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# Measuring the Impact of Covid-19 Pandemic and the Russian Ukrainian War on Dry Bulk Freight Market

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## ABSTRACT

***Purpose:*** *Covid-19 pandemic stands as a monumental disaster in human history, reshaping the global landscape and profoundly impacting various sectors of human life, most notably the world economy. The repercussions of the pandemic were felt acutely, resulting in significant disruptions marked by the variation of demand and supply and the effect on the supply chain. Furthermore, the conflict arising from Russia's invasion of Ukraine instigated a new global economic crisis, particularly in Europe. This war exerted a substantial toll on global economic growth, further compounded by the lingering consequences of Covid-19 pandemic.*

***Approach/Design/Methodology:*** *This research aims to investigate and analyze the impacts of the Russian Ukrainian war and Covid-19 pandemic; on the dry bulk freight market within the shipping industry during the period from 2019 to 2022. An electronic questionnaire was conducted, 472 samples were analyzed using SPSS. The study encompasses ship owners, ship operators, charterers, shipbrokers, investors engaged in the shipping business specially the dry cargos, international traders, importers, exporters, and governmental entities.*

***Findings:*** *The results show that Covid-19 pandemic had a negative impact on the bulk freight market as the freight decreased all over the world; and the Russian Ukrainian war had a negative impact on the dry bulk freight market as the freight increases suddenly all over the world.*

**Key-words:**
*Covid-19, Russian Ukrainian War, Dry Bulk Freight Market.*

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## INTRODUCTION

Maritime transport is responsible for ninety percent of total worldwide trade volume, which is considered the lifeline of the worldwide economy. Moreover, there could be no trade between the continents of the world without maritime transportation in terms of raw materials, food or manufactured items will be feasible (UNCTAD, 2018). The shipping industry consists of four interlinked shipping markets, which can be categorized as follows: The freight market, second-hand vessels market, new building market, and vessel demolition market. The freight market has sectors like tankers, passenger, containers, heavy lift, and dry Bulk. As it can be affected by supply and demand, world economy status, international maritime trading, and fuel prices also it can be affected by the other shipping industry elements.

The shipping sector is divided into various separate market niches, each with its own traits, levels of competition, and levels of competitiveness. Commodities are traded internationally, and there are many distinct types of commodities that are traded. It is impossible to overestimate the importance of both wet and dry bulk commodities. Dry bulk commodities make up over 66% of all seaborne trade globally when the volume of cargo transported by sea is totaled, and as of 2015, dry bulk cargo still accounts for around two-thirds of all seaborne trade internationally. The estimated four billion tons of bulk dry cargo that are shipped by sea serve as a reminder of the sector's importance and the fact that without it, there would be no viable global trade or industry. Dry bulk transportation is one of the global industries with the highest levels of competitiveness (Abrahamsson, 2019).

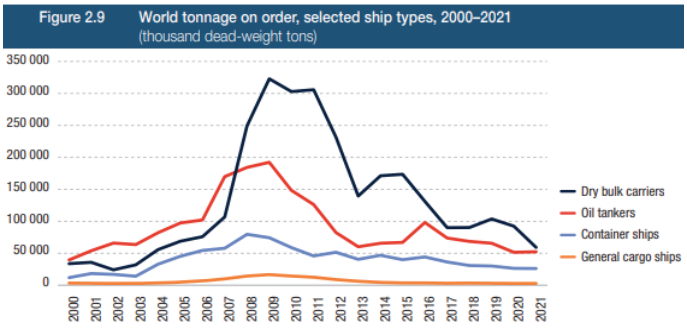


Fig. 1. World tonnage on order selected by ship types from 2000 to 2021.
Source: UNCTAD, 2021.

About 71% of the world's shipping is made up of dry bulk, with the second largest segment oil taking only 17%. Additionally, the Baltic Dry Index (BDI), which measures the performance of the dry bulk shipping market, is frequently employed. The BDI also functions as a global economic indicator. A high BDI value is an indicator of a strong economic climate in both the dry bulk shipping sector and the global market since dry bulk shipping accounts for 60% of all worldwide traffic in goods (Xu et al., 2021). Furthermore, because worldwide demand drives the shipping industry, it is susceptible to a variety of unforeseen events or shocks, which results in significant volatility and dangers. Volatility also increases when global problems arise. It is obvious that there are greater dangers associated with global difficulties in the dry bulk shipping business. Consequently, it is crucial to anticipate market risk during a global incident (Cho et al., 2020).

