

# MARITIME LOGISTICS AND GROSS DOMESTIC PRODUCT: A STUDY OF NIGERIA SEAPORTS

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## Abstract

Gross Domestic Product is significant in measuring economic well-being of countries world over. This study examined maritime Logistics factors on Nigeria Gross Domestic Product (GDP) with the view of evaluating the relationship as well as influence of the logistics factors (Vessel Movement ( $V_M$ ), and Cargo Throughput) in term of costs on Nigeria Gross Domestic Product. The study employed expo-facto research design with data obtained from Nigeria Port Authority (NPA), Central Bank of Nigeria (CBN) Statistical Bulletin and Records from Concessionaires of some of the ports. The results showed that Nigeria GDP has positive but weak association between Bulk Cargo ( $r = 0.16$ ) and Cargo Throughput ( $r = 0.29$ ) costs but inversely connected with Container Vessel ( $r = -0.33$ ) and Roro Vessel ( $r = -0.13$ ) costs. Though, the influence of the logistics factors except cargo throughput on Nigeria GDP is negatively insignificant. Nevertheless, they contributed 29.1% to the improvement of Nigeria GDP. It is recommended that government should augment cargo handling infrastructure at the seaports to increase costs efficiency that will not only increase revenue base of the government but also lead to improvement on Nigeria GDP.

**Keywords:** Gross Domestic Product, Maritime Logistics, Nigeria Seaports.

**JEL classification:** R40

## 1. INTRODUCTION

The maritime industry is a sub-sector of the transport sector. It includes people working for transportation companies which include freight forwarders and custom brokers; stevedoring companies; labor unions; chandlers; warehouses; ship building and repairs, importers or exporters, brokerage services, constructing,

manufacturing, acquiring, operating, supplying, shipyards, dry docks, marine railways and marine pilot associations (Lawal-Fagbo, 2018).

Globally, it has been observed that maritime industry accounts for nearly 90% of trade requirements of the world. It has been stated that seaborne trade, which also constitutes a larger chunk of water transport trade accounts for over 60% of the total Gross Domestic Product (GDP) of sixteen (16) countries (Benin , Burkina Faso , Cape Verde , Cote d'Ivoire, The Gambia, Ghana , Guinea , Guinea Bissau, Liberia, Mali , Mauritania , Niger , Nigeria , Senegal , Sierra Leone and Togo) that make up the Economic Community for West African States (ECOWAS) (Airahuobhor A., 2011).

As maritime activities are expanding, it brings benefits to people across the world. The sector is a major catalyst for socio-economic development and international competitiveness in a fast changing, globalized world (Fintell, 2014). It also affects a wide range of aspects of modern societies and their development. In the United States for instance, it has been discovered that for every job in the merchant marine, 4.4 additional jobs were created in the economy and for every dollar of household income in maritime sector, 3.4 dollars of additional income was created in the economy (Haralambides, 2014).

The significant impact of the maritime industry to a nation's economy is massive, particularly those nations with coastal and inland waterways like Nigeria. The maritime industry is a key sector in the Nigerian economy. Nigeria has a coastline of over 8000km; shipping, therefore, is a very critical sub-sector in this sector. The strategic importance of maritime transport to the Nigerian economy is that "the maritime industry is to the Nigerian economy what the artery is to the blood circulation system of the body". The current Minister of Transport, Rotimi Amaechi, observed that the maritime sector of the economy remains significant to meeting the yearning and aspirations of Nigerians, especially the youth (Lawal-Fagbo, 2018).

Nigeria is endowed with a vast coastline as well as navigable inland waterways and about 80% shipping business that takes place in West Africa is carried out in the country. Nigeria is also recognized as the 6th largest producer of crude oil in the world and has a large volume of gas reserves, rich in natural resources and agricultural produce (Lawal & Raji, 2017). The country is a major importer of finished and semi-finished goods, and its crude oil and gas are exported to international markets by sea where they are sold to earn foreign currency to ensure the country's development and this shows the economic significance of the maritime industry to the country. Studies have shown that over 80% of the global oil is transported by ship, in the case of Nigeria it is said to be an outright 100% (Haralambides, 2014).

