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Lead-Lag Effect between Import Container Vessel Traffic and Freight Rates at Dar Es Salaam Port in Tanzania

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Abstract:- It was found that a lead-lag relationship between container vessel traffic and periodic pattern in the import container freight rate exists, but there is a limited lag-lead relationship and specific estimated pattern of the period variation found in Tanzania.

The motive to this study was grounded on neo-classical economic theory that supply of cargo space by ship-owners or charters and derived demand for cargo space as the driving force towards basic ocean freight rates and its outcomes for the shipping business dynamics. Generally, container freight rates vary with periods of the year in an irregular way.

This Dissertation employed the multiple linear regression model to analyse the lead-lag effect between container vessel traffic and the import container basic ocean freight rates at Dar es Salaam Port in Tanzania. Moreover, the study employed statistical methods to Test whether the months of the calendar year and Container Freight rates are independent, testing whether number of containers imported per Bill of Lading (B/L) and Import Container basic ocean Freight rate are correlated and testing whether Import Container basic ocean Freight rate and Container vessels traffic are correlated.

However, statistical testing revealed that an import container basic ocean Freight rate is dependent on calendar year months since the null hypothesis was rejected (p-value=0.000) in favour of the alternative, an import Container basic ocean Freight is correlated with the number of containers imported per Bill of Lading (B/L) since the null hypothesis was also rejected (p-value=0.000) in favour of the alternative and an import Container basic ocean Freight rate has no correlation with Container vessels traffic since statistical test failed to reject the null hypothesis (p=0.371). Moreover, 70% of the respondents showed the proof of inter-dependence between an import container basic ocean freight rate and months of the calendar year as opinions gathered by questionnaires administered to 48 respondents who were picked randomly.

I. INTRODUCTION

A. Background of the Problem

To have the option to distinguish market conditions, lead lag effect of vessel traffic and freight market can be considered as a decent beginning stage. Variable of vessel traffic information can be an indicator for freight market of relevant vessel type (Hsiao & Wu, 2013).

There might be offers that are not supplied because of fleet limitation in short- or medium-term shortages. However, these offers are still effective for freight negotiations and totally exist in the market place. In the opposite case, shipping demand is fully supplied while a group of ships is idle and available for bids in the market place.

Indeed, regardless of whether shipping demand is fully supplied or not, they reflect the demand status and they can still be an indicator for short term fluctuation. Nevertheless, short term fluctuations are believed to be indicated better by assessing lead lag relationship which is the aim of this study.

Maritime transport is of major importance for the world's economy as some commentators' claim that over 90% by volume is carried by ships and over 80% of the world's trade is carried by sea as cited from the United Nations Conference on Trade and Development (UNCTAD) in 2017. It is the cheapest and most efficient way to transport goods in bulky. Containerization has greatly reduced the expense of international trade and increased its speed, especially in consumer goods and commodities. It has also intensely changed the ports' infrastructures and shipbuilding industry (Manolis, 2016). In 2020 Dar es Salaam port recorded 43% of the cargo throughput as containerized cargo, published by Tanzania Ports Authority (TPA) in their annual report of 2020.

Moreover, Container shipping has been the fastest growing sector of the global shipping market. Between 2008 and 2013, the demand for containerized trade grew at a rate of 3.4%. Considering the drop in 2009 and increased to 6.6% in 2013 but also 6.3 growth rate in 2016 (Visvikis, 2016).

The shipping business is portrayed by a significant degree of weakness, irregularity and cyclic pattern. Following the delicate emergency, in 2009 compartment cargo rates fell by 14% (UNCTAD, 2017) that was set off by the continuous diminishing of 10.8% of the load shipped in holders. It was the first run through since the development of the compartments that the World GDP became quicker than the World Seaborne Container Trade. Since then, the industry has been in an unstable state that sets grounds for doing this study to broaden knowledge on the container basic ocean freight rates information.

B. Statement of the Problem

Freight rates have been exceptionally low, transport esteems have dropped and rivalry on the different shipping lanes has heightened (Rex, 2016). Monster players in the transportation business are undermined by the cargo rates

ISSN No:-2456-2165

varieties. Cargo rate varieties have been so dubious and un-unsurprising in the business yet looked for of been needful for the going worry of players in the business. Transporting lines or Ocean transporters set cargo rates by considering various elements including monetary variables (request and supply of freight), market rivalry and functional expenses. Thusly, it merits investigating the matter towards Basic sea cargo rates on the import holders (TEUs). Notwithstanding, cargo rates have been recorded as the most fluctuating component that would perhaps prompt change in vessel and freight traffic at Dar es Salaam port.

Moreover, Extreme fluctuations in container basic ocean freight throughout the years have been affecting shipping companies' cash flows and companies might get kicked out of business. This lights-up the need of getting information about the freight rates for hedging purposes and contracts affreightment on futures, forwards, swaps and options.

So far, there are few studies done on the Lead-lag effect between import container vessel traffic and freight and this study focused on analyzing the lead-lag effect on the import container basic ocean freight rates and the relationship between key variables leading to variations of basic ocean freight rates of containers by considering its cyclical and linear patterns by using multiple linear regression model.