## LITERATURE REVIEW

In the early 2020, seaborne trade suffered from Covid-19 pandemic; freight rates in shipping were severely impacted and continued to be influenced by how supply capacity was managed. Dry bulk freight costs were impacted by the shock of low demand, mainly from China, due to the outbreak of the coronavirus. During the first six months of 2020, the market for dry bulk freight rates were influenced by supply and demand mismatches, which were exacerbated by the impact of the pandemic and resulted in considerable swings, particularly among larger vessels. Overcapacity was already affecting the dry bulk market, since supply growth had been outpacing demand for several years, as previously discussed.

This worsened by the negative demand shock of the pandemic, which put downward pressure on shipping freight rates (UNCTAD, 2021), and the noticeable rise in global oil prices, which reached 130 per barrel in March 2022, as well as the 40% increase in basic food commodities, particularly wheat, to reach 396 dollars per ton, and the 21% increase in corn prices as a result of the disruption in agricultural export movement in Ukraine, due to an increase in the insurance premiums required for shipping goods, shipment delays, and port congestion, the Black Sea has been classified as a risky area because marine fuel prices are tied to oil prices, ship charter fees have increased by almost 20%. Dong (2021) mentioned the impact of Covid-19 on Chinese shipping firms and government-promoted countermeasures, as well as an examination of how this pandemic affects shipping company operations and recommendations for them. Furthermore, the impact of this outbreak on China and other nations is an effect on a quickly shifting global supply chain, which is why so many countries are implicated and in such a

tricky situation. Besides, when Covid-19 occurred, shipping businesses encountered greater difficulties. Then, inspired by and related to the similarities of the 2008 economic crisis, the attention shifted to whether and how financial flexibility could affect shipping businesses and their performance following a pandemic.

Ho et al. (2021) used monthly panel data from 13 Chinese provinces (cities) from December 2019 to August 2020 to investigate the impact of Covid-19 on Chinese freight transport evidence, and analyzed the overall impact of the epidemic on China's freight transport from a macro-level perspective, contributing to the pandemic literature, the empirical findings filled gaps in the Covid-19 transport literature by supporting new consumption behavior during the Covid-19 outbreak, and the researchers used the multi-region demand model to examine the impact of Covid-19 on China's freight transport. However, the findings revealed that Covid-19 has a positive impact on road freight transport turnover; this effect is stronger when there are more verified Covid-19 instances and less gasoline production, and vice versa; moreover, these findings were robust when various dependents and independents were used.

Worldwide, Covid-19's economic effects have had an impact on a wide range of sectors and services. The slowdown in the global GDP, the drop in oil prices, and the disruptions to the supply chain are all indicators of how serious this epidemic is. Examining the trade activities of the top fifteen nations also demonstrates how Covid-19 has affected global commerce. When compared to the first quarter of 2018, the trading density dropped from 0.833 to 0.429. Every element of the global economy can clearly see how Covid-19 has reduced commercial activity (Xu et al., 2021).

International trade naturally decreased by a cliff's worth of percentage points because of the enormous hit to the world economy. The maritime sector took the heaviest hit from this health epidemic as it was the principal carrier of global trade. Liner firms canceled trips to save money when there was no demand for transportation (Marobhe, 2021). Dry bulk is shipped by land and rail to ports. Covid-19 outbreak-related initiatives had a substantial impact on every dry bulk trade mechanism throughout the pandemic. This condition had a significant impact on international sea transportation trade since governments banned transport connections with other nations based on physical distance restrictions (Wang et al., 2022). Based on the previous studies that were illustrated, the study can assume the hypothesis of the study, which is that there is a statistically negative relationship between Covid-19 on dry bulk freight market.

As Russia invaded Ukraine in 2022, geopolitical tensions between the West and Russia rose, lowering global growth expectations because it was uncertain how the battle would affect the global supply chain. The global economy is affected by the sanctions that the Western nations have placed on Russia. Conflict has triggered shocks in the trade, energy, and commodity markets as well as an increase in the price of commodities, energy, food which has resulted in worldwide inflation in many nations (Balbaa et al., 2022).

