

Modeling influences of Container Freight Ocean Shipping and Road Haulage Costs to Last-mile Trade Corridors on Price Inflation Trend in West Africa

Nwokedi ¹, Theophilus Chinonyerem ¹, Callistus Chukwudi. Ibe ², Mbachu Justice ¹, Okafor Cajethan Onyedikachi ¹

Abstract

The study investigated the influence of the TEU container freight ocean transportation cost from Shanghai port, China to Lagos seaport in West African and the road haulage cost of TEU container freight from Lagos ports to the hinterland markets in Nigeria on the increasing trend of inflation in the prices of imported market commodities in the economy. It employed ex-post factor research design in which time series secondary data covering a nine (9) years period from 2010 to 2018 was obtained for the TEU container freight ocean transport cost, price inflation rates in the economy, TEU container freight road haulage cost from Lagos seaports to the regional hinterland markets in Kano in the north, Onitsha in the east, and Alaba international market in the west. The multiple regression analysis method was used to analyze the obtained data using the OLS method. The findings indicate that, cumulatively, the TEU container freight ocean transport cost and road haulage costs borne by shippers in transporting imports from China through the Lagos seaports to the regional hinterland markets in Nigeria, West Africa, does not significantly influence levels of inflation in commodity prices in the Nigerian economy. The study concluded that, though transport cost influences price inflation rates in the economy; it is not a significant or determinant factor of inflation in commodity prices in the Nigerian economy. Recommendations were proffered on the basis of the research findings.

Keywords: Ocean-transport-cost, road-haulage-cost, container-freight, inflation, commodity, prices.

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1. Introduction

The haulage of imported freight on last mile road transport corridors from hub seaports to hinterland market centres and shippers warehouses, like ocean transport between load ports and disports in the export and import destinations, is an essential element of trade and commerce. It is a component subset of the set formed

by the transportation of imports from Countries of export through the disport in the import Country to the consignee's warehouses in the hinterland markets. See figure one below for illustration.^[1]

Figure1: Illustrating the basic three legs of transportation of imported consignments in Nigeria. ^[2]

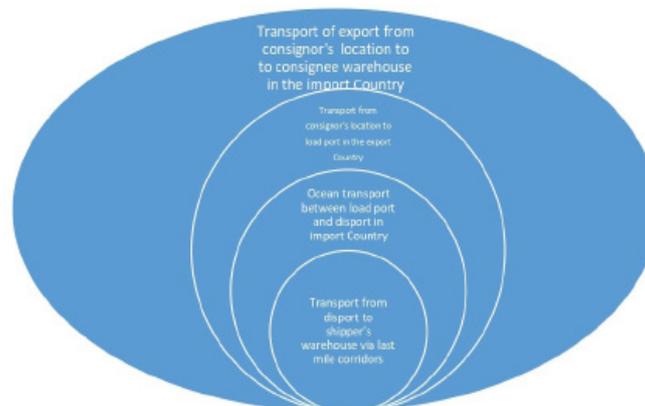


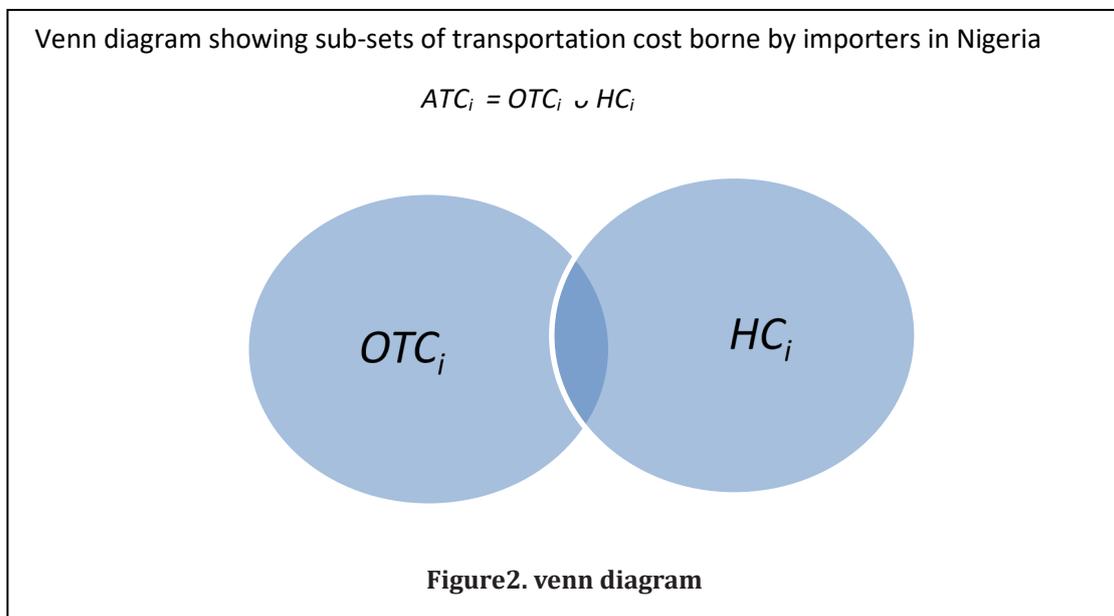
Figure1: Illustrating the basic three legs of transportation of imported consignments in Nigeria.

