Effects of Middle East Crisis on Dry Bulk Carriers Charter Rates between Port of Mersin and West African

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Abstract—**This study examines the impact of the Middle East crisis on voyage charter rates for Handymax bulk carriers operating between Mersin (Turkey) and Apapa, Lagos. Using secondary time-series data from January 2023 to June 2024, the study employs descriptive statistics, ANOVA, and trend analysis to compare pre-crisis and crisis-period freight dynamics and to forecast future rates. Results show a significant increase in average freight rates from $1,396.67/ton in the pre-crisis period to $1,894.44/ton during the crisis, indicating heightened market volatility driven by geopolitical risks, higher insurance costs, and longer voyage routes. While trend analysis indicates upward movements in both periods, these were not statistically significant, suggesting that the observed increases are primarily crisis-induced. Forecasts for July 2024 to June 2025 project continued elevated rates, with potential peaks exceeding $2,075/ton if disruptions persist. The findings highlight broader economic implications, including increased import costs and inflationary pressures in West Africa. The study concludes that geopolitical instability in the Middle East significantly affects global freight markets and recommends policy measures such as tax reliefs, investment in regional shipping capacity, and strategic import reserves to mitigate these impacts.**

Keywords—**middle east crisis, container shipping trade, freight rate, west African trade routes**

I. Introduction

The Middle East plays a critical role in global maritime transport, serving as a major logistics hub and hosting key shipping corridors such as the Suez Canal. Over the years, recurrent geopolitical crises in the region have disrupted maritime operations, with far-reaching consequences beyond the immediate area. These disruptions often lead to increased shipping costs, delays due to vessel rerouting, higher energy prices, and broader supply chain instability. While the humanitarian and regional economic impacts of such crises are widely acknowledged, their indirect effects on distant but connected markets—particularly in developing regions—remain insufficiently explored.

One such underexplored area is the effect of Middle East crises on maritime trade routes linking the region to West Africa. In particular, the shipping corridor between the Port of Mersin in Turkey and Apapa Port in Lagos represents an important trade link for dry bulk cargo. Despite its relevance, there is limited empirical evidence on how geopolitical instability in the Middle East translates into changes in freight rates along this route. This gap makes it difficult for ship-owners, operators, and policymakers to assess risk exposure and make informed decisions.

Against this backdrop, this study asks a central question: "to what extent has the ongoing Middle East crisis affected voyage charter rates for dry bulk carriers operating between Mersin and Lagos?". More specifically, the study examines whether significant differences exist between pre-crisis and crisis-period freight rates, and how these changes reflect broader disruptions in global shipping dynamics.

The motivation for this inquiry is strengthened by recent developments, particularly the 2023–2024 escalation of tensions in the Red Sea and surrounding waterways. These events have forced many vessels to reroute around the Cape of Good Hope, increasing voyage distances, fuel consumption, and insurance costs. Such changes not only affect routes directly passing through the conflict zone but also influence global vessel availability, tonnage distribution, and charter market conditions. As a result, even trade routes not directly

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transiting the Red Sea—such as Mersin to West Africa—may experience indirect cost and pricing effects.

This study contributes to the literature by providing route-specific empirical evidence on how geopolitical shocks transmit to freight markets in secondary but economically significant corridors. While existing studies largely focus on aggregate global effects, this research isolates the Mersin–West Africa trade route to offer a more nuanced understanding of regional market responses. It also highlights how global disruptions interact with local conditions in West African ports, such as congestion, operational inefficiencies, and hinterland logistics constraints, to shape freight rate outcomes.

Methodologically, the study employs time-series data and statistical techniques to compare freight rate behavior before and during the crisis period. By doing so, it quantifies the magnitude of change and assesses whether observed trends are statistically significant or primarily crisis-driven. The findings are expected to provide valuable insights for maritime stakeholders and inform policy strategies aimed at mitigating the adverse effects of external shocks on regional trade systems.

Overall, this research addresses a critical gap by linking geopolitical instability in the Middle East to measurable economic outcomes in West Africa's shipping sector, thereby offering both academic and practical relevance.

The central aim of the study is to investigate the influence of the Middle East crisis on the charter rates for dry bulk carriers between the port of Mersin and Lagos in West Africa. The specific objectives of the study are:

(i) To estimate the trend of pre-crisis charter rates for dry bulk carriers engaged in trade between the port of Mersin and Lagos West Africa

(ii) To determine the trend of charter rates for dry bulk carriers engaged in trade between the port of Mersin and West Africa in the crisis era

(iii) To compare the pre-crisis and crisis era charter rates for dry bulk carriers engaged in trade between the Middle East port of Mersin and Lagos West Africa

The research questions addressed include:

(i) Is there a significant increase in the trend of charter rates for dry bulk carriers engaged in trade between the port of Mersin and Lagos West Africa during the pre-crisis in the Middle East?

(ii) What is the extent of increase in the trend of charter rates for dry bulk carriers engaged in trade between the port of Mersin and West Africa in the crisis era?

(iii) Is there significant difference in the pre-crisis and crisis era charter rates for dry bulk carriers engaged in trade between the Middle East port of Mersin and Lagos West Africa?

The study proposed the following hypotheses:

H_{01}: There is no significant increase in the trend of charter rates for dry bulk carriers engaged in trade between the port of Mersin and Lagos West Africa during the pre-crisis in the Middle East.