Food supplies such as wheat, corn, and edible oils have been affected, as has the global consumer products industry (sunflower oil). A quarter of all exports from the area come from the export of wheat, which is one of the top exports from both Ukraine and Russia. While Ukraine is the only country that supplies most of China's corn needs, these two economies provide over 70% of the grain needed by nations like Turkey and Egypt. Approximately 50% of the total global export of sunflower oil is said to come from Ukraine, making it the largest exporter worldwide (Prakasa et al., 2022). These costs of the products, as well as those of other agricultural products that rely on those crops as raw materials, have increased dramatically due to a lack of them on the world market. According to short-term perspective research released by the European Commission, most EU countries are ready for increased pressure on the agri-food business. For instance, it is anticipated that regional milk output will diminish by about 1.5% soon, which will result in a decrease in products like cheese, butter, and other everyday items. Because some raw materials to produce feeds are imported from both Ukraine and Russia, the poultry farming industry is also anticipated to be negatively impacted (Orhan, 2022).

Rožić et al. (2022) investigated the fluctuating freight rates in the maritime container business because of Russia's invasion of Ukraine. Data from scholarly and scientific journals, as well as investigations by the IMO, the European Union, and the United Nations, served as the foundation for the analysis. These enormous rises in freight costs in the maritime container sector, which also have a considerable negative impact on supply chains, put the recovery of the global economy in jeopardy. The expenses of production and the prices of the goods that are dependent on the services provided by this company will be impacted by a rise in freight rates in this market. As was previously said, it is estimated that in 2023 the increase in consumer product prices because of the change in freight rates will be 1.5%. For the least developed nations

MRT
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and islands, this is particularly important. There, the anticipated price rises for consumer items brought on by higher freight costs might reach approximately 9% in 2023. The distance between these nations and the industrialized nations serves as an additional obstacle for these nations, and efforts should be made to lessen this barrier. The European Union has already experienced an ongoing rise in consumer goods prices, which began when the pandemic initial spread and was further exacerbated by Russia's invasion of Ukraine.

Because of the huge disruptions that this invasion—which, tragically, is still causing—has caused, it is anticipated that the process of returning to the pre-crisis scenario would be exceedingly challenging. Increased economies are having to contend with inflationary pressures, financial market imbalances, and problems importing goods from the Russian and Ukrainian markets. The pandemic's disruptions have had an impact on both supply and demand, which emphasizes the need for having a lot of flexibility to lower the dangers from the epidemic and balance demand. Freight prices have gone up since the pandemic initially began but their largest development dynamics were visible in the period right after the beginning of the Russian invasion of Ukraine. Based on prior experiences with crisis situations, it is projected that the disruptions may hinder the dynamics of the recovery of some national economies and will have a higher impact on smaller economies (Rožić et al., 2022).

Allam et al. (2022) clarified that uncertainty has grown because of the ongoing conflict between Russia and Ukraine at a time when the global economy is recovering from the Covid-19 outbreak. The conflict had a significant effect on the tanker market because Russia is a major player in the oil and gas industry, but the impact on the dry bulk industry was less significant because of the small contributions made by both Russia and Ukraine to the global dry bulk trade. Based on the previous studies that were illustrated, the study can assume its hypothesis, which is that there is a statistically negative relationship between the Russian-Ukrainian war on dry bulk freight market.