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The movement of imported cargo, particularly containerized freight from major import destinations to hinterland markets in Nigeria is viewed to be comprised basically of three (3) legs of individual journeys by different transport operators, following the non existence of a developed and operational multi-modal transport corridors cum policy in the Country; limiting the achievement of the transportation need by use of multi-modal transport operators. It is important to note that, the transport sector and the allied sub-sectors, determine the level and ease of access to finished goods for domestic use, semi-finished goods and raw materials for industrial usage within the economy. Several studies have identified that transportation cost influences commodity prices and price levels in most economies. UNCTAD reports indicate that ocean transportation cost as a factor, influences commodity prices and price levels particularly in developing economies. But how significantly it does influence prices, particularly in Nigeria and West Africa, is a matter yet to be empirically investigated. One may imply giving the position of UNCTAD that, increasing transportation cost will have direct positive relationship and inflationary effects on commodity prices and price levels in any given market economy. Inflation in this context is a measure of how much more expensive commodities and services have become over a certain period, usually a year, in a given economy. It is the increase in the market prices of goods and service over a period of time (usually one year) and which leads to a decline in purchasing , and subsequently in living standard. Jang agree that transportation cost trends could be used as strategic factor to induce either deflationary or inflationary trends in the prices of market commodities and imports ; and therefore improve and/or decline purchasing power within an economy. This makes the study of the relationship between transportation costs and price inflation levels for selected commodity types such as

imports, basis of empirical information and knowledge on how the prices within a given economy should at all times be prevented from suffering transportation-cost induced inflation. [3]

In Nigeria, Shippers have continued to groan under the hike in Twenty Foot Equivalent Unit (TEU) container haulage cost between hub-seaports and most last-mile road routes to hinterland markets and shippers' warehouses, coupled with outrageous multiple charges on shipment in ocean transport leg of the journey by shipping companies and terminal operators. Analyst have linked the inflation in commodity prices in the local markets to the hike in both freight container ocean transportation cost and road haulage cost on last-mile corridors occasioned by the outbreak of the Covid-19 pandemic. The implication of the aforementioned hike in transportation cost in both the ocean and last-mile legs of the journey of all imports into Nigeria is that the shippers suffers the double economic jeopardy and burden induced by the hikes and in order to recover, will transfer these to the final consumers in the form of high prices, causing inflation. Evidently, the Nigeria shippers take responsibility for both the increasing ocean transport cost (OTC_i) of their imports as well as the haulage cost (HC) on road trade routes to the hinterland markets in the Country, in line with the provisions of Nigeria's shipping policy for the import of goods on Free-on-Board (FOB,) trade terms; which are subsequently transferred to the final consumers in the form of high prices, thereby decreasing their purchasing power. The consignor in the export Country in line with the FOB contract terms is assumed to take responsibility for the transportation cost of the consignment to the load-port in the export market. The set of aggregate transportation cost for imports (ATC_i) for a given shipment is viewed to constitute the summation or union of sub-sets: OTC_i and HC_i as shown below: [4]