He further observed that the Nigerian oil and gas sector requires huge shipping and logistic services for its smooth operations. This subsector of the maritime industry is estimated to be over \$3 billion. The maritime sector's

contributions to the GDP of some countries in 2012 include India (28.1), China (9.7), Russia (5.9), Brazil (2.8), South Africa (1.3) and Nigeria (0.15). Statistics from the Nigerian Ports Authority (NPA) on ship call to Nigeria revealed that between 2009 and 2012, Nigeria's tonnage grew from 82 million tons to over 150 million with an estimated payment rising from \$4.1 billion to above \$7.5 billion annually (Lawal-Fagbo, 2018).

Alexandru (2013) was of the view that, with the rapid growth in container ship size, in the race for reducing transport costs per container, more and more pressure began to be put on the container terminal operators. Thus, not only that the time for operating a vessel has declined dramatically in order to reduce the costs associated with port charges, higher for large vessels, but also massive flows of containers need to be managed in such a manner that congestion be eliminated and containers directed most efficiently to end users. To achieve effective and efficient port operations require adequate logistics.

Logistics has become one of the essential elements of trade because of its active role in development of nations (Pinar, 2015). With globalization, countries have improved their logistics through expansion of international trade volume such that it makes ease of production, distribution and marketing investments of countries. This field has also provided a significant competitive advantage in related global trade. An accurate and effective planning of logistics activities is an important way of cost efficiency for countries ports activities as well as sustainable GDP growth.

Sanchez, Shen & Peng (2004) opine that investment in port infrastructure makes a direct proportionate contribution to the GDP growth, and usually leads to improvements in profitability and a reduction in costs for the different economic agents of the society. The provision of economic infrastructure like seaports and airports can expand the productive capacity of the economy by increasing the quantity and quality of such infrastructure. The transformation curve or the production possibility frontier curve would shift with the expansion of the economic infrastructure bases, thereby accelerating the rate of economic growth and enhancing the pace of socio-economic development better and proper management of economic infrastructure would have positive output income and employment effects on the economy.

Egert (2009) investigation between infrastructure investments (roads, motorways, railways, electricity, and telephone line) and economic growth for 24 OECD countries between 1960 and 2005 revealed that infrastructure investments have a significant impact on economic growth. Also, a cross-section analysis illustrated that infrastructure investments in telecommunication and electricity sectors had a strong positive impact on growth.

Boopen (2006) in his study analysis of transportation infrastructure and economic growth for two different countries in Sub-Saharan Africa found out that transportation infrastructure makes positive contributions to economic development

of the countries. Kayode (2013) in his analyses of relationship between investments on transportation infrastructure and economic growth of Nigeria between 1997 and 2009 showed that the investments in transportation infrastructure had an insignificant role on determination of economic growth.

In the literature, there have been extensive studies on investment on transportation infrastructure and economic growth across nations. However, most of the studies dwell more in aggregation of transportation infrastructure to modal (road, rail, maritime and air) combination. More so, when attention is paid on the contribution of each mode of transportation, individual factors or variables of each of the mode of transportation focus on data obtained in particular location especially Lagos, while many other locations within the country receives little attention.

In Nigeria for instance, the answer to the development of seaports or port terminals came in the form of horizontal expansion and massive technology improvement in port activities. As observed by Lawal-Fagbo (2018), the cargo throughput handled in the Nigerian ports increased from 114,920,094 metric tons in 2015 to 122,922,056 metric tons in 2016 indicating a 12% increase. Most researchers' concentration when reporting maritime logistics focuses their report on seaport located in Lagos, the Nigerian economic hub with little mention and collection of data from other seaports. With globalization and the significance of water transportation to the development of nations across the globe, the study aims at examining Maritime Logistics Factors (MLF) and Nigeria Cross Domestic Product (GDP) by analyzing the relationship among the logistic factors and GDP; and as well explored the influence of the logistic factors on GDP.

## **2. LITERATURE REVIEW**

The section reviewed concepts (variables) used in the study and these include Gross Domestic Product (GDP), Maritime Transportation, Maritime logistic factors which comprises Vessel Movement (Bulk Cargo, Container Vessel and RoRo Vessel) and Cargo Throughput. Also discussed was economic impact of Nigeria maritime transport industry.

### **2.1 GROSS DOMESTIC PRODUCT**

The most comprehensive measure of the total output or performance of an economy is the GDP. It is the name given to the total market value of the final goods and services produced within a nation during a given year. Other concepts that are frequently cited include Net Domestic Product (NDP) and Gross National Product (GNP). The relationship among these three concepts (GDP, GNP and NDP) is that they measure an economy output.