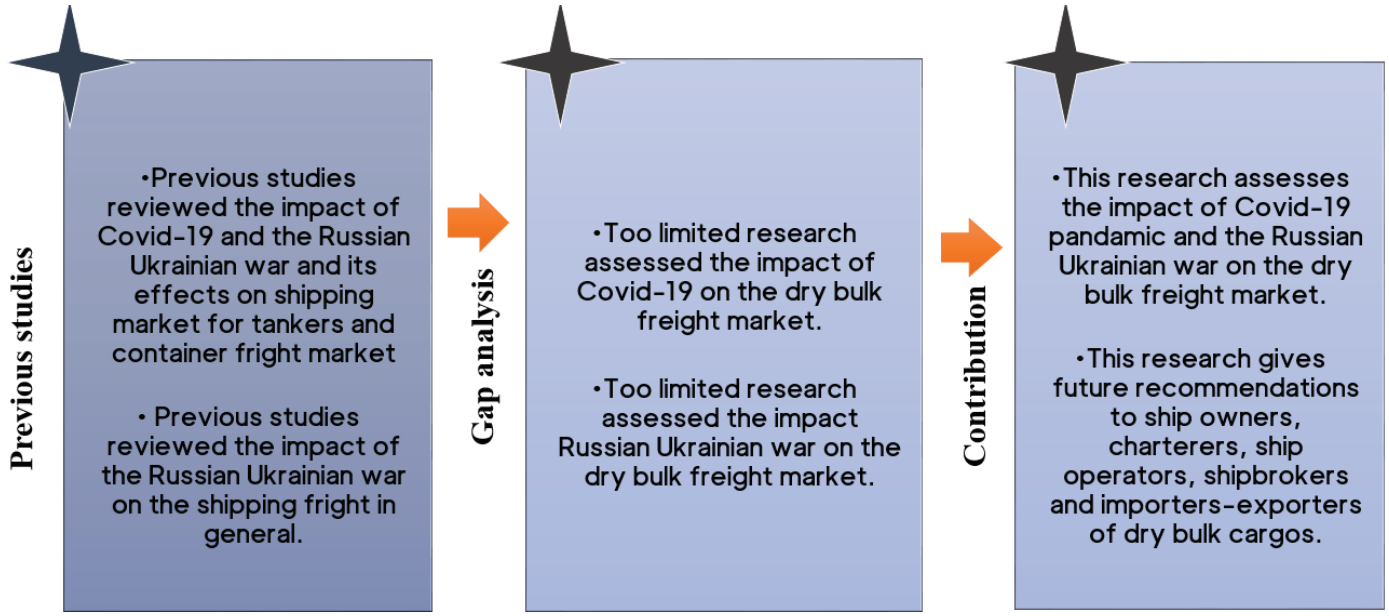


Fig. 2. Research gap and contribution

## Statement of the Problem

Covid-19 outbreak is a disaster in human history, which changed the world system and affected many life sectors such as the world economic sector, which was seriously damaged due to fluctuation and imbalance of demand and supply. Ocean freight is an important means of transporting goods and commodities globally, the year of Covid-19 and its aftermath revealed a wide range of challenges for this type of transportation, such as the prohibitive cost of sea freight, which led to an increase in the prices of goods for consumers. The index of Panamax and capsize dry bulk carriers decreased by 16.92%, 24.56%, and 38.94%, respectively, when the freight rate performance in 2019 and 2020 before and after the Covid-19 pandemic was ???. In addition, the invasion of Ukraine by Russia set off a fresh global fiscal crisis in Europe and that the consequences of the Covid-19 pandemic, which slowed down economies around the world by imposing port closures, had a substantial influence on global growth, and that Russia's military actions in Ukraine added to the disruption of the world supply chain. Figure (3) depicts the oscillations in the bulk freight industry.

MRT
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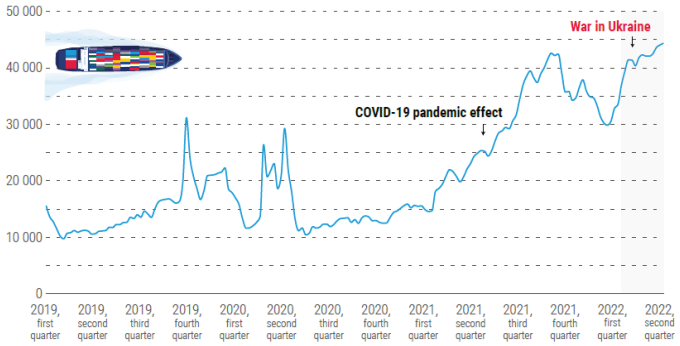


Fig. 3. Bulk freight market fluctuations from 2019 to 2022.
Reference: Clarksons Research Studies, 2022.