Source: Nwokedi et al. (2021)

It is noteworthy that any factor, such as transport cost induced inflation, with capacity to cause declining trend in the purchasing power of the working population within an economy, invariably will cause increase in cost of living within the economy and subsequently declining trend in the living standard. Approaches that will bring about a reversal in effects and deflation in prices of goods to significantly improve purchasing power are thus important and recommendable. At present, there is the need to determine the significances of the influence of the rate of change of both TEU container freight ocean transport cost and haulage cost en route road corridors between the hub seaports and shippers warehouses in the last-mile on inflation levels in commodity prices in Nigeria. See figure2 below of trends of ocean transport cost (OTC) from China to Lagos ports and the TEU container freight road haulage costs (HC) to regional hinterland markets in Nigeria. [5]

The figure depicts a rising trend in both container freight ocean transportation cost to Nigeria and container freight road haulage costs to all the three identified regional hinterland trade routes in Nigeria.

Similarly, the trend of inflation in the prices of market commodities over the same period is as shown in figure3 below. [6]

The Western Port of Lagos constitutes the major hub port handling significant portion of Nigeria's imports. The Lagos seaports service the major hinterland markets in the geopolitical regions including Onitsha in the South-East, Kano in the North and Lagos mainland in the West. In some cases, the container freight haulage cost from the Lagos seaport to some regional market centres such as Kano in the North is seen to be far higher than the ocean transportation cost of laden TEU container freight from the import Country to the disport in Nigeria. This has led to agitations for

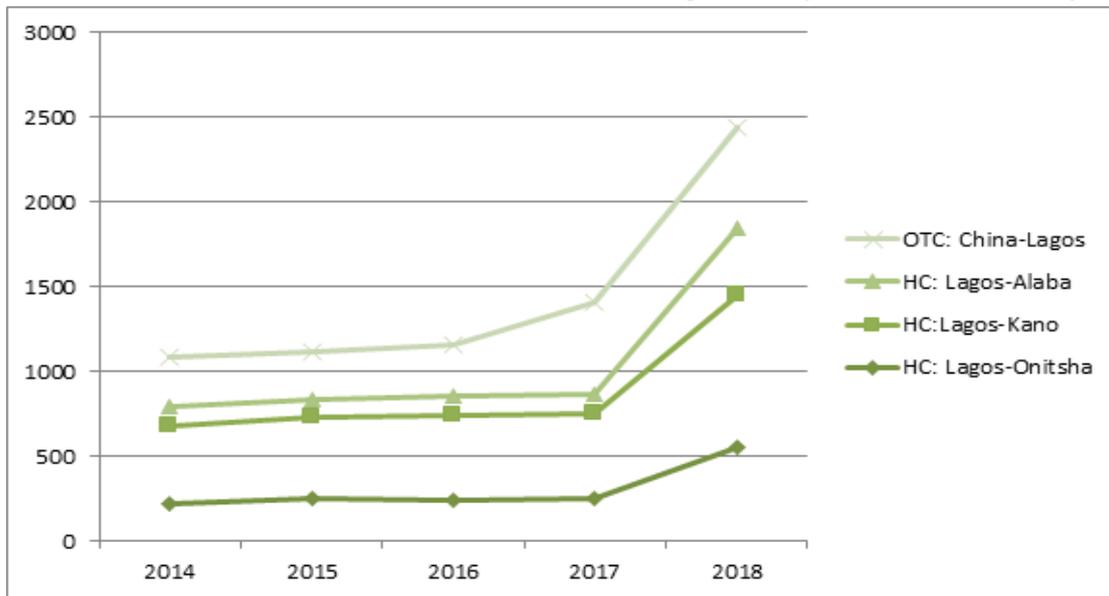


Figure3: Source: prepared by authors.

