Global Journal of Social Sciences Studies

Vol. 2, No. 3, 144-149, 2016
e-ISSN: 2518-0614

Modelling the Relationship between Demand for River Port Services and Vessel Supply Costs: Empirical Evidence from Nigeria

Ibeawuchi C. Nze[1]---Innocent C. Ogwude[2] --- Kenneth U. Nnadi [3] ---Callistus C. Ibe[4]

[1,3]*Department of Maritime Management Technology, Federal University of Technology, Owerri-Nigeria*

[2,4]*Department of Transport Management Technology, Federal University of Technology, Owerri-Nigeria*

(*Corresponding Author)*

ABSTRACT

The quantitative estimates from this study are concerned with the activities associated with the operations of Nigerian river ports as well as the costs and the benefits derived to users of these ports. A structural equation model(SEM) of the river port operations is derived and estimated by the application of LISREL software to generate reduced form of equations and parameter estimates given as: $Y_5 = 1.183X_1 - 1.390X_2 + 0.597X_3$. The results of the SEM technique shows that the demand for port services is significantly related to vessel supplies cost. It is proven that IWT will conveniently divert traffic from the congested corridors of road transport and that the river ports will yield significant benefits to the economic growth of Nigeria, which is revealed in the comparative scenario analysis that quantified the ratio of the magnitude of economic activities at the sea ports to the river terminals considering key similar variables- ware house operations, gang operations and ship turnaround time respectively. The study concludes that Inland waterways transportation has a significant contribution to economic development of Nigeria, if the potentials are fully harnessed. Therefore, it is recommended that government should enforce sustainable legislation to make IWT operations attractive to private organizations for optimal benefits.

Keywords: Capacity, Costs, Inland waterways, Modeling, Ports.

DOI: 10.20448/807.2.3.144.149

Citation | Ibeawuchi C. Nze; Innocent C. Ogwude; Kenneth U. Nnadi; Callistus C. Ibe (2016). Modelling the Relationship between Demand for River Port Services and Vessel Supply Costs: Empirical Evidence from Nigeria. Global Journal of Social Sciences Studies, 2(3): 144-149.

Funding : This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

History : **Received:** 15 June 2016/ **Revised:** 22 August 2016/ **Accepted:** 21 September 2016/ **Published:** 29 October 2016

Publisher: Online Science Publishing

1. INTRODUCTION

Inland waterways have been used as important corridors of transportation in different parts of the world from pre historic times. The important ancient civilizations developed along the banks of major rivers like the Nile, Indus, Euphrates and Tigris because water could be used not only for agricultural and drinking purposes but also for transportation of goods and people. As civilization progressed and new technologies were developed, rivers were made and canals were constructed to provide an intricate system of waterway

networks through which agricultural, industrial, mineral and energy products could be transported (Dogarawa, 2012).

Many of the industrial centers in Europe during the Industrial Revolution developed along the various rivers, since it provided easy availability of water for industrial processes, discharge of waste products to the rivers at minimal costs and transportation of raw materials to factories and manufactured goods to customers (Ashraf, 2013). Additionally, Biswas (1987) posits that the increase in energy prices has given inland waterways an added advantage during the past decade, and many countries – especially the oil importing developing countries that have potentials for this type of transport – are now making a determined effort to expand and modernize their existing waterways transportation. It should be noted that inland waterways transportation, coastal and ocean shipping are often interrelated. Sometimes transportation of goods begins and / or ends in inland waterways, but the rest of the journey could entail coastal and ocean shipping. Similarly, there are complementary relationships between road and rail transportation and waterway carriage of goods (Brenthurst, 2010). This therefore, reveals the importance of river ports as terminals and nodes of water transportation for the carriage of goods and persons.

1.1. The Problem

Managing cargo flows between ports and inland destinations has remained a challenge for terminal operators. For shippers, delay in ports means rising costs, adding to customer pressure for goods to be delivered just in time. Most studies indicate that it is difficult to model the entire container terminal in a single integrated optimization model. Consequently, most of the studies have focused on developing models to solve individual problems related to specific terminal equipments (especially the quay crane) and not integrated or combine problems relating to handling equipment. It is necessary for the terminal yard and quays to be managed in an integrated fashion i.e. with simultaneous regard for parallel processes. Such problems, as selecting which equipment to invest on or to deploy, may need to be approached from an integrated perspective since they concern the entire terminal.