Paul (2012) defines GDP as the dollar flow of total product for a nation. It could be measured using the flow-of-cost approach or the income approach. Ruffin (1998), emphasized that GDP is the broadcast measure of the total output of the

economy. Only final goods and services are included to avoid double counting of products. Nnamocha (2002) pointed out that GDP is the total money value of all goods and services produced in the domestic economy by everybody in that economy no matter where he/she comes from provided he/she resides within the economy. Abdulrasheed (2005), in his work titled “The effect of inflation on GDP” stated that Gross Domestic Product is used as a means of adjusting the assets location and to decide where the best opportunity of investors lies. Kimberly (2008) description of GDP involves everything produced by all the people and all the companies within an economy. The difference between GDP and GNP is the fact that GDP is concerned with the region in which income is generated and focuses on where the output is produced rather than who produces it. Kumar (2010), in his work “Macroeconomics Theory, Analysis and Policy”, observed that the use of the word “gross” along with “domestic product” indicates that we are calculating domestic product inclusive of the depreciation allowance or consumption of fixed capital.

The Bureau of Economic Analysis (BEA) cited in Dynan & Sheiner (2018) observed that GDP is the value of the goods and services produced by the nation’s economy less the value of the goods and services used up in production. GDP is also equal to the sum of personal consumption expenditures, gross private domestic investment, net exports of goods and services, and government consumption expenditures and gross investment. The real Gross Domestic Product (real GDP) of any country is a measure of the value of economic output adjusted for price changes in that country. It is the sum of the consumer spending, the investment made by industry, the excess of exports over imports, and the government spending (Ademuyiwa & Adetunji, 2019). It is therefore a widespread measure of economic output of a nation.

## **2.2 MARITIME TRANSPORTATION**

Maritime transportation, also known as waterborne transportation, is one of the modes of transporting goods, persons and services. Maritime transport to Igbokwe (2001) is the means of carrying goods and persons by water, whether inland waterways including rivers or oceans.

The Maritime Transport industry serves as an input into every other industry in the National economy, it can be noted that there is hardly any segment of an economy that can do without the maritime transportation sector because of its significance bringing the needed materials for economic activities in every nation. Marine transportation sector has three types of activities which are maritime transport services, maritime auxiliary services and port services (Austria, 2002).

Gardner, MacAskill & DeBow (2009) see water transportation industry as consisting of all activities of shipping companies, cruise ships and ferry operators, as well as revenues generated by cargo loading and unloading, port fees and pilotage authority. It constitutes economic activities that have some direct and indirect relationship with the sea, that is, maritime transportation includes water

transportation as well as ocean transportation. The industry has different industries within it; it is often associated with shipping lines involved in the carriage of cargo as well as including associated service providers.

Maritime transportation has been in the world since the beginning of creation. Thus, the industry provides various services to a nation and its people; it serves as a means of transportation to people and also as a means of recreation in terms of cruise shipping and the likes. It facilitates the flow of goods and services worth billions of dollars yearly in different countries which invariably helps in the growth and sustainability of GDP.

## 2.3 VESSEL MOVEMENTS

Vessel Movements is the sailing of vessels in the sea caused by the action of the waves. A vessel at sea may move in six different directions. For instance, when the vessel rises or falls in its entirety, the movement is termed as *heave*. Forward or aft movement of the entire vessel is called *surge*. A vessel *sways* when it moves sideways. The rise and fall motion on the width center axis is termed as *pitch*. Side to side rocking motion on the length center axis is called *roll and port* and starboard twisting motion on the vertical center axis is called *yaw*. These movements are typical of the different vessels such as Bulk Cargo, Container Vessel and RoRo Vessel.

### 2.3.1 BULK CARGO

A bulk carrier, bulk freighter, or colloquially, bulker is a merchant ship specially designed to transport unpackaged bulk cargo, such as grains, coal, ore, and cement in its cargo holds. Since the first specialized bulk carrier was built in 1852, economic forces have fueled the development of these ships, causing them to grow and sophistication. Today's bulk carriers are specially designed to maximize capacity, safety, efficiency, and durability.

On bulk carriers, crews are involved in operation management and maintenance of the vessel taking care of safety, navigation, maintenance and cargo care, in accordance with international maritime legislation. Cargo loading operations vary in complexity and loading and discharging of cargo can take several days, Bulk carriers can be gearless (dependent upon terminal equipment) or geared (having cranes integral to the vessel). Crews can range in size from three people on the smallest ships to over 30 on the largest.

