations Conference on Trade and Development (UNCTAD). Review of maritime transport 2020. United Nations Conference on Trade and Development, 2020.

[17] Jenkins, C. Reforming port governance: A path to improved shipping trade. Transport Reviews, 2018, 38(4), 499–517.