In the light of the above, this research tends to bridge the gap created by past researchers by developing an econometric model for river port operations in Nigeria and as well attempt the quantification of the relationship between supply and demand variables inInland Waterways Transport (IWT) in Nigeria.

1.2. Objective of the Study

The overall objective is to estimate the relationships provided by river ports and the extent to which it can be quantified both on the demand and supply sides. The specific objective is:

To determine the degree of relationship between the demand for ports service and vessel supplies cost.

1.3. Research Question

In line with the specific objectives, the research question is:

- At what level of significance is the demand for port services related to vessel supplies cost?

1.4. Hypothesis

- $H_{0:}$ The demand for port services is not significantly related to vessel supplies costs.

1.5. Justification of the Study

The findings of this research will in no small measure be of utmost importance to shippers, terminal operators, policy makers and government; the academia and World Bank, in the areas of river port development and pricing in developing countries.

1.6. Scope of the Study

This study models the performance and costs associated with the operation of Nigerian river ports or terminals. This involves the cost of doing business at the ports and the level of service offered and the utility obtained by users of the ports which invariably increases patronage. This study concentrates mainly on econometric methods to achieve the set objective.

2. REVIEW OF RELATED LITERATURE

2.1. Inland and Coastal Trade in West Africa

West African sub-region consists of 16 countries out of which three are landlocked and 13 are coastal states with a total of 16,663 km of navigable rivers and inland waterways. Inland waterways and the stretches of coastlines are used for both domestic and sub regional movements of goods and passengers. The coastal states of West Africa are relatively equipped with seaports, cargo handling equipment, private and public maritime education and training institutions with the main seaports in Nigeria, for example, concessioned to foreign operators. Maritime trade in West Africa is dominated by foreigners from Western countries with indigenous entrepreneurs trailing far behind due to lack of finance / capital (UNCTAD, 1995). Agreements under bilateral and multilateral platforms are largely inconclusive and those that were concluded have remained passive. However, Brander *et al.* (2006) observed that trade between West Africa and most Islamic Countries is very low. He therefore seeks to raise the consciousness of West African Countries and Selected Islamic Countries about the patterns of trade existing between them and its maritime implications. This intends to encourage government officials to fast-track Bilateral Agreements between them, utilise the existing multilateral platforms to promote trade and investments as well as to facilitate private sector networking as a starting point for sustained business relationships.

The West African sub region consists of 16 countries including Benin, Burkina Faso, Cape Verde, Cote D'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo. Whereas Burkina Faso, Mali and Niger are landlocked countries, the rest are coastal States with a total of 16,663 KM of navigable rivers and other inland waterways. However, the period of navigability of rivers and lakes is often limited to the rainy season. Longer dry season or low rainfall shortens the navigable periods. Inland waterways and the stretches of coastlines are used for both domestic and subregional movements of goods and passengers.

The coastal States of West Africa are relatively equipped with seaports, cargo handling equipment as well as private and public maritime education and training institutions with the main seaports in Nigeria, for example, being operated by big international operators. Although the actual ship-port turnaround is about seven days in most West African seaports, Governments are encouraging officials and the operators to attain the 72 hours target time frame (UNCTAD, 2010). This is expected to be achieved through drastic reduction in delays and corruption as well as attracting investment in infrastructure thereby reducing the costs of goods and services.

2.2. Estimation of Production and Cost Functions in Ports

The estimation of key indicators representing the technical production properties of firms within an industry, such as economies of scale and scope, plays an essential role in the determination of the optimal industrial organization, i.e. that which induces the best assignment of resources. As known, technical properties can be analyzed directly through the study of the relations between inputs and outputs by means of production or transformation functions. Beatriz *et al.* (2004) states that cost analysis permits theevaluation of port's returns and productivity by calculating different indicators or cost drivers. Additionally, it allows comparison of the productive efficiency among firms and a long time for a single firm. Strandenes (2004) posits that the provision of port infrastructure and extent of cargo handling services, go a long way to reducing port costs.

Finally, there is a knowledge gap which exists in the literature with respect to envisaged relationship derivable from river port operations in developing countries especially Nigeria. This study tends to bridge this gap.