C. Main Objective

To analyse the lead-lag effect between container vessel traffic and the import container basic ocean freight rates at Dar es Salaam Port in Tanzania.

a) Specific Objectives

This study was guided by the following specific objectives;

- To examine the evidence of a monthly periodic effect on freight rates of import containerized cargo
- To determine the relationship between the import container freight rates and number of containers imported per Bill of Lading (B/L)
- To assess individual opinions towards the cyclic nature of import basic container freight rates and container vessel traffic

D. Hypothesis

- Testing whether calendar year months and Container Freight rates are independent
  H01: Import Container basic ocean Freight rate is independent on calendar year months
  H11: Import Container basic ocean Freight rate is dependent on calendar year months
- Testing whether the number of containers imported per Bill of Lading (B/L) and Import Container basic ocean Freight rate are correlated
  H02: Import Container basic ocean Freight rate has no correlation with the number of containers imported per Bill of Lading (B/L)
  H12: Import Container basic ocean Freight is correlated with the number of containers imported per Bill of Lading (B/L)
- Testing whether Import Container basic ocean Freight rate and Container vessels traffic are correlated
  H03: Import Container basic ocean Freight rate does not correlate with Container vessels traffic
  H13: Import Container basic ocean Freight rate correlates with Container vessels traffic

II. LITERATURE REVIEW

A. Theoretical Literature Review

In shipping theory, when cargo rates are low or the oil esteem is high, the administrators decline cruising velocity to decrease functional costs (Ronen, 1982). In the dry mass delivery market, transport proprietors by and large accelerate when cargo rates are high to benefit from the great monetary market settings (Tsioumas, 2016). Moreover, neo-classical economic theory that supply freight space by transport proprietors or sanctions and interest for freight space as the main impetus towards fundamental sea cargo rates and its results for the transportation business elements (Kelly, 2021).

Concerning assessments in sea financial matters viewpoints, adequate exploration has been done in endeavoring to guess raw petroleum or dry mass lists, costs and cargo rates yet no review utilized both various relapse model and test measurements. They center around customs data, delivering records, and other data. Han in 2014 introduced a further developed Support Vector Machine model to gauge dry mass freight cargo record (BDI).

As a market being supply driven and spot coordinated by the presence of topographical worth trade, it proposes that looking in to overall boat arranging and vessel movement may give huge comprehension in anticipating. Besides, the dry mass market is more liberal to the extent monetary and specific ramifications than stood out from the huge hauler and compartment industry and is dependent upon more fluctuations (Han, 2014).

B. Empirical Literature Review

Kutin, 2017 used the Markov-Switching Vector Auto Regressive model as one of the time series models and explored the association between the China Containerized Freight Index (CCFI), Clarksons normal Containership Earnings, Fleet Development, the expense of Crude Oil and Global Real Economic Activity by applying Markov-Switching Vector Auto Regressive model and Impulse reaction work draws near. Regardless, the model was used without example and block by anticipating the presence of two rules. The previously was depicted when in doubt of emergency, low cargo rates and high instability occurred after the Subprime emergency, while the ensuing one is a state of steady turn of events and low unforeseen in the transportation business.

The distinguished systems are exceptionally industrious and track well the patterns and business cycles in the delivery business by which 3 significant business cycles were found. The first is described by a time of long and consistent development, temporary and the cycle was

ISSN No:-2456-2165

portrayed by exceptionally low cargo rates, low profit and generous size of the world fleet.

From when the Subprime Crisis, cargo rates in the liner transporting industry have been extremely unstable and numerous observational examinations have been led to comprehend its conduct. De Oliveira (2014) applied various strategies for relapses, for example, the arbitrary impacts and fixed impacts and the Hausman–Taylor assessor to examine the cargo rates.

Hausman–Taylor concentrate on included 1,128 citations for shipping a standard 20-foot compartment between six European nations and 47 accomplices. The free factors in his model were the port-to-port distance, the quantity of parcels, economies of scale and Liner Shipping Connectivity Index. The outcomes show that internal cargo rates are all things considered, 23% higher than for outward ones, with the opposition strongly affecting the cargo rates and overcharges giving off an impression of being one of the principle income producers.

C. Research Gap

Considering the nonlinear relations between the various elements impacting cargo rates and their association, a few creators have applied diverse autoregressive models. Veenstra and Franses (1997) utilized the Multivariate Co-mix way to deal with investigate the relationship of six mass cargo rates identified with various products and courses.

Additionally, the stochastic pattern of all factors shown that a significant piece of the example of the cargo rates can't be anticipated. Veenstra (1999) utilized the Vector Autoregressive model to look at the connection among spot and period cargo rates for the sea dry mass transportation market. Therefore, for the richness and practice of freight rates prediction in Tanzania, this research study is foreseeable to give confidence to the key players in the industry through the conclusions and recommendations.

D. Research Model

Mabrouki (2016), captured the casual link between export and GDP growth by using a multiple linear regression model and Kong (2018) used a multiple linear regression model to analyze the relationship between trade orientation, trade distortions and forecasting cargo growth and the development of the port.

As adopted from the study of multiple linear regression in estimating the relationship between variables conducted by Uyanik (2013). This study employed the multiple linear Regression model to estimate the combined influence of several factors including the number of containers imported mainly TEUs and Months of the calendar year upon the import Container freight rates. This model provided a mathematical measure of the average relationship between containership traffic and the basic ocean freight for import containers.

As a predictive analysis, the multiple linear regression was used to explain the relationship between average basic ocean freight rate as a continuous dependent variable versus container vessel traffic, number of imported containers (TEUs) and months of the calendar year as independent variables. Whereby months of the calendar year was a categorical variable and others were discrete variables.