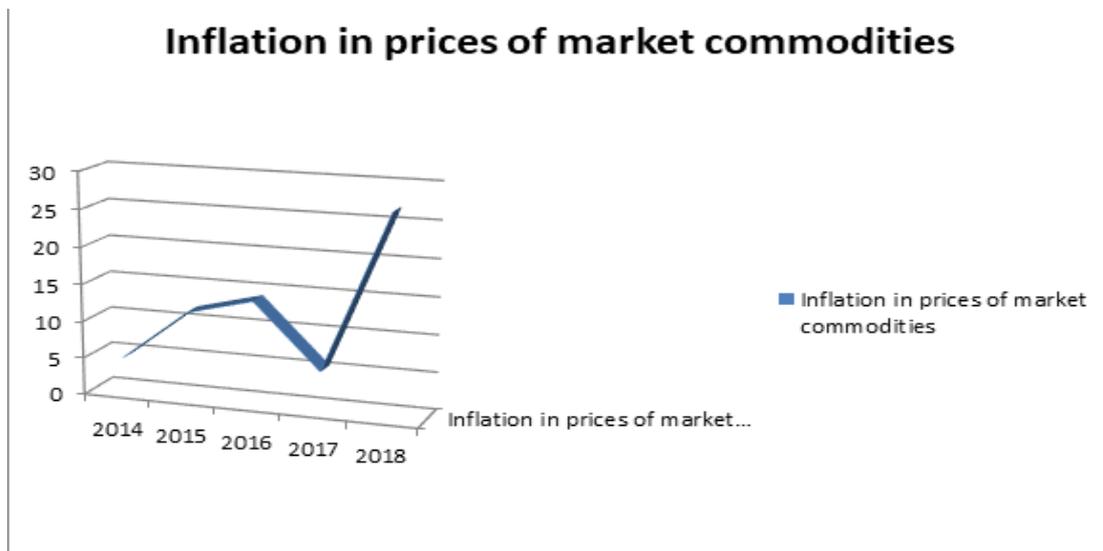


Figure 4: Source: Prepared by the author.

the development of functional rail freight corridors that will minimize the cost of laden TEU delivery between the seaports and the hinterland markets in major import Cities. The disproportionate container freight haulage cost to the various hinterland markets in the regions, which is reflective of the distances of the regions from the hub seaport, has led to disproportionate prices charged for similar or same commodities in the regions too. Inflation in prices of imported goods, raw materials and semi-finished goods in the domestic markets are seriously viewed to be associated with the hike in transportation of container freight between hub seaports and hinterland markets. It is considered that availability of freight transport options to the various regional markets would be able to address these challenges.^[8]

To address the problems identified, the study is seeking to provide empirical knowledge and evidence of the significances of the influence of container freight transportation costs between the Lagos hub port and regional hinterland markets in Kano, Onitsha, and Alaba in Lagos mainland; each on the last-mile corridors, on the level of price inflation in the economy. It will determine the rates of change of container freight TEU haulage cost of each trade each identified route relative to trends of inflation in the prices of commodities in the economy. The significance of the influence the ocean container transportation cost on price inflation in the economy and its rate of change are also important factors to be determined in the study in comparison with those of the TEU haulage costs on last-mile road corridors.^[9]

2.0 Brief Review of Literature

Amir, Muhammad and Omid established that freight transportation cost as a significant economic indicators of supply chain efficiency and identified three perspectives in which freight transportation cost can be viewed to include:^[10]

(i) From the carriers and freight transport operators’ Perspective; freight transport costs refer to the expenditure they incur in providing the services. These costs refer to operational costs. This magnitude of freight transport cost viewed from this perspective influence the determination of the amount to be charged shippers (users of freight transport services) for units of freight transport services consumed.^[11]

(ii) From the shippers of freight owners’ Perspective, freight transport costs refer mainly to the prices or charges they pay to freight transport operators. Similarly, the amount paid by shippers to operators for

freight transport influences the commodity prices in the domestic markets since shippers recoup these payments by transferring it over the final consumers in the form of commodity prices. This, high transportation cost paid by shippers have the consequences of causing commodity price inflation Amir, Muhammad and Omid.