H_{02}: There is no significant increase in the trend of charter rates for dry bulk carriers engaged in trade between the port of Mersin and West Africa in the crisis era.

H_{03}: There is no significant difference in the pre-crisis and crisis era charter rates for dry bulk carriers engaged in trade between the Middle East port of Mersin and Lagos West Africa

II. Literature Review

Ozili (2020), in his work titled COVID-19 in Africa: Socio-economic impact, policy response and opportunities in Africa, employed a discourse analysis approach to demonstrate that the COVID-19 pandemic exerted profound socio-economic effects across African countries. The study highlighted that safety measures such as physical distancing significantly constrained economic activity and social interaction. According to Ozili (2020), the crisis altered social policies, directly undermining the economic and social well-being of citizens, largely due to the sharp decline in economic activities. By implication, just as the pandemic reshaped socio-economic realities, the Middle East crisis and similar large-scale conflicts are also likely to disrupt public welfare and economic systems. Specifically, the Middle East conflict has been shown to impose severe constraints on global shipping. Nevertheless, empirical evidence on the full scope of these effects remains scarce, underscoring the need for studies that can measure and control such negative consequences with greater precision (Ozili, 2020).

Huizhu, Quigcheng, and Hercules (2024) investigated the Consequences of freight rate volatility in liner shipping and the role of strategic alliances.Their study analyzed how fluctuations in freight rates impact both upstream actors (such as shippers and ship manufacturers) and downstream stakeholders (including ports and ship recyclers) within the vertical maritime supply chain. The findings revealed that after 2013, increased volatility in freight rates adversely affected shippers and ports by intensifying unpredictability in costs and operational planning (Huizhu, Quigcheng, and Hercules, 2024). The study further showed that industry consolidation efforts are less prominent in booming shipping markets with high freight revenues, but more intense during market downturns. Importantly, their research provided empirical evidence on the spillover effects of freight rate fluctuations across different markets and emphasized the role of strategic alliances and acquisitions in shaping industry responses. These insights are especially valuable for policymakers and business leaders navigating the dynamics of maritime supply chains (Huizhu, Quigcheng, and Hercules, 2024).

In another study, Okeleke and Aponjolosun (2020) examined the effects of the COVID-19 crisis on Nigerian maritime workers using a survey research design. Their findings indicated that the pandemic disrupted global shipping progress and severely complicated crew change processes, thereby reducing efficiency and productivity (Okeleke & Aponjolosun, 2020). Lockdown measures significantly hindered seafarers from taking leave or being relieved at ports. Their conclusions align with those

of Ozili (2020), reinforcing that crises, including the Middle East conflict, negatively impact socio-economic activities and shipping operations in particular.

Tomislav, Naletina, and Zając (2022) explored volatility in freight rates within the maritime container industry during crises. They emphasized that recurrent disruptions—such as the Middle East conflict—destabilize supply chains and substantially raise freight transport costs, thereby creating pronounced imbalances in shipping trends (Tomislav, Naletina, and Zając, 2022). Their research underscored that the COVID-19 pandemic was the most disruptive crisis to global supply chains in recent history, while the Russian invasion of Ukraine further intensified the post-pandemic challenges (Tomislav, Naletina, and Zając, 2022).

Similarly, Nwokedi, Okoroji, Nwokodi, Efanga, and Okafor (2021) reported that the COVID-19 outbreak caused substantial increases in TEU transport costs across shipping, rail, and road corridors in West Africa. These cost escalations coincided with disruptions in containerized trade flows from Nigerian seaports to major hinterland markets. The study recommended that post-pandemic economic recovery strategies must account for the inflationary pressures induced by higher TEU transport costs along last-mile corridors (Nwokedi *et al*., 2021).

Deluair, Muhammad, Kenner, and Kaufman (2024) also assessed the impact of freight rates on US containerized agricultural trade. Their analysis showed that the unprecedented freight rate surge in 2021 significantly reduced trade flows. Specifically, they found that a 10% increase in shipping costs reduced US agricultural export values by 0.58% and imports by 1.72% (Deluair, Muhammad, Kenner, & Kaufman, 2024).

Additionally, Nwokedi, Ibe, Mbachu, and Okafor (2022) examined how TEU freight costs from Shanghai to Lagos, combined with road haulage expenses to Nigerian hinterland markets, influenced inflation in imported commodity prices. Using secondary data and a quantitative design, they concluded that, although transportation costs affect inflationary trends, the ocean freight rate per TEU between China and Lagos did not significantly influence commodity price inflation in Nigeria (Nwokedi *et al*., 2022). The authors stressed that while transport costs matter, they are not the primary driver of inflation in the Nigerian economy.

Lun *et al*. (2023) and Yilmazkuday (2025). provided further insights into freight rate dynamics, analyzing demand and supply factors in maritime transport. On the demand side, they identified determinants such as global economic conditions, seaborne commodity trade, transport costs, and random shocks like crises. On the supply side, fleet capacity and operational efficiency were identified as critical (Lun *et al*., 2023). They highlighted that crises, including the Middle East conflict and the COVID-19 pandemic, alter shipping demand–supply dynamics, thereby reshaping freight rates (Lun *et al*., 2023; Yilmazkuday, 2025).