This model assumed the presence of a linear relationship between basic ocean freight rate and other independent variables including container vessel traffic, the number of imported containers (TEUs) and months of the calendar year, normal distribution of the dataset, no multicollinearity between independent variables and homoscedasticity between the independent variables. Equation 2.1showsa mathematical expression of the multiple linear regression model of the study;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (2.1)$$

Whereby;

Y = Dependent variable (Basic Import ocean freight rate)

β_0 = Constant term of the model

X_1 = Independent variable (container vessel traffic)

X_2 = Independent variable (number of imported containers (TEUs))

X_3 = Independent variable (months of the calendar year)

β_1 = Coefficient term of the independent variable (container vessel traffic)

β_2 = Coefficient term of the independent variable (number of imported containers (TEUs))

β_3 = Coefficient term of the independent variable (months of the calendar year)

ε = Error term of the model

E. Conceptual framework

The conceptual framework for this study involves both the dependent variable which is Basic ocean freight rates (USD) and independent variables including months of the calendar year(Months), container vessel traffic (Number containerships) and number of containers transported (Number of TEUs).

III. METHODOLOGY

A. Research Approach

To achieve the research objectives and to address the research problem the researcher employed a quantitative approach to gathering information for answering the hypotheses of this research. The intent of using only a quantitative approach is to bring on-board the analysis of a huge historical dataset on the container freight rates and containership traffic. Thus the quantitative approach involved the use of secondary dataset and quantitative analytical methods of data processing that drew the relationship between container vessel traffic and import container freight rates at Dar es Salaam Port Tanzania.

IV. PRESENTATION AND DISCUSSIONOF FINDINGS

A. Container Vessel traffic in Dar es Salaam Port

Dar es Salaam port does not only provide a gateway for 90% of Tanzanian trade, but also the access route to six landlocked countries including Malawi, Zambia, Burundi,

ISSN No:-2456-2165

Rwanda, Uganda, as well as Eastern DRC and great lake countries. The growth of the shipping business in container ships has been continuous, particularly since 2006, when the Emma Maersk broke into the world of sea shipping. Studies analysed the growth of vessel size globally, the factors that condition it, and the timespan before bigger ships (Sanchez and Perrotti, 2021). Historically, knowledge of factors affecting growth trends in containerships at Dar es Salaam port had proven directly applicable in predicting trends and future of container ships arrival.

Figure showed the monthly seasonality of the containership arrival at Dar es Salaam port from 2015 to 2020. This evidences the increasing trend of containerships arrival with a clear pattern as in November every year it has been recorded maximum number containerships arriving at Dar es Salaam port which was above 50 container vessels. Moreover, figure 4.2 displays the seasonality trends in the quantity of imported containers at Dar es Salaam port as a maximum number of imported TEUs were recorded in March but on average, a large number of TEUs are imported in December and through questionnaires with TPA employees and other players in the shipping industry 70% of the respondents argued that shippers tend to import more in December than other months whereby altogether contribute to the lead-lag effect towards import container freight rates at Dar es Salaam port.

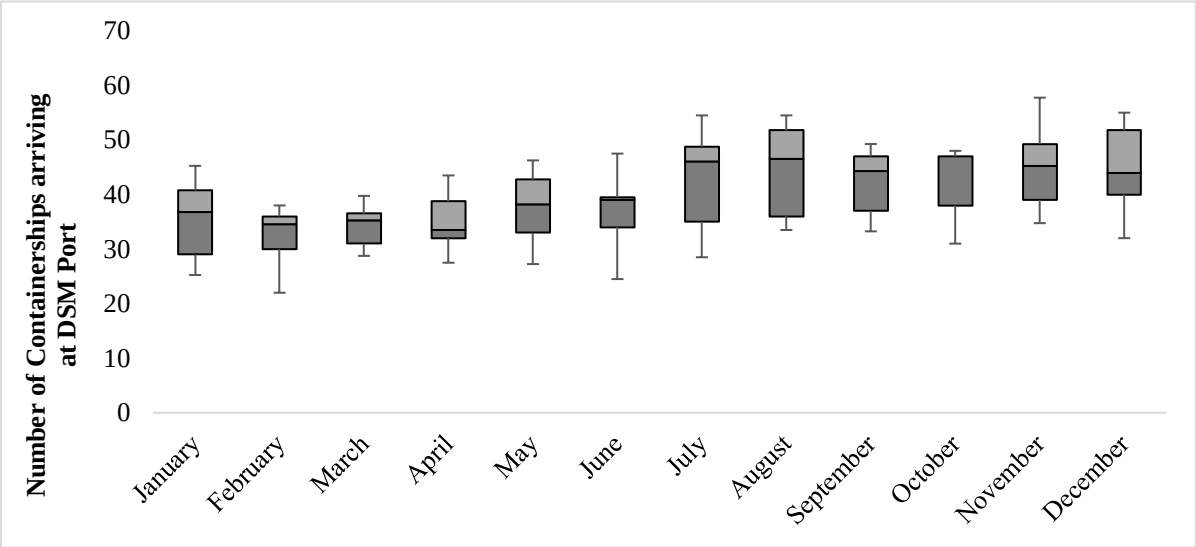

Fig. 1: Containership Traffic Monthly seasonality at DSM Port (2015 - 2020)

Source: Author, 2021

B. Import Container (TEUs) Throughput

According to the data collected from TPA, Tanzania Container Port import throughput was reported at 293,706 TEUs in 2016 with a monthly average of 24,476 TEUs. This record a decrease from the previous number of 308,601 TEUs in 2015 with a monthly average of 25,717 TEUs as displayed in figure 2. The monthly trend showed a concentration of imported TEUs in December every year and low in September every year.