Bulk cargo can be very dense, corrosive, or abrasive. This can present safety problems: cargo shifting, spontaneous combustion, and cargo saturation can threaten a ship. The use of ships that are old and have corrosion problems has been linked to a spate of bulk carrier sinking in the 1990s, as have the bulk carrier's large hatchways, important for efficient cargo handling. New international regulations have since been introduced to improve ship design and inspection, and to streamline the process of abandoning ship.

### **2.3.2 CONTAINER VESSEL**

As the name suggests, a vessel structured specifically to hold huge quantities of cargo compacted in different types of containers is referred to as a container vessel (ship). The process of sending cargo in special containers is known as containerization. The initiation of the container shipping forms one of the most remarkable developments in the maritime cargo industry. Container ships, a type of cargo ship, have revolutionized the manner in which cargo supplies are ferried and transported across the world, by providing assurance of safety and security of the thus transported cargo supplies. Some of the biggest shipping companies today deal mainly with containerized form of cargo.

The very first models of container ships were launched in the early 1950s and were mainly designed to ferry goods trains' freight cars. Using crane systems and ramp systems, these freight cars could be loaded and unloaded from the vessels. Over the years technological advancement has made it possible for comparatively far more feasible methodologies, though crane systems still play a major role in the loading and unloading operations of the containers to and from the vessels' holds. Specialized lashing and cargo handling systems are used to secure the containers in their places.

Container vessels are typical in that that they are constructed to accommodate immense possible cargo loads. The load holding capacitance of container vessels is measured in terms of Twenty-foot Equivalent Units (TEUs), with the biggest container ships carrying as much as over 15,000 -16,000 TEUs. Because of such high capacities, some of the largest ships in the world are container ships. Within a container ship, there are well demarcated holds that separate each container from each other which simplifies the entirety of the piling of the containers.

### **2.3.3 RORO VESSEL**

Ro-Ro is an acronym for Roll-on/Roll-off. Roll-on/Roll-off ships are vessels that are used to carry wheeled cargo. The ro-ro ship is different from lo-lo (lift on-lift off) ship that uses a crane to load the cargo. The vehicles in the ship are loaded and unloaded by means of built-in ramps. Normally these ramps are made towards the stern (backside) of the ship. In some ships, they are also found on the bow side (front) as well as the sides. The vessel can be of both military and civilian types.

RoRo Vessel are vessels designed to carry wheeled cargo, such as cars, trucks, semi-trailer trucks, trailers, and railroad cars, that are driven on and off the ship on their own wheels or using a platform vehicle, such as a self-propelled modular transporter. This is in contrast to lift-on/lift-off (LoLo) vessels, which use a crane to load and unload cargo.

RoRo vessels have either built-in or shore-based ramps that allow the cargo to be efficiently rolled on and off the vessel when in port. While smaller ferries that operate across rivers and other short distances often have built-in ramps, the term

RORO is generally reserved for large oceangoing vessels. The ramps and doors may be located in stern, bow or sides, or any combination thereof. At first, wheeled vehicles carried as cargo on oceangoing ships were treated like any other cargo. Automobiles had their fuel tanks emptied and their batteries disconnected before being hoisted into the ship's hold, where they were chocked and secured. This process was tedious and difficult, and vehicles were subject to damage and could not be used for routine travel.

## **2.4 CARGO THROUGHPUT**

Cargo throughput can be describe as the quantity of cargo and passengers that can pass through a port on a daily basis from arrival at the port to loading into a ship, or from the discharge from a ship to the exit (clearance) from the port complex. Throughput is usually expressed in measurement tons, short tons, or passengers.

Cargo throughput measures reflect the amount of cargo or number of vessels the port handles over time. These measures are affected by many variables beyond physical capacity. For example, international and domestic demand for cargo handled by the port, competition with other ports, contractual arrangements with carriers, and changes in distant facilities such as expansion of the Panama Canal are among the factors that affect cargo volumes and the number and size of vessels that call. The throughput statistics observed in this study are (i) cargo tonnage, (ii) container TEU, and (iii) vessel calls categorized by the costs of commodities carried.

## **2.5 ECONOMIC IMPACT OF NIGERIA MARITIME TRANSPORT INDUSTRY**

The economic impact of any industry in an economy is routinely measured in terms of its contribution or value added to GDP of that economy or nation. It should be noted that the concept of value added to GDP is not total sales or an equivalent by this industry, since total value of sales of an industry includes the value of all the inputs that have been purchased from other industries; the sum of final sales across all industries can therefore end up "counting" some output a multitude of times (for example, the crude oil that is refined into fuel, and the fuel that is purchased by a ship operator) and is not used as a measure of economic activity for a country as a whole. Instead the GDP which is considered here is the "value added" to products by the maritime transport industry. In most studies relating to the impact of maritime transport, it has been noted that the economic impact was divided into three parts which are; the direct impact, the indirect impact and the induced impact (Oxford Economics, 2009; Apex Companies, 2010).