Finally, Konstantinos and Nektarios (2021) explored threshold relationships between commodity prices and ship charter rates using a lagged regression model. Their findings revealed that sharp drops in commodity prices strongly influence freight rates, with such effects often persisting over time. The study showed that during these shocks, oil prices become less important while freight rates adjust more dynamically to preserve the transport cost–commodity price ratio (Konstantinos & Nektarios, 2021). They also observed a significant lead-lag relationship between commodity prices and charter rates, underscoring the long-term effects of market shocks (Konstantinos & Nektarios, 2021; Yilmazkuday, 2019).

The study has been able to identify the research and knowledge gaps after critical review of empirical literature as shown in section 2.0. Although few l empiric studies have been carried out in this area, the study identified some knowledge gaps in line with the objectives of the study such that there is a lack of empirical knowledge on what constitute the trend of spot and time charter rates for dry bulk carriers engaged in trade between the West African and Middle East trade route before the crisis in the Middle as the basis for understanding the impacts of the crisis on spot and time charter rates for dry bulk shipping market on the route. There is need to understand whether the trend was increasing or otherwise over the period.

III. Data and Methods

The study adopts a quantitative research design utilizing time-series secondary data. This approach was selected because longitudinal data is essential for capturing the volatility and temporal shifts in the maritime industry between pre-crisis and crisis periods. Data on container shipping freight rates between West African ports (specifically Lagos) and Mersin Port in the Middle East was sourced from the UNCTAD Maritime Transport Review and augmented with Clarkson's Freight Index reports. These sources provide the standardized, high-frequency metrics required for rigorous econometric modeling.

The empirical approach was structured to move from descriptive identification to comparative analysis and, finally, predictive modeling. The specific methodologies were chosen based on the following justifications:

- **Trend Analysis (Objectives 1 & 2):** To estimate the movement of freight rates during the pre-crisis and crisis eras, trend analysis was utilized over simple averages. This method is superior for this objective as it identifies the direction and rate of change over time, allowing for a clear visualization of how the crisis fundamentally altered market trajectories.
- **Difference of Means** Model **(Objective 3):** To compare the two eras for significant differences, the difference of means (t-test) was deployed. This parametric approach was chosen because it provides a statistically robust way to determine if the observed variations in freight rates were significant anomalies caused by the crisis or merely standard market fluctuations.

- **Econometric Forecasting/Trend Model (Objective 4):** For extrapolating future trends, a trend-based forecasting model was applied. While complex machine learning models exist, the trend model was deemed most appropriate for this time-series data to maintain high interpretability for stakeholders in the shipping industry while effectively capturing the historical momentum of the route.

The integration of these statistical and econometric tools ensures that the findings are not merely descriptive but provide a verifiable basis for policy and operational decisions in the West African-Middle Eastern maritime corridor. See Fig. 1 below presents the methods of data analysis.

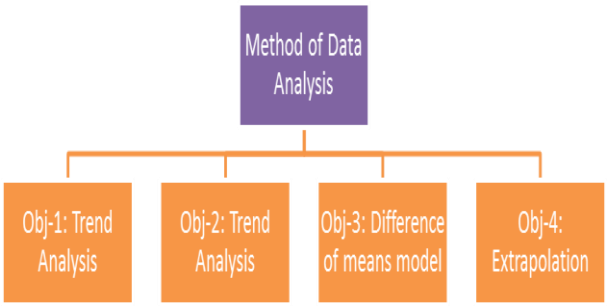

Fig. 1. Methods of data analysis.

The trend of container shipping freight rate in the pre-crisis (***FREIGHT***$_{pre}$) and crisis era (***FREIGHT***$_{crisis}$) between the West African port of Lagos and port of Mersin in the Middle East was estimated by the use of trend analysis. The model specification is as shown below:

$$FREIGHT_{pre} = \beta_0 + \beta_1 X_1 + e \quad (1)$$

$$FREIGHT_{crisis} = \beta_0 + \beta_1 X_2 + e \quad (2)$$

where:

β_0 = regression constant

β_1 = coefficients of regression.

The difference of means model assesses whether the means of the two groups of container shipping freight rates in the pre and crisis war eras are statistically, significantly different from each other.

The formula is given below:

Difference of mean $X_{diff} = \sqrt{\frac{\bar{x}_f - \bar{x}_l}{\frac{S_f^2}{n_f} + \frac{S_l^2}{n_l}}}$

where t= t-statistics results for the difference of means.

$\bar{x}_f$ = mean of shipping freight rate in the pre-war era.

$\bar{x}_l$ = Mean of shipping freight rate in the post war era.