(iii) From the national perspective, freight transport costs include costs associated with social, environmental and economic aspects, which include financial, non-financial, tangible and intangible components. Freight cost viewed from this perspective is inclusion of externalities costs. It is important to however assert that in the context of this study, freight transportation cost is viewed strictly in the light of the second perspective, which views it as the amount by shippers to transport their goods to destination markets. This is exclusive of carrier cost of service provision and externalities cost. The freight transportation cost for a giving consignment is note to in most cases have several components and sub-divisions as aforementioned in previous sections . For example, freight transportation for the delivery of a given import consignment may be an aggregation of amount paid to the carriers for the actual transportation and delivery to warehouse form the departure location, stevedoring charges (Loading unto and unloading from various vehicles types e. truck, rail flat car, vessel), Insurance premium, Clearing and documentation charges, unitization, etc.^[12]

Studies by De Souza identified increased freight transportation cost as a problem associated with associated with last mile deliveries as a result of disruptions in supply networks. The study opined that challenges of high transportation limit availability rates and accessibility to market commodities, with subsequently effect of commodity price increments and inflation. Studies by Uzonwanne, Ezenekwe and Nzeribe found the existence of increasing trend in transportation cost of consignments with the Nigeria economy. The study also found that transportation cost significantly influence the prices of commodities in the domestics markets. Comparing the levels of increases in TEU container freight haulage cost from the hub seaport to the regional hinterland markets in Nigeria in pre and in Covid-19 periods, Nwokedi found disproportionate increases in TEU haulage cost to the identified regional hinterland markets between 2017 and 2018 alone as shown below:^[13]

Table1: Increase in TEU Freight Haulage Cost to Regional Hinterland Markets from Lagos Apapa Seaport in Nigeria

Year	Lagos Apapa seaport to Onitsha (N)	Lagos seaport to Kano (N)	Lagos seaport to Alaba market (N)	Remarks
2017	250,000	500000	120000	Increase
2018	550000	900000	400000	Increase
%change	54.5%	44.4%	70%	Increase

Source: Adapted from Nwokedi et al., (2020)

The report however did not investigate further to ascertain the influence of these outrageous increments in TEU container freight haulage cost across the routes on commodity prices and inflation over the period. Ndikom and Nwokedi however linked the increasing TEU container freight haulage cost from the Lagos seaports to the regional hinterland Cities and markets to the perennial traffic congestion gridlock challenges en route the Apapa seaport in Lagos; culminating into serious disruption of supply chain and deliveries to shippers warehouses in the hinterland markets in the hinterland markets. The review of related literature provide further evidence on the seeming unavailability of empirical studies has been carried out to investigate the influence of the increasing ocean container freight transportation cost and haulage cost of TEU freight between hub seaports and hinterland Markets on commodity prices and inflation levels in Nigeria. This gap in knowledge is the central aim the study cast to provide with particular concentration of the Lagos seaport to last-mile road routes to regional hinterland markets in various Cities in Nigeria. [14]

3.0 Materials and Methods

The study employed data sourced from secondary sources in achieving the study objectives. Secondary data on the ocean transport cost of laden TEU container freight from the Port of Shanghai, China (load-port) to Lagos Apapa port (disport) in Nigeria was obtained from UNCTAD review of maritime transport, 2015 edition. The TEU container haulage cost from the Lagos Apapa port (disport) to each of the regional hinterland markets in Kano, Onitsha, and Alaba (Lagos) used in the study were sourced from the records of Nigeria Association Government approved Freight Forwarders (NAGAFF), operating in the Lagos Apapa wharf zone; while data on the levels of price inflation for commodities the domestic market was obtained from the statistics publications of the Central Bank of Nigeria (CBN). The data obtained for each class of dataset is a time series data covering a period of 9 years from 2010-2018. The ocean transport cost for journeys between the port of Shanghai, China as load-port and Lagos Apapa port as disport was chosen because that is the dominant route for the flow of most imports of

Results and Discussion

Table4.1: Descriptive Statistics of the variables

Variable	Mean	Std. Deviation	N
INFLA	17.1611	25.88333	9
OTC	364793.2444	116447.43579	9
HCKano	485555.5556	165311.15443	9
HCalaba	132222.2222	101983.79501	9
HCONitsha	201666.6667	60000.00000	9

Source: Author’s calculation

processed consumer commodities into Nigeria, West Africa. [15]