The direct effects of the Marine Transport Industry are obvious. The concept of direct impacts can be best illustrated through the case of imported goods coming to Nigeria on a Nigerian owned vessel. Usually, a vessel is guided into a port by a pilot boat, arranged by the ship's agent. In some instances, the vessel may require tugs in addition to the pilot boat. The vessel is then tied up by stevedores. Once

secure, the vessel is boarded by the ship's boarding agent and customs inspectors. The crew may disembark and spend money on either personal or ship's provisions. Documentation is handled by the ship's agent, customs broker or freight forwarder. The vessel must be cleared in and out by the Nigerian Customs Agency. Cargo can then be loaded in and/or out. The effect of the activity of this one vessel will impact the Nigerian economy not only by providing income and employment to its own crew but also to the crew of the pilot boat, stevedores, and ship agents. The direct impact includes the value added to GDP, industry revenue and profits, number of employees, wages and net export (Oxford Economics, 2009), while according to Oxford economics, it is employment and contribution to GDP. The direct impact can therefore be seen as the impact arising from the expenditures made by firms in the subject industries on the goods and services needed to produce industry outputs. The direct GDP impact of this industry on the Nigerian economy was approximately 3% in 2010 (Olayiwola, 2010).

The indirect impact is said to be the inter-industry purchases triggered by the direct demand; they are backward linkages to the economy. It is the impact on economic sector that the maritime transport industry, can have on other sectors through their demand of those sector's goods and services as input to its own production (Oxford Economics, 2009). For example, pilot boats buy fuel from suppliers and repair services from shipyards, while the stevedoring companies buy or lease vehicles. The vendors of these goods and services in turn purchase more basic goods and services, and so on. The indirect impact is mainly measured by using the input- output analysis.

The induced effect refers to the demand created in the broader economy through consumer spending of incomes earned by those employed in direct and indirect activities of the maritime transport industry (Apex Companies, 2010). For instance, a decline in wages in the maritime transport industry, or in one of its suppliers, will result in less spending by employees and therefore a drop in demand for consumer goods from other industries. The induced impact might take a while, say one year, before it works its way through the economy.

The economic impact of an industry, even though often measured by the level of economic activity of that industry, in the form of value added to GDP and employment generation, is not only restricted to these economic activities but also include the impact of these industry on other aspects of the economy such as; its effect in facilitation of trade and commerce, revenue generation and availability of finance, promotion of tourism, enhancement of industrial growth and development, international relations and peaceful co-existence, socio-political harmony, defense and security- territorial protection and also for transportation of persons across places in Nigeria (Igbokwe, 2001).

The level of adequacy of the maritime transport industry in an economy will determine if the economy can partake in international trade or not. The performance of the maritime transport sector is closely linked to the derived demand of the

merchandise sector in an economy. Maritime transport, otherwise known as shipping, has been an important human activity throughout history, particularly where prosperity depended primarily on international and interregional trade (Corbett and Winebrake, 2008).

For a nation like Nigeria which relies heavily on external trade to sustain its domestic economy through importation of raw materials, equipment and machineries used by manufacturers and for exportation of its crude oil, agricultural and manufactured products, the importance of a cheap mode of transport which maritime transport offers does not only make the total cost of these cargoes lower but also makes it possible for large quantity of goods to be carried over long distance and landed in Nigeria, thus reducing the cost of imported goods. A very large percentage of world's trade is carried by water, thus, the demand for maritime transport has been on the increase due to the effect of globalization and liberalization of trade, which has made the demand for goods between countries increase, thus increasing the need for maritime transport.

The maritime transport industry, apart from generating revenue and profit for companies under it, also generates revenue to a nation through the form of corporate tax, VAT, and many other ways (Oxford Economics, 2009). The role of maritime transport industries in revenue generation for the Nigerian government cannot be underestimated. The revenue which is realized from these industries are used in providing better welfare for the citizenry by investing more in maritime infrastructures and also investing in other sectors of the economy. The revenues come from fees for the registration of ships and their mortgages, custom duties, ports charges and tariff realized by the Nigerian Port Authority for the use of its facilities for vessels or ships which berth at Nigerian ports, corporate taxes paid by shipping companies, fees for licensing, clearing and forwarding agents or freight forwarders and the registration of shipping companies. The National Maritime Authority collects 2% statutory charge on gross earnings of shipping companies on imports and exports (section 17, National Shipping Policy Act).