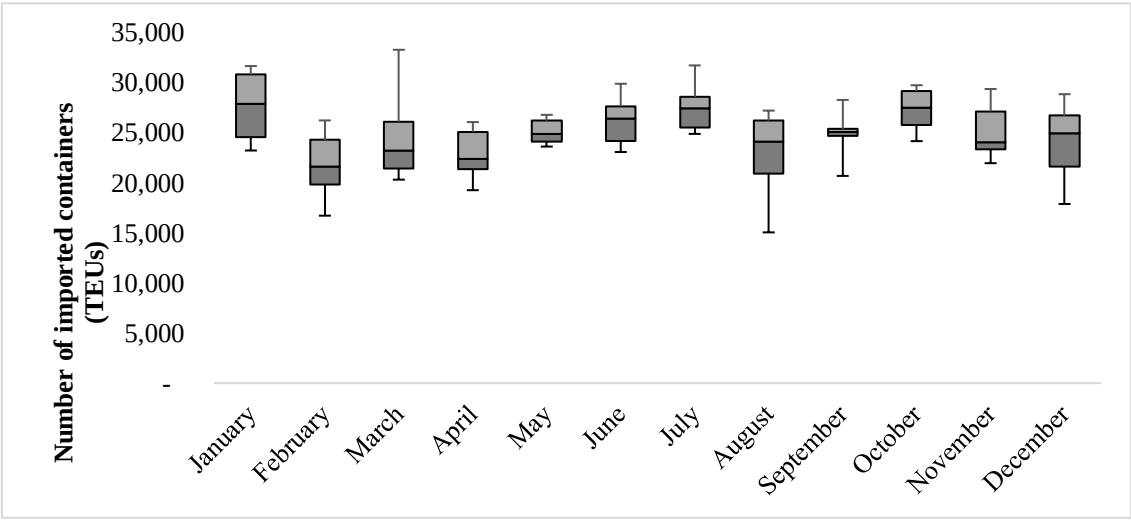

Fig. 2: Import Container throughput-TEUs Monthly seasonality at DSM Port (2015 – 2020)

Source: Author, 2021

ISSN No:-2456-2165

C. Monthly Freight Rates Effect and Trend of import containers – TEUs

Findings showed that, the average freight rate of importing a single TEU container to Dar es Salaam port from China, India, the Arabian gulf and far east countries been high in December every year as according to the dataset collected from TASAC for two years (2019 to 2020) with a maximum import freight rate per TEU of 1,652 USD, minimum freight rate of 911 USD per TEU and average freight rate of 1,281 USD per imported TEU. Moreover, the findings show that the lowest freight rate was recorded in May every year with a minimum freight rate of 212 USD per imported TEU, maximum freight rate of 586 USD and an average freight rate of 399 USD per imported TEU container as displayed in figure 3.

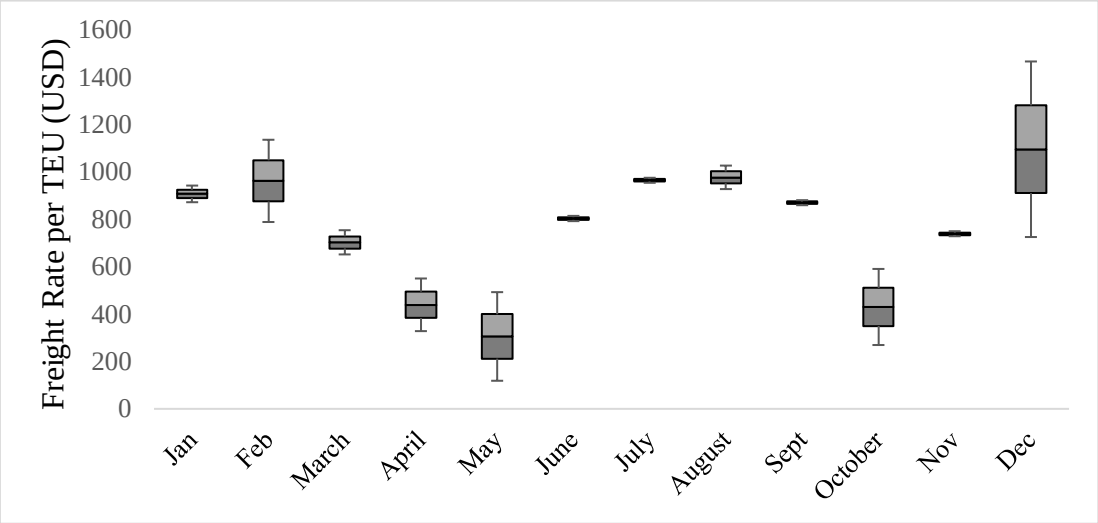

Fig. 3: Freight Rates Monthly Seasonality at DSM port (2019 - 2020)1

Source: Author, 2021

D. Monthly Trend of Import Freight Rate per TEU at Dar es Salaam Port

During the research, in interviews it was given an example of freight from Dar es Salaam to Jabel Al which dropped from $900 to $250 in 2019 per TEU. Findings for this research showed the decreasing trend of import freight rates to Dar es Salaam port as displayed in figure 4 whereby the linear trend line went down as from 2019 to 2020.