The study employed ex-post factor research designed to assess the influence of ocean transport cost and haulage cost of TEU container freight transportation on level of inflation in the prices of market commodities in West Africa, Nigeria. The multiple regression analysis method was thus employed in analyzing the data obtained. The specification of the model is such that price inflation rates over the period was used as the dependent variable (explained variable) while the values of ocean transport cost from Shanghai to Lagos, haulage cost from Lagos to Kano, Onitsha and Alaba were used as the independent (explanatory) variables. This enables the study to investigate the rate of change of price inflation rates relative to the rates of change of the explanatory variables. The model specification is shown below:

$$INFLA_{price} = \beta_0 + \beta_1 OTC_{i(China-Lagos)} + \beta_2 HC_{iKanolastmile} + \beta_3 HC_{iAlabalastmile} + \beta_4 HC_{iOnitshalastmile} + \epsilon \tag{1}$$

Ordinary least square (OLS) estimation was carried out to determine the influences on the explanatory variables on the dependent variable. Normal hypotheses testing method for OLS estimation using t-test was used to determine the significance of the relationships.

- Where:
- $INFLA_{price}$ = price inflation
- β_0 = regression constant
- $\beta_1 - \beta_4$ = rate of change of explanatory variables
- 1 -4= regression coefficients
- $\beta_1 OTC_{i(China-Lagos)}$ = TEU Ocean transport cost for import consignments from China to Lagos ports
- $HC_{iKanolastmile}$ = haulage cost of imported TEU container freight from Lagos port to Kano last mile road routes in the North
- $HC_{iAlabalastmile}$ = haulage cost of imported TEU container freight from Lagos port to Alaba market last mile road routes in South West
- $HC_{iOnitshalastmile}$ = haulage cost of imported TEU container freight from Lagos port to Aba last mile road routes in the South East. [16]

The result indicates that over the 9 years period covered in the study between 2010 and 2018, the average rate inflation in the prices of consumer commodities in the local markets in Nigeria, West Africa is 17.2% with standard deviation of 25.88. The average annual amount charged by ocean carriers to transport laden TEU of container freight from the Shanghai ports, China (load-port) to Lagos Apapa ports, West Africa (disport) between 2010 and 2018 is 364793.24 Nigeria naira per TEU, with standard deviation of 116447.43. The average amount paid by shippers as haulage cost to transport per TEU of container freight from the Lagos

Apapa ports through the last-mile road routes to the hinterland markets in the regions are 485555.56 naira, 132222.22 naira and 201666.66 naira respectively to Kano (Northern region), Alaba market in Lagos (South West), and Onitsha hinterland market in the South-East region with respective standard deviations of 165311.15, 101983.79 and 60000.0. The implication is that it cost more to transport per TEU of container freight from China to Lagos, West Africa by sea, than it takes to haul laden TEU container freight by road to Kano, in Northern Nigeria. The significance of this difference will be examined in subsequent sections. [17]

Table 4.2 Influence of TEU Container Ocean Transport Cost and TEU container Freight Haulage Cost on Rate of Change of Price Inflation in Nigeria’s Economy

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-71.897	101.798		-.706	.519
OTC	.003	..004	-.454	.733	.504
HC _{kano}	.005	.001	2.494	.586	.589
HC _{alaba}	.001	.001	-1.898	.364	.734
HC _{onitsha}	-2.132E-007	30.27035	.000	.000	1.000
R-Square	.316				

Source: Author’s calculation.

The result indicates a regression constant of -71.897. it also indicates rates of change (coefficients of regression) values of 0.003, 0.005, 0.001 and 0.00000002 respectively for ocean transport cost of TEU container freight from China to Lagos (OTC), TEU haulage cost from Lagos to Kano, TEU haulage cost from Lagos to Alaba market, and TEU haulage cost from Lagos to Onitsha market, relative to changes in levels of inflation in the prices of market commodities over the period. The quantitative model showing the influence of the various groups of TEU container freight transportation cost on price inflation in the economy is:

$$INFLA_{price} = -71.897 + 0.003OTC_{i(China-Lagos)} + 0.005HC_{iKanolastmile} + 0.001HC_{iAlabalastmile} + 0.00000002HC_{iOnitshalastmile} + \epsilon \text{ ----- (2).}$$