The National Maritime Authority also fines erring tankers that pollute the Nigerian marine environment, and every vessel lifting Nigerian crude oil pays a mandatory fee. Billions of Naira is being generated yearly as revenue by Customs through import and export duties. A large portion of the revenue collected by the Nigerian Port Authority and the National Maritime Authority is in foreign currency, thereby enhancing the nation's foreign reserve (Igbokwe, 2001). Apart from these sources the income tax paid by employees of this key industry increases the fund which is available to the Nigerian government to help develop the nation, and also to invest more in key sectors of the economy.

The impact of transportation on the economic emancipation of a country cannot be over emphasized. In Nigeria, transport accounts for approximately 3% of the Gross Domestic Product (GDP) (Olayiwola, 2010). A vibrant, responsive, effective and efficient transport system will enhance Nigeria's economic,

developmental and strategic roles in the global economy. For this reason, transportation ought to be accorded high priority in the Nigerian economy.

From the literature, GDP is very valuable in economic analyses but the most significance is that, it measures the overall performance of an economy and this overall performance can be measured as a flow of final products or as a flow of costs. The final products or costs in the study are variables discussed in this section. Thus, the study tends to investigate the flow of costs of these variables and make recommendations based on the data obtained.

### 3. METHODOLOGY

The study employed expo-facto design. The research design was adopted because the data used for the study were obtained from secondary sources. Secondary data obtained for the study include Vessel Movement (Bulk Cargo, Container Vessel and Roro Vessel) and Cargo Throughput which were sourced from Nigeria Port Authority (NPA), Central Bank of Nigeria (CBN) Statistical Bulletin and Terminal Operators from 2001 to 2019. Nigeria Gross Domestic Product for the years under review was obtained from World Development Indicator (WDI) and CBN.

However, data from 2001 to 2017 were used for the study and this was attributed to missing data in some of the information collected from the seaports between 2018 and 2019 which we believe may not be evocative hence, we used the information from 2001 to 2017 for the analyses.

#### 3.1 CALIBRATION OF VARIABLES AND MODEL SPECIFICATION

##### 3.1.1. VARIABLES CALIBRATION

In carrying out the analyses, data obtained were calibrated (Table 1) and model used specified. Nigeria Gross Domestic Product was represented by  $G_{DP}$ , Vessel Movements was presented as  $V_M$  and  $C_T$  represents Cargo Throughput. Bulk Cargo, Container Cargo and RoRo Cargo were represented as  $B_c$ ,  $C_c$ , and  $R_c$ , respectively. All the variables are measured in term of costs of tonnage.

**Table 1:** Calibration of Nigeria Gross Domestic Product and Factors of Maritime Logistic

Variables	Description	Measurement
$G_{DP}$	<b>Economic Growth</b>	Gross Domestic Product Monetary (Discrete Variable)
$V_M$	<b>Vessel Movement</b>	Monetary and Output (Discrete Variable)
$B_c$	Bulk Cargo	Monetary and Output (Discrete Variable)

C <sub>c</sub>	Container Vessel	Monetary and Output (Discrete Variable)
R <sub>v</sub>	RoRo Vessel	Monetary and Output (Discrete Variable)
C <sub>T</sub>	<b>Cargo Throughput</b>	Monetary and Output (Discrete Variable)

Source: Authors' Field Survey

### 3.1.2 MODEL SPECIFICATION

Inferential statistics (correlation and regression) analyses were used to test hypotheses of the study. As stated in the introductory part of the study that: “the study aims at examining maritime logistic factors and Nigeria Cross Domestic Product (GDP) by analyzing the relationship among Maritime Logistics Factors and GDP; and as well explored the influence of Maritime Logistics Factors on GDP”, this statement, which represent the objectives of the study led to the following hypotheses which in its null form are:

1. There is no significant relationship between Nigeria Gross Domestic Product and Maritime Logistics Factors.
2. There is no significant impact of Maritime Logistics Factors on Nigeria Gross Domestic Product.