E. Evidence of Monthly Periodic Effect on Freight Rates of Import Containerized Cargo

In examining the evidence of a monthly periodic effect on freight rates of import containerized cargo, the study established hypothesis to be statistically tested as testing whether calendar year months and Container Freight rates were independent as stated in Null and alternative hypothesis stated below;

H_{01}: Import Container basic ocean Freight rate is independent on calendar year months

H_{11}: Import Container basic ocean Freight rate is dependent on calendar year months

The Q-Q plots were produced to check the normality of the collected data as displayed on figure 4.5 that shows the collected dataset was normally distributed and arrival date of the containerships was considered as non-continuous independent variable and freight rates as continuous dependent variable.

F. Chi-Square test of Independence between an Import basic Container freight rate and Months of the Calendar Year

From "Chi-Square Tests of independence" table 1 generated using Statistical Package for Social Sciences (SPSS), the null hypothesis was rejected, since the p value of 0.00 is less than 0.05 at a 95% confidence interval. This result shows that, there is strong evidence to suggest that Import Container basic ocean Freight rate is dependent on calendar year months.

	DATE	TEUF
Chi-Square	5937.719[a]	10548.952[b]
Df	217	254
Asymp. Sig.	.000	.000

Table 1**:** Chi-square test of independence

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 7.3.
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 6.3.

Source: Author, 2021

ISSN No:-2456-2165

G. Relationship between the Import Container Freight Rates and Number of Containers Imported Per Bill of Lading (B/L)

In determining the lead-lag effect between the import container freight rates and number of containers imported per Bill of Lading (B/L), the study established hypothesis to be statistically tested as testing whether Import Container basic ocean Freight rate has no correlation with the number of containers imported per Bill of Lading (B/L) as stated in null and alternative hypothesis stated below;

H02: Import Container basic ocean Freight rate has no correlation with the number of containers imported per Bill of Lading (B/L)

H12: Import Container basic ocean Freight rate is correlated with the number of containers imported per Bill of Lading (B/L)

From table 4.2, the Pearson correlation test displays a correlation of -0.193 with a p-value of 0.000 which was less than 0.05, which means there was enough evidence to reject the prior-stated null hypotheses in favor of the alternative hypothesis. Hence, Import Container basic ocean freight rate is correlated with the number of containers imported per Bill of Lading (B/L).

Elsevier (2014) discussed one of the Determinants of freight rates in the container shipping industry as the actual goods being shipped. He pointed out that, the more containers you transport, the cheaper it is. This is an important factor in the rate charged to people or companies involved in the container shipping industry. This research, shows a significant negative relationship of -0.193 (Table 4.2) which suggests that, shippers who imports more containers (TEUs) to Dar es Salaam port are charged lower freight rates as compared to those who import few containers.

Table 2 displays a Pearson correlation between import container freight rates and the number of containers imported to Dar es Salaam port of -0.193 with a p-value of 0.000 which means the correlation was statistically significant since the displayed p-value as processed with SPSS was less than 0.05. However, the correlation between the number of imported containers and import container freight rates was found to be indirect weak with an implication inverse relationship in which an increase in the number of containers imported by shippers or other players in the shipping business leads to the discount or decrease of the import container freight rates.

		TEUN	TEUF
TEUN	Pearson Correlation	1	-.193**
	Sig. (2-tailed)		.000
	N	1597	1597
TEUF	Pearson Correlation	-.193**	1
	Sig. (2-tailed)	.000	
	N	1597	1597

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation test between import container freight rates and number of containers imported per Bill of Lading (B/L)

Source: Author, 2021

H. Lead-Lag Effect between Import Container Basic Ocean Freight Rate and Container Vessels Traffic

The lead-lag effect between an import container basic ocean freight rate and container vessel traffic calling to Dar es Salaam port in this study was determined by a correlation test. Whereby,the established hypothesis was statistically tested whether an import Container basic ocean Freight rate and Container vessels traffic is correlated as stated in null and alternative hypothesis stated below;

H03: Import Container basic ocean Freight rate has no correlation with Container vessels traffic

H13: Import Container basic ocean Freight rate has a correlation with Container vessels traffic

From Table 4.3, the correlation test displays a negative weak correlation of -0.022 between an import container basic ocean freight rate and container vessel traffic calling to Dar es Salaam port. The p-value of 0.371 is greater than 0.05 under the confidence interval of 95% which means it was not statistically significant, this implies that there was enough evidence of failing to reject a prior defined null hypothesis. Therefore, an import Container basic ocean Freight rate has no correlation with Container vessels traffic

		TEUF	TRAFFIC
TEUF	Pearson Correlation	1	-.022
	Sig. (2-tailed)		.371
	N	1597	1597
TRAFFIC	Pearson Correlation	-.022	1
	Sig. (2-tailed)	.371	
	N	1597	1597

Table 3: Correlation between Import Container basic Ocean Freight Rates and Container Vessel Traffic

Source: Author, 2021

I. Individual opinions towards cyclic nature of Import Basic Container Freight Rates and Container Vessel Traffic

According to Duru (2020), global ocean shipping rates for containers are being highly cyclical through system dynamics modelling but this study also found the cyclical nature of the import container freight rates in Tanzania. Moreover, Stopford (2009) asserted market cycles pervade the shipping industry.