S_f^2 = Variance of individual parameter readings for shipping freight rates for pre war

S_l^2 = Variance of parameter estimates for shipping freight rate for post war.

n_f = n_l = N = Samples sizes which is the number of months over the data of freight rates covers. An independent sample T-test may equally be used to estimate the significances of the differences in the pre and post crisis era fright rates. The formula for the T-Test is shown below:

$$T = \frac{XT - XC}{\sqrt{\frac{VarT}{NT} + \frac{Varc}{Nc}}}$$

The hypotheses will be tested by the use of F-test and t-test corresponding to the statistical tools used in the analysis

IV. Results and Discussion

The result of the study shown on Table I above indicates average voyage charter rates of Handymax bulkers ($/Ton) (charter rates for bulkers) from Middle-East Ports (Mersin) to West Africa (Lagos) in the Pre-Crisis and Crisis Eras. The result shows that in the pre-crisis era from September 2023 to September 2023, the shipper paid an average of 1396.667USD/ton to engage handymax dry bulk carrier types from the Middle East port of Mersin to West African port of Apapa Lagos, with a standard deviation of 82.76. The minimum amount paid by shippers to engage handymax dry ships in a voyage charter contract on the route is 1300USD/ton while the maximum paid to engage handymax dry bulk carrier ships in voyage charter contracts per ton in the pre-crisis era was 1550USD/ton. The range which indicates the difference between the highest and least amount paid by shippers to engage handymax dry bulk carriers in voyage charter contracts on the route from the Middle-East to the West Africa port of Apapa, Lagos is 250USD. This implies that in the pre-crisis era, it cost shippers 1300USD/ton ≤1550USD/ton to ship per ton of dry bulk cargo between Mersin Port in the Middle-East and Lagos Apapa port in West Africa, on a voyage charter contract.

Similarly, the average amount paid by shippers to ship per ton of dry bulk cargo on voyage charter contracts between the port of Mersin and Apapa port in Lagos West Africa during the crisis era covering the period between October 2023 and June 2024 is 1894.444USD/ton with standard deviation of 123.601. The highest amount paid to ship per ton of dry bulk cargo on voyage charter contract basis between the ports during the crisis era is 2050USD while the least amount paid for shipping per FEU of laden container over the same period is 1700USD. The range which indicates the difference between the maximum and minimum amount paid by shippers to ship per ton of dry bulk cargo in voyage charter contract basis on the Middle-East-West Africa route is 350USD. The implication is that during the crisis era in the middle-east, it cost between 1700USD≤2050USD to ship per ton of dry bulk cargo in voyage charter contracts between the Middle-East port of Mersin and Apapa Lagos in West Africa.

TABLE I. THE AVERAGE VOYAGE CHARTER RATES OF HANDYMAX BULKERS FROM MIDDLE-EAST PORTS (MERSIN) TO WEST AFRICA (LAGOS) IN THE PRE-CRISIS AND CRISIS ERAS

Voyage rates ($/Ton pre-crisis era	*Voyage charter rate pre-crisis*	*charter rates ($/Ton) in crisis era*	*crisis era*
Mean	1396.667	Mean	1894.444
Standard Error	27.58824	Standard Error	41.2011
Median	1400	Median	1900
Mode	1350	Mode	1850
Standard Deviation	82.76473	Standard Deviation	123.6033
Sample Variance	6850	Sample Variance	15277.78
Kurtosis	−0.15358	Kurtosis	−0.93613
Skewness	0.60702	Skewness	−0.15629
Range	250	Range	350
Minimum	1300	Minimum	1700
Maximum	1550	Maximum	2050
Sum	12570	Sum	17050
Count	9	Count	9

Source: Author's calculation.

The significances of the differences in the freight cost for shipping per ton of dry bulk cargo in voyage charter contracts between the middle-east port of Mersin and Lagos Apapa port in West Africa is discussed in the Table11below.

TABLE II. DIFFERENCE BETWEEN THE PRE-CRISIS ERA AND CRISIS ERA VOYAGE CHARTER RATES OF HANDYMAX BULKERS

Anova: Two-Factor Without Replication						
SUMMARY	*Count*	*Sum*	*Average*	*Variance*		
Row 1	2	3050	1525	61250		
Row 2	2	3150	1575	151250		
Row 3	2	3300	1650	125000		
Row 4	2	3500	1750	180000		
Row 5	2	3320	1660	72200		
Row 6	2	3050	1525	101250		
Row 7	2	3250	1625	151250		
Row 8	2	3400	1700	180000		
Row 9	2	3600	1800	125000		
Pre-crisis era	9	12570	1396.667	6850		
Crisis Era	9	17050	1894.444	15277.78		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	144844.4	8	18105.56	4.501381	0.023935	3.438101
Columns	1115022	1	1115022	277.2155	1.71E-07	5.317655
Error	32177.78	8	4022.222			
Total	1292044	17				

Source; Author's calculation.

The result of the study shown in Table II above shows the differences between the freight rate for shipping per ton of dry bulk cargo in voyage charter contracts between West African Ports and the Middle East Ports in the Pre-Crisis and Crisis Era. The result indicates that while the mean freight rate paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts involving handymax vessels 1396.67USD/ton on the middle-east-West African route in the pre-crisis era is with a variance of 6850. Similarly in the crisis era, the fright rate for shipping per ton of dry bulk cargoes in voyage charter contracts involving the use of hnadymax bulkers on the same route is an average of 1894.44USD with a variance of 15277.78.

The result indicates a mean difference of 497.77USD/ton between the freight rate for shipping per ton of dry bulk cargoes in voyage charter contracts by engaging handymax bulkers between the port of Mersin in the Middle-East and Apapa port in Lagos West Africa. The F-score value is 277.2155 while the f-critical value is 5.3177 at 0.05 level of significance. Since 277.2155>5.3177 (ie: f-score>f-critical); it implies that the freight rates paid by shippers for shipping per ton of dry bulk cargoes in voyage charter contracts by engaging handymax bulkers between the middle-east port of Mersin and Apapa port in Lagos West Africa, in the pre-crisis and crisis eras is significantly varied. Therefore, a significantly higher freight rate is paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts by engaging handymax bulkers during the crisis era than in the pre-crisis era.