Evaluating the first hypothesis, correlation analysis was used to establish relationship between each of the variables such that the relationship between G<sub>DP</sub> and V<sub>M</sub> is given as:

$$r_{NG_{DP}V_M} = \frac{N \sum G_{DP}V_M - \sum G_{DP} \sum V_M}{\sqrt{[N \sum G_{DP}^2 - (\sum G_{DP})^2][N \sum V_M^2 - (\sum V_M)^2]}} \quad 1$$

Between NG<sub>DP</sub> and C<sub>T</sub> is given as:

$$r_{G_{DP}.C_T} = \frac{N \sum G_{DP}C_T - \sum G_{DP} \sum C_T}{\sqrt{[N \sum G_{DP}^2 - (\sum G_{DP})^2][N \sum C_T^2 - (\sum C_T)^2]}} \quad 2$$

Between V<sub>M</sub> and C<sub>T</sub> is given as:

$$r_{V_M.C_T} = \frac{N \sum V_M C_T - \sum V_M \sum C_T}{\sqrt{[N \sum V_M^2 - (\sum V_M)^2][N \sum C_T^2 - (\sum C_T)^2]}} \quad 3$$

Regarding hypothesis two (2), Multiple Regression Analysis (MRA) was employed such that:

$$G_{DP} = \omega + \beta_i V_M + \beta_j C_T + \epsilon \quad 4$$

$$G_{DP} = \omega + \beta_k B_c + \beta_l C_v + \beta_m R_v + \beta_j C_T + \epsilon \quad 5$$

$$LinNG_{DP} = \omega + \beta_k LinB_c + \beta_l LinC_v + \beta_m LinR_v + \beta_j LinC_T + \epsilon \quad 6$$

Where

- $\omega$  represent the intercept/constant,
- $\beta_k, \beta_l, \beta_m, \beta_j$  in equation 6 represent the regression coefficients of Bulk Cargo, Container Vessel, RoRo Vessel and Cargo Throughput respectively and  $\epsilon$  represent error term of the model.

#### 4. RESULTS AND DISCUSSION

The findings of maritime logistics and gross domestic product with respect to Nigeria seaports were discussed in this section under the following subheadings:

- Relationship between Nigeria Gross Domestic Product and Maritime Logistics Factors.
- Impact of Maritime Logistics Factors on Nigeria Gross Domestic Product.

##### 4.1 RELATIONSHIP BETWEEN GROSS DOMESTIC PRODUCT AND MARITIME LOGISTICS FACTORS

The connections between Maritime Logistic Factors ( $C_M, C_T$ ) and Nigeria gross domestic product ( $G_{DP}$ ) are significant and critical in financial and economic analyses. In order to establish the connection between these variables equation 1 to equation 3 was used to produce table 2.

*Table 2: Association between GDP,  $C_M$  and  $C_T$*

Variables	NGDP	C <sub>M</sub>			C <sub>T</sub>
	NGDP	B <sub>C</sub>	C <sub>V</sub>	R <sub>V</sub>	C <sub>T</sub>
NGDP	1	.164	-.334	-.126	.285
		.529	.190	.630	.267
B <sub>C</sub>		1	.738**	.653**	.938**
			.001	.004	.000
C <sub>V</sub>			1	.764**	.745**
				.000	.001
R <sub>V</sub>				1	.558*
					.020
C <sub>T</sub>					1
** Correlation is significant at 0.01 level (2-tailed)					
* Correlation is significant at 0.05 level (2-tailed)					

*Source: Authors' Field Survey*

Pairwise association between gross domestic product, vessel movement and cargo throughput measured in term of costs of tonnage in table 2 showed a positive but weak association between gross domestic product and bulk cargo ( $r = .164$ ), and gross domestic product and cargo throughput ( $r = .285$ ). Though, there was a negatively weak association between gross domestic product and container vessel ( $r = -.334$ ), and gross domestic product and ro-ro vessel ( $r = -.126$ ), gross domestic product increases with increasing costs of tonnage of bulk cargo and cargo throughput but decreases with increasing costs of tonnage of container cargo and ro-ro vessel.

More so, there is a positively strong association between costs of tonnage of bulk cargo and container cargo ( $r = .738$ ), bulk cargo and ro-ro vessel ( $r = .653$ ), and bulk cargo and cargo throughput ( $r = .938$ ), which showed an increase in similar direction for the years under review.