The implication is that a unit increase (change) in ocean transport cost of TEU container freight from China to Lagos increase inflation rates in prices of market commodities by 0.003 units. Units increases (changes) in TEU haulage costs from Lagos to kano, Alaba and Onitsha regional hinterland markets increases inflation in prices of market commodities in the regions by 0.05 , 0.01 and 0.0000002 respectively. The R-square, which measures the explanatory power of the model is 0.32. This indicates that, the explanatory variables only explain about 32% variations in levels of inflations in prices of commodities in the markets, leaving about 68% explained variations. The implication of this is that other factors other than transport cost such as trend of exchange rate, production cost, supply and demand

forces, etc, is responsible for about 68% of variations in increasing inflation in prices of market commodities in Nigeria. The significances of the influence of each group of TEU container freight transport cost on inflation rates is evidenced in the values of t-test for each variable. The result shows t-score of 0.733 and p-value of 0.504 at alpha value of 0.05. Since the p-value is greater than the alpha value of 0.05 (ie: 0.504>0.05); it implies that the TEU container freight ocean transport cost does not have significant influence on the level of inflation in prices of local commodities in the Nigerian economy. Similarly, the t-scores of TEU container haulage cost from the Lagos seaport to each of the hinterland markets in the last-mile routes of Kano, Alaba and Onitsha are 0.586, 0.364 and 0.000 respectively with respective p-values of 0.589, 0.734 and 1.000 at alpha value of 0.05. Since in each case, the p-value>alpha value (p-value>0.05); it implies that TEU haulage cost in each trade route between the hub port (Lagos) and regional hinterland markets does not significantly influence inflation rates in commodity prices in the economies of the regions. The findings also reveal than transportation cost does not solely significantly influence levels of inflation in commodity prices in the economy. Others factors such as foreign exchange rates, manufacturing costs, demand and supply forces, type of goods (whether a substitute good or not), etc play joint roles in influencing price inflation in the economy.

Table 4.3: Investigating the Joint/cumulative Influence of Ocean Transport and Road Haulage Costs on Price Inflation Levels in Nigerian Economy

ANOVA ^a					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1694.400	4	423.600	.462	.763b
Residual	3665.176	4	916.294		
Total	5359.576	8			

Source: Author’s calculation.

Table 4.3 shows the test of the model significance which measures the cumulative influence of all the independent variables (TEU container freight ocean transport cost and road haulage cost) on the level of inflation in prices of commodities in the economy using F-test. It indicates an F-score of 0.462, p-value of 0.763 and at alpha value of 0.05. Given that the 0.763>0.05 (ie: p-value>alpha value), we conclude that cumulatively, TEU container freight ocean transport cost and road haulage cost borne by shippers in transporting imports from China through the Lagos seaports to the regional hinterland markets in Nigeria, West Africa, does not significantly influence levels of inflation in commodity prices in the Nigerian economy. We thus assert that, though transport cost influences price inflation rates in the economy; it is not a significant or determinant factor of levels of inflation in commodity prices in the Nigerian economy.

5.0 Conclusion

The study concludes as follows:

(1) The quantitative expression showing the influence of the TEU container freight ocean transportation cost and road haulage cost on price inflation rates in the economy is:

$$INFLA_{price} = -71.897 + 0.0030TC_{i(China-Lagos)} + 0.005HC_{iKanolastmile} + 0.001HC_{iAlabalastmile} + 0.0000002HC_{iOnitshalastmile} + \epsilon$$

(2) The cumulative influence of the TEU container freight ocean transport cost and road haulage cost borne by shippers in transporting imports from China through the Lagos seaports to the regional hinterland markets in Nigeria, West Africa, does not significantly influence levels of inflation in commodity prices in the Nigerian economy. Therefore, though transport cost influences price inflation rates in the economy; it is not a significant or determinant factor of inflation in commodity prices in the Nigerian economy.

6.0 Recommendation

Since transportation cost solely is not a significantly determinant of level of inflation in commodity prices in the economy; to reverse the rising trend of inflation in the economy, factors other than transport cost must also be considered. Such factors may include but not limited to foreign exchange rates, manufacturing costs, demand and supply forces, type of goods (whether a substitute good or not), etc.

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