The study gathered individual opinions towards shipping cycles due to cyclical fluctuations in the supply of import container vessels from 48 respondents who are the key players in the shipping business. Respondents involved in the sample of this study included employees from shipping agencies and cargo consolidators/de-consolidators.

Decisions in the four shipping markets including freight, secondhand, new building and scrap were not jointly determined. These cycles correct markets when supply and demand are out of balance. Shipping markets are driven by freight rates, which can move up, move down or remain unchanged. This study focused on the Lead-lag effect between import container vessel traffic and freight rates at Dar es Salaam port in Tanzania. Moreover, shipping cycles are therefore determined by the fluctuations of these freight rates.

J. Multiple linear Regression Model

The study employed a multiple linear regression model to measure the extent of the combined influence of the number of containers imported to Dar es Salaam port in Tanzania, import container vessel traffic and months of the calendar year towards freight rate of an imported container as multiple Correlation and the Lead-lag effect between import container vessel traffic and freight rates at Dar es Salaam port in Tanzania.

a) Linear Relationship Assumption

Key assumptions of linear the relationship between an import container freight rate as the dependent variable and other three independent variables were checked by scatter plots displayed in figure 4.6, figure 4.7 and figure 4.8 with the value of R-squared of 3.7%, 0.4% and 0.01% respectively. The implication led to the fulfilment of the assumption of linearity as 3.7% of the import container freight rate was explained by the number of containers imported, 0.4% explained by months of the calendar year and 0.01% explained by the container vessel traffic calling to Dar es Salaam port in Tanzania.