#### 4.2 IMPACT OF MARITIME LOGISTICS FACTORS ON NIGERIA GROSS DOMESTIC PRODUCT.

The impact of maritime logistic factors (vessel movements ( $V_M$ ) and cargo throughput ( $C_T$ )) on Nigeria Gross domestic Product ( $G_{DP}$ ) was model in equation 6 such that:

$$LinG_{DP} = \omega + \beta_k LinB_c + \beta_1 LinC_v + \beta_m LinR_v + \beta_j LinC_T + \epsilon \quad 6$$

Table 3 showed the results of MRA where the coefficients  $\beta_k, \beta_1, \beta_m, \beta_j$  of the costs of tonnage of bulk cargo ( $B_c$ ), container vessel ( $C_v$ ), ro-ro vessel ( $R_v$ ) and cargo throughput ( $C_T$ ) are  $-.213, -.353, -.498$  and  $1.026$  respectively. The results showed that bulk cargo, container vessel and ro-ro vessel costs have negative but insignificant influence on gross domestic product. By implication, increases on these costs, lead to reduction in Nigeria GDP. However, cargo throughput costs, has positive but insignificant influence on Nigeria GDP, suggesting that increase in cargo throughput leads improvement on Nigeria GDP. Thus, the equation of the model becomes:

$$LinG_D = -2.800 - 0.2130LinB_c - 0.353LinC_v - 0.498LinR_v + 1.026LinC_T + \epsilon \quad 7$$

**Table 3:** Analysis of Impact of Maritime Logistic Factors on GDP

Model	Unstandardized Coefficient		Standardized Coefficient	t	Sig
	$\beta$	Std. Error	Beta		
(Constant)	-2.800	7.622		-.367	.720
$B_c$	-.329	1.066	-.213	-.308	.763
$C_v$	-.566	.661	-.353	-.857	.408
$R_v$	-1.183	.870	-.498	-1.360	.199
$C_T$	2.561	1.713	1.026	1.495	.161
<b>a. Dependent Variable NG<sub>DP</sub></b>					
<b>Model Summary</b>					

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.684 <sup>a</sup>	.468	.291	.2655

a. Predictors: (Constant), C<sub>T</sub>, R<sub>v</sub>, C<sub>v</sub>, B<sub>c</sub>

*Source: Authors' Field Survey*

**Table 4:** Variation in GDP and Maritime Logistic Factors

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	.745	4	.186	2.642	.086 <sup>b</sup>
Residual	.846	12	.070		
Total	1.591	16			

a. Dependent Variable: NG<sub>DP</sub>

b. Predictors: (Constant), C<sub>T</sub>, R<sub>v</sub>, C<sub>v</sub>, B<sub>c</sub>

*Source: Authors' Field Survey*

Variation in Nigeria GDP and Maritime Logistic Factors in table 4 showed that the mean variation of the variables is equally insignificant which indicates that the costs of tonnage of bulk cargo, container vessel, ro-ro vessel and cargo throughput do not significantly change Nigeria GDP. However, the coefficient of determination (adjusted R<sup>2</sup>) showed that the costs of tonnage contributed 29.1% to Nigeria GDP.

In general, the implication of these results is that, while it is expected that increase in costs ordinarily would lead to reduction in revenue, it may be important that efforts be made to enhance cost efficiency in cargo handling at the seaports such that per unit cost incurred on maritime logistics factors lead to increase in GDP rather than reduction as in this case.

## 5. SUMMARY AND CONCLUSION

The study examined Maritime Logistics Factors (MLF) and Nigeria Gross Domestic Product (GDP) by evaluating the relationship among the logistics factors (bulk cargo, container vessel, ro-ro vessel and cargo throughput) and GDP and as well estimated the influence of the logistics factors on GDP in term of costs of tonnage. Findings showed that the relationship between GDP and MLF are positive but weak with respect to bulk cargo and cargo throughput and negatively weak towards container vessel and ro-ro vessel. Nevertheless, association between bulk cargo and container cargo, bulk cargo and ro-ro vessel seems positively strong.

More so, the regression coefficients of MLF and variability in Nigeria GDP and MLF are statistically insignificant. There is also the need for improvement in seaports infrastructure, the result of which is in divergence with Kayode (2013) observation that the relationship between investments on transportation infrastructure and economic growth in Nigeria showed that the investments in

transportation infrastructure had an insignificant role on determination of economic growth. Despite insignificant influence of maritime logistics factors on Nigeria GDP, variables contributions of 29.1% to the GDP worth mentioning.

Thus, there is the need for government to embark on massive investment on cargo handling equipment in all the seaports so as to reduce the costs incurred on tonnage of cargo and as well assist in the sustainability of the GDP.

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