This has implications on the prices of imported commodities in the local markets, production costs, raw material cost, among others in both eras. It is expected that prices of market commodities and production costs will be cheaper/lower in the pre-crisis era than in the

crisis period. This is because the shippers who encountered increased freight charges of shipping per ton of dry bulk cargoes in voyage charter contracts on the route by 497.77USD as well as other surcharges will definitely transfer these increased costs of transportation to the prices of the imported dry bulk commodities, raw materials and associated products; leading to increased commodity prices and inflation. It thus implies that the war/crisis in the middle-east has led to increased shipping freight rates on the middle-east to West African sea routes and is consequently part of the factors leading to inflation, rising commodity prices and rising cost of production in West Africa.

TABLE III. TREND OF VOYAGE CHARTER RATES OF HANDYMAX BULKERS THE PRE-CRISIS ERA (JANUARY –SEPTEMBER, 2023)

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.468763					
R Square	0.219738					
Adjusted R Square	0.108273					
Standard Error	78.15583					
Observations	9					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	12041.67	12041.67	1.971351	0.203083	
Residual	7	42758.33	6108.333			
Total	8	54800				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1325.833	56.77889	23.35081	6.71E-08	1191.573	1460.094
X Variable	14.16667	10.08987	1.404048	0.203083	-9.69209	38.02543

Source: Author's calculation.

Table III above shows the result of the trend of voyage charter rates (USD/Ton) of handymax bulkers from Middle-East Ports (Mersin) to West Africa (Lagos) in the Pre-crisis Era (January–September, 2023). The result reveal that the multiple R which indicates the coefficient of correlation between variations in time and the shipping freight rate paid by shippers to ship per ton of dry bulk cargoes in voyage charter contracts involving the engagement of handymax vessels between the Port of Mersin in the Middle-East and Apapa Port in Lagos West Africa in the pre-crisis era (January 2023 to September 2023) is 0.468. This indicates that their exist about 47% positive correlation between variations in time (measured in months) and amount paid as freight rate by shippers for shipping per ton of dry bulk cargo between the Port of Mersin in the Middle-East and Apapa Port in Lagos West Africa during the pre-crisis era, by engaging handymax bulkers in voyage charter contracts. The implication is that as time increases (in months), during the pre-crisis era, freight rates for shipping per ton of dry bulk consignments on the route were also increasing.

The equation showing the trend of freight rates paid by shippers for shipping per ton of dry bulk consignments in voyage charter contracts involving the use of handymax bulkers between the ports in the 9 months period covered in the pre-crisis era is:

$$HANDYMAXBULKRATE_{pre\text{-}crisis} = 1325.833 + 14.167X_t \quad (7)$$

The implication is that with each monthly increase in time during the pre-crisis era (one unit increase in time), the freight rate for shipping per ton of dry bulk cargo in voyage charter contracts by the engagement of handymax bulkers between the port of Mersin in the Middle-East and Lagos Apapa port in West Africa increases by 14.167USD/ton. This indicates that variations in time over the period influenced freight rate for shipping per ton of dry bulk cargo in voyage charter contracts involving the engagement of handymax bulkers on the route to increase by an average of 14.167USD/ton each month.

The coefficient of determination which measures the explanatory power of the model is approximately 0.219. This implies that about 22% variations in the freight rates paid by shippers for shipping per ton of dry bulk cargo in voyage charter contracts by the engagement of handymax bulkers between the port of Mersin in the Middle-East and Lagos Apapa port during the pre-crisis era is explained by changes in time over the 9 months period considered in the study.

The test of hypothesis which examines the significance of the extents of the increasing trend in freight rates paid to ship per ton of dry bulk cargi in voyage charter contracts on the route in the pre-crisis era was done in subsequent section of this study.

Table IV above shows the result of the trend of voyage charter rates (USD/Ton) of handymax bulkers from Middle-East Ports (Mersin) to West Africa (Lagos) during the crisis Era (October 2023–June 2024). The result reveal that the multiple R which indicates the coefficient of correlation between variations in time and the shipping freight rate paid by shippers to ship per ton of dry bulk cargoes in voyage charter contracts involving the engagement of handymax vessels between the Port of Mersin in the Middle-East and Apapa Port in Lagos West Africa in the crisis era is 0.572375. This indicates that their exist about 57% positive correlation between variations in time (measured in months) and amount paid as freight rate by shippers for shipping per ton of dry bulk cargo between the Port of Mersin in the Middle-East and Apapa Port in Lagos West Africa during the crisis era, by engaging handymax bulkers in voyage charter contracts.

The implication is that as time increases (in months), during the crisis era, freight rates for shipping per ton of dry bulk consignments on the route were also increasing.

TABLE IV. TREND OF VOYAGE CHARTER RATES OF HANDYMAX BULKERS IN THE CRISIS ERAS (OCTOBER 2023-JUNE 2024)

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.572375					
R Square	0.327614					
Adjusted R Square	0.231558					
Standard Error	108.3516					
Observations	9					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	40041.67	40041.67	3.410681	0.107269	
Residual	7	82180.56	11740.08			
Total	8	122222.2				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	1765.278	78.71565	22.42601	8.87E-08	1579.145	1951.411
X Variable 1	25.83333	13.98814	1.846803	0.107269	-7.24336	58.91002

Source: Author's calculation.