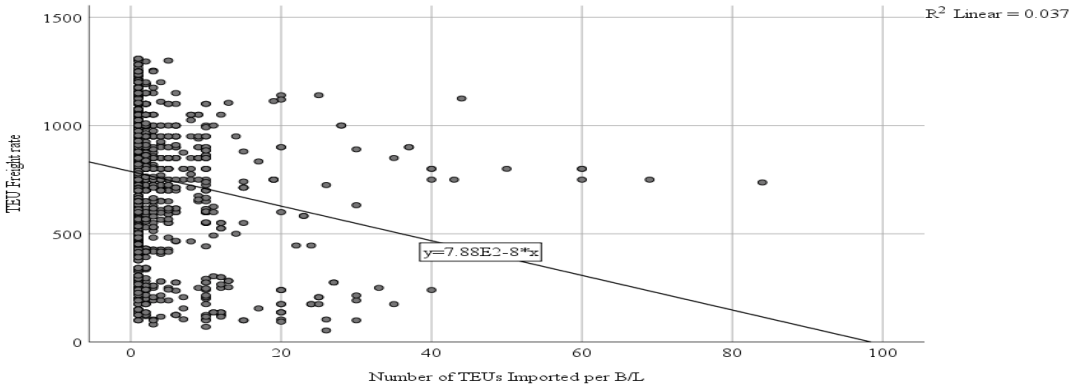

Fig. 4: Scatter Plot for TEU's Freight rate by Number of TEUs Imported

Source: Author, 2021

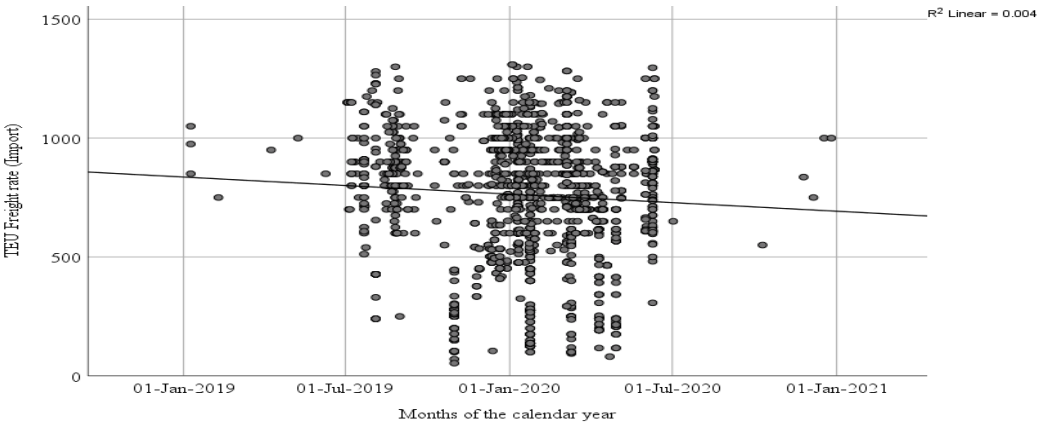

Fig. 5: Scatter Plot for TEU's Freight rate by Months of the calendar year

Source: Author, 2021

ISSN No:-2456-2165

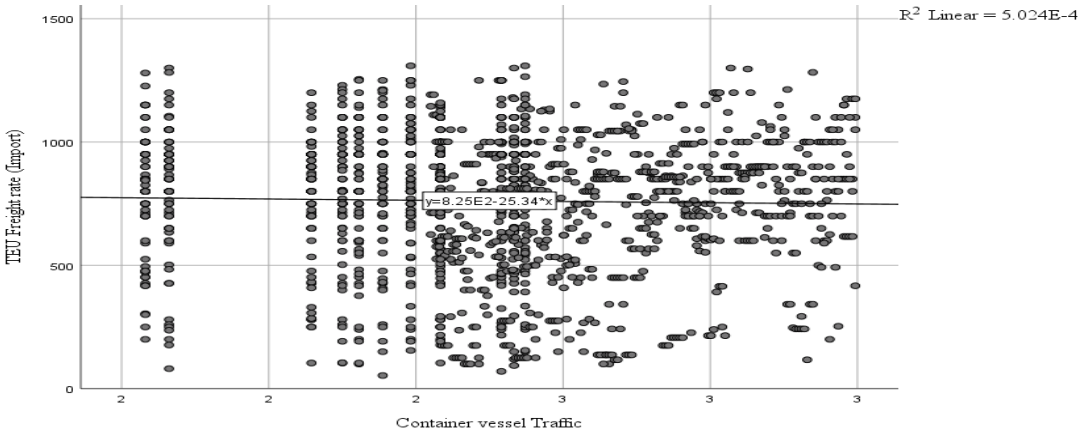

Fig. 6: Scatter Plot for TEU's Freight rate by Container vessel traffic calling to Dar e Salaam Port

Source: Author, 2021

b) Multivariate normality assumption on the number of containers imported, months of the calendar year and Container Vessel Traffic upon an import container freight rate

The assumption of multivariate normality for the multiple regression model was met with the dataset for this study as assumed the residual statistics are normally distributed with zero mean and constant variance as displayed in Table 2 whereby the mean was 0.000 with a constant variance of 262.097.

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	103.22	838.72	761.33	53.782	1597
Residual	-694.416	707.419	.000	262.097	1597
Std. Predicted Value	-12.237	1.439	.000	1.000	1597
Std. Residual	-2.647	2.697	.000	.999	1597

a. Dependent Variable: TEU freight rate

Table 4: Residuals Statistics[a]

Source: Author, 2021

c) No multicollinearity assumption number of containers imported, months of the calendar year and container vessel traffic

This study assumed that number of containers imported, months of the calendar year and container vessel traffic are not highly correlated with each other as it was tested by Correlation matrix and collinearity diagnostics in Table 4.14. Whereby a matrix of Pearson's bivariate correlations among all independent variables and the magnitude of the correlation coefficients found to be less than 0.80 as displayed in Table 4.13 which means the assumption was fulfilled.

		TEUF	TEUN	TRAFFIC	DATE
TEUF	Pearson Correlation	1	-.193**	-.022	-.066**
	Sig. (2-tailed)		.000	.371	.008
	N	1597	1597	1597	1597
TEUN	Pearson Correlation	-.193**	1	.035	.057*
	Sig. (2-tailed)	.000		.159	.022
	N	1597	1597	1597	1597
TRAFFIC	Pearson Correlation	-.022	.035	1	.085**
	Sig. (2-tailed)	.371	.159		.001
	N	1597	1597	1597	1597
DATE	Pearson Correlation	-.066**	.057*	.085**	1
	Sig. (2-tailed)	.008	.022	.001	
	N	1597	1597	1597	1597

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5: Correlation test for Multicollinearity

Source: Author, 2021

ISSN No:-2456-2165

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	DATE	TEUN	TRAFFIC
1	1	3.271	1.000	.00	.00	.03	.00
	2	.723	2.127	.00	.00	.97	.00
	3	.006	23.525	.00	.00	.00	.99
	4	1.562E-7	4575.869	1.00	1.00	.00	.01

a. Dependent Variable: TEU freight rate

Table 6: Collinearity Diagnostics[a]

Source: Author, 2021

d) Homoscedasticity assumption among the number of containers imported, months of the calendar year and container vessel traffic

This assumption was met by the data collected for this study as figure 4.9 of Normal P – P plot of Regression Standardized Residual display the variance of error terms that are similar across the values of the number of containers imported, months of the calendar year and container vessel traffic. Moreover, the plot of standardized residuals versus predicted values can show whether points are equally distributed across all values of the independent variables.

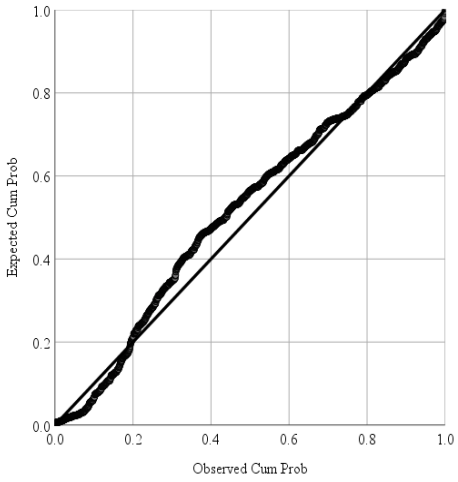

Fig. 7: Normal P – P plot of Regression Standardized Residual (Dependent Variable – TEU Freight rate)

Source: Author, 2021

e) Multiple Linear Regression Model

Relaxing other factors constant as far as a month of the calendar year change then freight rate for importing one TEU container will proportionate slightly decrease by 0.5% with a P-value=0.024 that means statistically significant as it is less than 0.05 under 95% confidence interval. Moreover, if a shipper or player in the shipping business increase the number of containers imported via Dar es Salaam port in Tanzania will get a decrease or discount in import container freight rate by 19% with a p-value of 0.000 which is also statistically significant as it is less than 0.05. however, whatever container vessel traffic calling to Dar es Salaam port increases, decrease TEU freight rate by 1.1% as displayed in standardized coefficients on Table 4.15. Moreover, Table 4.16 shows the value of R-squared as 0.0404 which means 4% of the basic ocean freight rate as a dependent variable is explained by months of the calendar year, Number of TEU containers imported and Container vessel traffic to Dar es Salaam port.