3. METHODOLOGY

3.1. Secondary Data Collection

Secondary data consists of data collected from both internal and external data sources. Data collected from sources outside the case studied e.g. books, academic journals, publications and other scientific literature are considered as secondary data. One advantage with such data lies in the ease of acquisition. Secondary source of data was a survey of existing documents and published materials like NPA Simplified Tariff, NPA Handbook, NPA Annual Reports, Current Publication, Journals and from the internet as well as the publications of NIWA and the Federal Ministry of Transport.

3.2. Analytical Technique

Secondary data sourced from NIWA Annual reports, Bankable Feasibility Studies and NIWA tariff. Since data are key issue in developing optimization and structural equation, it is therefore necessary to get accurate data as much as possible. Our interest is on empirical data. Hence, to provide empirical answers to the research questions, Lisrel 9.1 Software was used for the structural equation model, to reveal the relationship.

Several computation were made from the above mentioned sources with respect to the following variables defined as follows :

Y_5 = supplies cost (USD);

X_1 = Gang Time (hrs)

X_2 = Ship Turnaround Time (hrs)

X_3 = Ware house Time

4. DATA ANALYSIS PRESENTATION AND DISCUSSION

4.1. Analysis of the Parameter Estimates of the Structural Equation Model

Estimated Equations

$Y_5 = 0.0 + 1.183*X_1 - 1.390*X_2 + 0.597*X_3 + \text{Error}, R^2 = 0.809$

Standerr (0.127) (0.246) (0.231) (0.191)

t-values 0.0 4.808 -6.014 3.129

P-values 1.000 0.000 0.000 0.009

Error Variance = 0.243

Instrumental Variables: Y_6 Y_7 Y_8 Y_9

The equation for Y_5(Vessel supplies cost) shows that the coefficient of determination R^2 is 0.809 which means that the regression line gives a good fit to the observed data, since this line explains 81% of the total variation of the Y values around their mean. The remaining 19% of the total variation in Y is unaccounted for by the regression line and is attributed to the factors included in the disturbance variable denoted here as Error. The t-test reveals that X_1,X_2 and X_3 are significant in the model, since the t- values of X_1(4.808) and X_3(3.129)are greater than 2,while t-value for X_2(-6.014)is smaller than -2. Hence we reject the null hypothesis that the demand for the port services are not significant to the vessels supplies cost .This is evidenced in the high level of significance of the variables X_1,X_2 and X_3;Gang time ,ship turnaround time and warehouse time which respectively, represent the optimal time frames in port. The P-values for the variables are less than or equal to the level of significance for the model.

The equation can be written as:$Y_5 = 1.183X_1 - 1.390X_2 + 0.597X_3$

4.2. Discussion of Results

The results and analysis reveals the degree of relationship between the demand for ports service and vessel supplies cost. This shows that the river terminals and the maritime industry are indeed a vital part of the Nigerian Economy. Not only do the ports and the maritime industry provide a significant impact to the regional and national economies, they also provide one of the most likely targets for future investments and development of the economy of Nigeria.

The degree of relationship between the demand for port services and the vessel supplies cost was determined from the results, which reveals a high degree of significance. This is in line with the rejection of the null hypothesis that the demand for port services and vessel supplies cost are not significantly related. The model (Y_5) also reveals that the demand for port services is elastic as any slight or proportionate change in demand will increase the supply by 0.597. This relationship is supported by Heaver (2006) which agrees that the issue of the structure of costs and appropriate level of charges for the use of port facilities and services have been consistent issues in port economics. This he further stressed is reflected in some studies over time, for example Strandenes (2004) and Steenken and Robert (2004). The studies reveal the effects of the level and Structure of prices on the efficiency of shipping and ports. There by relating port charges to port costs and to time with respect to access to berths and service quality. These improvements in service quality of a port will invariably increase patronage and demand.

Finally, the structural equation model shows that the demand for ports service is significantly related to the vessels supply cost. The demand and supply of port services is elastic as revealed by the structural equation model.

5. CONCLUSION

The study therefore concludes that Inland waterways transportation will have significant impact on the socio- economic development of Nigeria, when the potentials are fully harnessed. A proportionate change in demand for river port services will increase the supply of vessel services by 0.597 since there is currently an overcharge of price of services in river port operations in Nigeria.

5.1. Recommendations

- NIWA should intensify efforts to actualize the concession of the terminals to private organizations for full capacity utilization of the terminals; this should be done in a cost effective manner in order to keep handling costs at optimal level.
- Government should enforce sustainable legislation to make IWT operations attractive to private organizations for optimal benefits by operating at reduced cost.

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