The equation showing the trend of freight rates paid by shippers for shipping per ton of dry bulk consignments in voyage charter contracts involving the use of handymax bulkers between the ports in the 9 months period covered in the crisis era is:

$$HANDYMAXBULKRATE_{crisis} = 1765.278 + 25.83X_t \quad (8)$$

The implication is that with each monthly increase in time during the crisis era (one unit increase in time), the freight rate for shipping per ton of dry bulk cargo in voyage charter contracts by the engagement of handymax bulkers between the port of Mersin in the Middle-East and Lagos Apapa port in West Africa increases by 25.83USD/ton. This indicates that variations in time over the period influenced freight rate for shipping per ton of dry bulk cargo in voyage charter contracts involving the engagement of handymax bulkers on the route to increase by an average of 25.83USD/ton each month.

The coefficient of determination which measures the explanatory power of the model is approximately 0.328. This implies that about 33% variations in the freight rates paid by shippers for shipping per ton of dry bulk cargo in voyage charter contracts by the engagement of handymax bulkers between the port of Mersin in the Middle-East and Lagos Apapa port during the crisis era is explained by changes in time over the 9 months period considered in the study.

The test of hypothesis which examines the significance of the extents of the increasing trend in freight rates paid to ship per ton of dry bulk cargo in voyage charter contracts on the route in the crisis era was done in subsequent section of this study. Fig. 3 below shows the chart of the trend lines showing variations in charter rates per ton of dry bulk cargo shipped relative to changes in time over the 9 months period in crisis period.

The result shown in Table 7 aboveindicates a *p*-value of 0.203083, t-score of 1.404048 and alpha-value of 0.05 for the trend of spot charter rates paid for shipping per ton of dry bulk cargo in voyage charter contracts by engaging handymax bulkers from the Middle East port of Mersin to West African port of Apapa in the pre-crisis era. Since the *p*-value is greater than the alpha-value (0.203083>0.05); the study accepts the sub-hypothesis H_{01}. The study infers that in the pre-crisis era, there is no significant increase in the trend of freight rate paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts involving the use of handymax bulkers between the port of Mersin in the Middle East and the Apapa port in Lagos West Africa.

The result on Table VI indicates a *p*-value of 0.107269, t-score of 1.846803 and alpha-value of 0.05 for the trend of freight paid for shipping per ton of dry bulk cargo in voyage charter contracts by engaging handymax bulkers from the Middle East port of Mersin to West African port of Apapa in the crisis era. Since the *p*-value is greater than the alpha-value (0.107269>0.05); the study accepts the sub-hypothesis H_{02}. The study infers that in the crisis era, there is no significant increase in the trend of freight rate paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts involving the use of handymax bulkers between the port of Mersin in the Middle East and the Apapa port in Lagos West Africa.

Table VII shows the result of the f-test carried out to determine the significances of the differences/variations in freight rates paid by shippers' on the route between the crisis and pre-crisis eras.

The result also indicates f-score of 277.2155 and f-critical value of 5.31766 for the differences/variation between the freight rates paid by shippers per ton of dry bulk cargo shipped in a voyage charter contract involving the use of handymax bulkers from the port of Mersin in the Middle east to the Apapa in Lagos West Africa during the pre-crisis and crisis eras. Since the f-score is greater than the f-critical (277.2155>5.31766), the study rejects the sub-hypothesis H_{03}. The study infers that, there is significant difference between the freight rate paid by shippers per ton of dry bulk cargo shipped in voyage charter contracts between the pre-crisis era and the crisis era on the sea route from the Mersin port in the Middle East to the Apapa port in West Africa. The freight paid for shipping per ton of dry bulk cargo shipped in voyage

charter contract in the crisis era is significantly higher by 497.777.