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	T	Sig.
1	(Constant)	26595.074	11742.051		2.265	.024
	DATE	-1.868E-6	.000	-.054	-2.194	.028
	TEUN	-7.858	1.020	-.190	-7.706	.000
	TRAFFIC	-12.577	27.862	-.011	-.451	.652

a. Dependent Variable: TEU freight Rate

Table 7: Coefficients[a] of Multiple Regression Model

Source: Author, 2021

Source	SS	Df	MS	Number of obs.	1,597
				F(3, 1593)	22.36
Model	4616496.47	3	1538832.16	Prob > F	0
Residual	109637273	1,593	68824.4026	R-squared	0.0404
				Adj R-squared	0.0386
Total	114253770	1,596	71587.5751	Root MSE	262.34

Table 8: Fitness of the Model

Source: Author, 2021

f) TEU Container Freight Rate Equation

Equation 4.1 shows the mathematical expression of an import container freight rate as a dependent variable as influenced by the number of containers imported to Tanzania via Dar es Salaam port, months of the calendar year and container vessel traffic calling to Dar es Salaam port which is the Multiple linear regression model that guide this study and implies the lead-lag effect to the import container freight rate.

$$Y = 26595.074 - 12.577\ X_1 - 7.858\ X_2 - 0.000001\ X_3 + 11742.051 \quad (4.1)$$

Whereby;

Y = Basic Import container freight rate

X_1 = Independent variable (container vessel traffic)

X_2 = Independent variable (number of imported containers (TEUs))

X_3 = Independent variable (months of the calendar year)

Model Equation 4.1 implied that, whenever the shipper imports a large number of TEU containers which is an independent variable in the model then he or she will pay lower Basic Import container freight rate which is the dependent variable in the model for example when a shipper imports 2000 TEUs, he/she will pay 22,570.82USD whereby when he/she import 200 then he has to pay 36,715.22 USD.

V. CONCLUSION AND RECOMMENDATIONS

A. Conclusion

This study was carried out to analyze the Lead-lag effect between import container vessel traffic and freight rates at Dar es Salaam port in Tanzania specifically on examining the evidence of a monthly periodic effect on freight rates of import containerized cargo, determining the relationship between the import container freight rates and the number of containers imported per Bill of Lading (B/L) and assessing individual opinions towards cyclic nature of import basic container freight rates and container vessel traffic**.**

The study found a significant weak negative correlation of -0.193 between Import Container basic ocean Freight rate and the number of containers imported per Bill of Lading (B/L) with an implication that, the more the number of containers imported via Dar es Salaam port Tanzania leads to a decrease of about 19% in the TEU container import freight rate.

The study also found the dependence between an import Container basic ocean Freight rate and calendar year months as evidenced by the chi-square test of independence whereby the p-value was 0.00 which is less than 0.05 under 95% confidence interval, the null hypothesis was rejected in favor of the alternative hypothesis.

Moreover, the study analysed the lead-lag effect between container vessel traffic and the import container basic ocean freight rates at Dar es Salaam Port in Tanzania by gathering individual opinions towards the relationship and a sample of 48 respondents were interviewed through questionnaires. It was revealed that 70% of the respondents agreed that shippers tend to import more during the end of the year months including December that complementing the inter-dependence between an import container freight rate and months of the calendar year.

Finally, this study a multiple linear regression model to analyze the Lead-lag effect between import container vessel traffic and freight rates at Dar es Salaam port in Tanzania. However, the negative relationship was found with an implication that, if a shipper or player in the shipping business increase the number of containers imported via Dar es Salaam port in Tanzania will get a decrease or discount in import container freight rate by 19%.

B. Recommendations to Various Stakeholders

a) Recommendations to Government, ports Authority and other Government Agencies

The government, Ports Authority and other Government agencies should provide a platform for shippers and other players in the industry to communicate the trend of shipping seasonality especially on the average freight rates per specific months of the calendar year to lessen-up other port dues and surcharges during high freight rates.

b) Recommendations to Shippers and Key Players in the Shipping industry

Shippers and other players in the industry are advised to be cost conscious in importing TEU containers through importing a slightly large number of TEUs either jointly or individually to get low basic ocean freight per container. However, they are advised to observe the trend of basic ocean freight rate in months of the calendar year and container vessel traffic to import during the period of low freight rates. This could make them practice economies of scale and lead to industry growth in the competitive market hence generating more wealth.

c) Recommendations for Further Studies

This paper contributes to the existing literature by exploring the lead-lag effect and relationship between

container vessel traffic calling to Dar es Salaam port, number of TEU containers imported to Dar es Salaam port, months of the calendar year towards an import container freight rate. The study applied the Multiple Linear Regression model by assuming the presence of linear relationship, multivariate normality, no multicollinearity and homoscedasticity among the independent variables.

Potential future research could include the use of another model to find out the lead-lag effect and relationshipof incoming container vessel traffic, the number of containers imported, months of the calendar year towards an import container freight rates instead of multiple linear regression model.Moreover, other researchers might think of gathering daily statistics to find out the day effect among the variables.

The research did not go deep on other surcharges and port dues as drivers to gross ocean freight rate for an import TEU container. Therefore, there is a need to research on the lead-lag effect between other factors as drivers for freight rate.

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