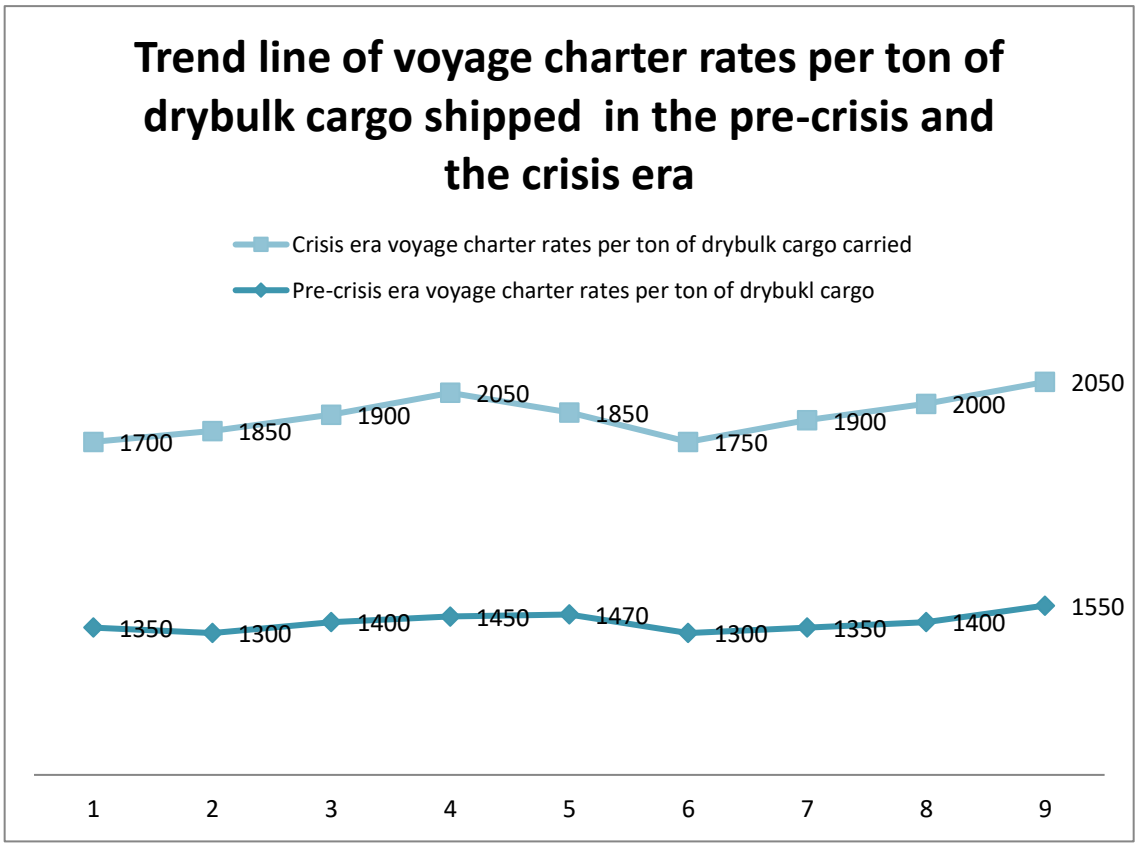

Fig. 3. Chart of the trend lines charter rates per ton of dry bulk cargo shipped relative to changes in time over the crisis period. Source: Author's calculation.

TABLE V. TEST OF HYPOTHESIS H01

Variable	Hypothesis	T-score.	*p*-value/sig.	Decision
Voyage charter rate for dry bulk trade	H_{01c}	1.404048	0.203083	Accept H_{01c}

Source: Author's calculation. Reject *null hypothesis if p-value<0.05; if p-value>0.05, Accept null hypothesis*

TABLE VI. TEST OF HYPOTHESIS H02

Variable	Hypothesis	T-score	*p*-value/sig.	Decision
Voyage charter rate for dry bulk trade	H_{02}	1.846803	0.107269	*Accept* H_{02c}

Source: Author's calculation. Reject null hypothesis if *p*-value<0.05; if *p*-value>0.05, Accept null hypothesis.

TABLE VII. TEST OF HYPOTHESIS H03

Variable	Hypothesis	F-score	F-critical	Decision
Voyage charter rate for dry bulk trade	H_{03c}	277.2155	5.317655	Reject H_{03c}

Source: Author's calculation. Reject *null hypothesis if F-cal> f-critical; Accept null hypotheses if F-cal.< F-critical.*

The result of Table VIII shows that between July 2024 and April 2025 period covered in the forecast, the shipping freight rates to be paid by shippers per ton in voyage charter contracts of affreightment between the regions is 1933.173USD/ton of dry bulk cargo. Since 1933.173USD>0; the study rejects null hypothesis H_{04}. The study infers that the expected shipping freight rates to be paid by shippers for shipping trade between the port of Mersin and West African port of Lagos relative to the trend of freight rates in the crisis era from July 2024 and October April 2025 is determinate.

TABLE VIII. TEST OF HYPOTHESIS H04

	Dry bulk voyage charter rate per ton	Decision: Accept H_{04} if average rate = 0
Average freight rate	1933.173USD	Reject H_{04}

Source: Prepared by the Author. Note: since freight average is > 0; we Reject $H_{04.}$

Table IX shows the forecasted value determined as freight rates for shipping per TEU of container shipping trade, Per FEU of container shipping trade and per ton of dry bulk cargo in voyage charter contracts involving the use on handymax bulkers on the Middle East to West Africa sea route between July 2024 to June 2025, covering a one year period in the crisis era. The result indicates that, the average freight rate for shipping per ton of dry bulk cargo in a voyage charter contract by engaging the services of handymax bulker on the route is expected to hit 1933.173USD/ton in the crisis continues up to June 2025.

TABLE IX. FORECASTED VALUES OF SHIPPING FREIGHT RATES BETWEEN THE PORT OF MERSIN AND WEST AFRICAN PORT OF LAGOS FOR THE PERIOD COVERING JULY 2024 TO APRIL 2025 IN THE CRISIS PERIOD

s/n	Month	Forecasted shipping freight rates
		Per ton of dry bulk cargo in voyage charter contract on a handymax bulker (USD/ton)
1	July 2024	1791.108
2	August 2024	1816.938
3	September 2024	1842.768
4	October 2024	1868.598
5	November 2024	1894.428
6	December 2024	1920.258
7	January 2025	1946.088
8	February 2024	1971.918
9	March 2025	1997.748
10	April 2025	2023.578
11	May 2025	2049.408
12	June 2025	2075.238
Average		**1933.173USD**

Source: Author's calculation.

The implications are that in the situation that the crisis continues, between July 2024 and June 2025, commodity prices, raw material prices, production cost, and overall living cost will continue to increase in the same direction as the increased transportation cost of shipping between the port of Mersin in the Middle East and Apapa port in Lagos West Africa. The tests of the significances of the increasing trend in freight rates charged by ship operators operating on the route in the pre-crisis and during the crisis era are investigated in section 4.3 on the test of hypotheses.

Discussion of Results and Policy Implications

The findings reveal a clear disruption in freight dynamics between Mersin (Middle East) and Apapa, Lagos (West Africa) during the crisis era. For example, the ANOVA results ($F = 277.22$, $p < 0.05$) confirm this difference is statistically significant. This means the Middle East crisis directly contributed to sharp freight rate increases on the route. The wider dispersion in the crisis era suggests heightened uncertainty in shipping markets. Operators likely incorporated risk premiums to offset war-related disruptions, insurance costs, and supply-chain bottlenecks.

Although the trends are upward, their lack of statistical significance indicates that the spike in freight rates was driven more by the crisis shock than by normal time-based escalation. From July 2024 to June 2025, freight rates are projected to average $1,933.17/ton, peaking above $2,075/ton by June 2025 if the crisis persists. This forecast implies sustained high costs that will continue to burden shippers, manufacturers, and consumers in West Africa. The economic implications of this is that increased freight costs transfer directly into higher import prices, raw material costs, and production expenses. This cost-push inflation mechanism indicates that the Middle East crisis is not just a geopolitical issue but also an economic stressor for West Africa.

The results carry significant policy lessons for Nigeria, West Africa, and trade partners. For example, the findings of the study suggests the need for development of trade policies to cost mitigation. Governments should explore temporary tariff or tax reductions on imported raw materials to cushion manufacturers against rising freight charges. Subsidizing key industrial inputs could prevent runaway inflation in essential goods. There is also the need for policies requiring Nigeria and ECOWAS states to strengthen regional shipping capacity (e.g., encourage indigenous bulk carrier operations) to reduce reliance on foreign charterers who amplify risk premiums during crises. Investment in logistics infrastructure (deep seaports, storage, inland waterways) can reduce congestion costs and partly offset higher freight rates. The findings of the study suggests the need for establishing strategic reserves for critical bulk commodities (e.g., grains, fertilizer inputs, cement raw materials) can help stabilize supply when freight costs spike. Incentives for domestic production and processing will reduce dependence on vulnerable long-distance imports. Shippers and governments should adopt hedging strategies such as freight derivatives and cargo insurance pooling to spread risks of crisis-induced freight volatility.

The findings of the study also suggests the need for policies aimed at regional and international cooperation to address the highlighted challenges. For example, ECOWAS states should collaborate on joint freight negotiations with carriers to leverage economies of scale. Nigeria should work with global trade partners (e.g., Middle East suppliers) to establish bilateral freight stabilization agreements during crisis periods.

The findings of the study also have implications on inflation management in Nigeria and West Africa. Since freight rates are a major driver of imported inflation, monetary and fiscal policies should anticipate supply-side shocks. This includes targeted subsidies, price monitoring mechanisms, and coordinated inflation-control measures.

V. CONCLUSION

(i) In the pre-crisis era, there is no significant increase in the trend of freight rate paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts involving the use of handymax bulkers between the port of Mersin in the Middle East and the Apapa port in Lagos West Africa.

(ii) There is no significant increase in the trend of freight rate paid by shippers to ship per ton of dry bulk cargo in voyage charter contracts involving the use of handymax bulkers between the port of Mersin in the Middle East and the Apapa port in Lagos West Africa.

(i) There is significant difference between the freight rate paid by shippers per ton of dry bulk cargo shipped in voyage charter contracts between the pre-crisis era and the crisis era on the sea route from the Mersin port in the Middle East to the Apapa port in West Africa. The freight paid for shipping per ton of dry bulk cargo shipped in voyage charter contract in the crisis era is significantly higher by 497.777.

(ii) The expected shipping freight rates to be paid by shippers for shipping trade between the port of Mersin and West African port of Lagos relative to the trend of freight rates in the crisis era from July 2024 and October April 2025 is determinate.

Recommendation: The significantly increasing trend in freight rate for shipping per ton of dry bulk cargo in voyage charter contracts between the port of Mersin and Apapa port in the crisis era suggesting that production cost in the West African states will witness rising trend as result. This is because most bulk cargoes and used as raw materials for further production. To address this, it is recommended that the authorities in Nigeria should focus of lowering production/manufacturing taxes in order to achieve a trade-off between it and the rising shipping cost of dry bulk raw materials. This will help to cushion the effects of rising shipping cost of dry bulk raw materials on production cost and stabilize the production cost in the local economy.

Suggestion for Further Research: It is suggested that further research should be carried out on the topic: "Resilience Strategies for West African Maritime Trade: Assessing the Role of Regional Shipping Capacity and Import Substitution in Mitigating Crisis-Induced Freight Volatility".

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

TCN and CE conceived and wrote the introduction. YNB and JFO did the literature review. IIE and LO did the methodology section. COA and EGCE wrote the discussion of results of the study and wrote the conclusion and recommendation. all authors had approved the final version.

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