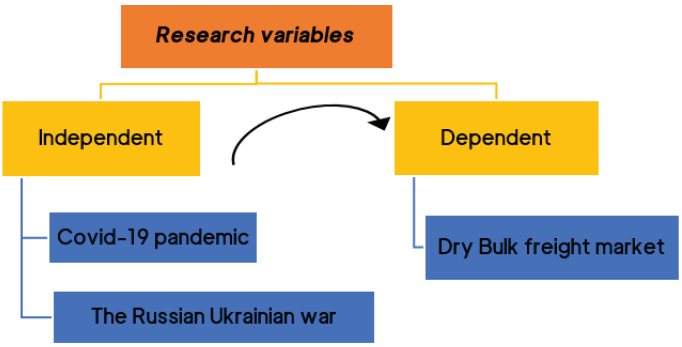


Fig. 4. Research variables
Source: Author

## Research Aims and Objectives

This research aims to find out the effect of Covid-19 pandemic and the Russian Ukrainian war on the dry bulk freight market, ship owners, ship operators, charterers, shipbrokers, investors in shipping business, international traders, importers and exporters of the dry bulk cargos and the governments. In addition, it aims to find solutions so as to mitigate effects of such things as pandemic in the future. Research objectives are to investigate the effect of Covid-19 pandemic and the Russian Ukrainian war on the dry bulk freight market.

## Research Hypothesis

- Covid-19 pandemic has a negative impact on the dry bulk freight market.
- Russian Ukrainian war has a negative impact on the dry bulk freight market.

# RESEARCH METHODOLOGY

This research follows a deductive approach through using an electronic questionnaire that was conducted by using interview and analyzed by using SPSS Software. The questionnaire helps to find out the impact of Covid-19 pandemic and the war between Russia and Ukraine on the dry bulk freight market. Research variables can be illustrated as in Figure 4.

The entire set of cases from which the sample is drawn is referred to as the population. The researcher selects the appropriate sample that best addresses his research aims in accordance with the objectives of the study. Dry bulk ship owners, operators, brokers, charterers, importers, and exporters make up the sample frame of the research. The exact number of stakeholders could not be identified. Thus, the researcher used other theories to determine the sample size. Helal (2020) identified that using ratio of variables to 15 participants, as this research has only three variables, 45 participants could be enough to calculate this research. However, the researchers found that they can distribute more than this number for the validity of the results of the research.

# STATISTICAL DATA ANALYSIS

The statistical package for social sciences (SPSS V28) was utilized for both descriptive and inferential statistics, and Smart PLS 3.2.9 was used for (SEM-PLS) modeling.

## Data Preliminary Examination

In quantitative research, this analysis is crucial. According to Sue and Ritter (2012), mistakes and incomplete responses should be removed from the gathered data by screening and cleaning. The inspection is crucial to guarantee that the results of the statistical analysis are accurate, even when remedial measures are not usually required. According to Hair et al. (2017), it is important to examine the problems with the data that were gathered, such as odd answer patterns, disengaged respondents, missing data, outliers, data distribution, and common technique bias. Therefore, SPSS is used to evaluate those major data difficulties in the following steps.

MRT
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## Outliers

Outliers, which happen when one or more responses were noticeably different from other responses, are a common illustration of illogical answers (Sekaran and Bougie, 2016). Outliers are cases that have anomalous values (either too low or too high) that set them apart from other examples. Outliers have the potential to skew statistical tests (Field, 2013), change the distribution of the data and undermine the validity of the data. In conclusion, outliers have an impact on the normalcy of data distribution, hence it was critical to check the dataset for outliers before submitting it to a parametric analysis. In the results the researchers achieved there is no outliers. As such, it is essential to identify and manage outliers. Finding the cases with variable values that are either extremely high or low is known as univariate identification of outliers. Minimum and maximum values can be used to identify this kind of anomaly (Sarstedt and Mooi, 2014).

## Missing Data

Missing data are a widespread problem in behavioral, marketing, and social science studies (Hair et al., 2017). When researchers do not have missing data issues, it is sporadic. Also, missing data occur when participants leave one or more questionnaire questions unanswered (Sekaran and Bougie, 2016). Moreover, missing data are an issue since they reduce the quantity of data accessible for analysis and may lead to incorrect conclusions, which adds to bias in the results (Hair et al., 2014). Because the SEM-PLS approach is not designed to examine partial data, the impact of missing data is overly critical when using it for data analysis. Furthermore, when the sample contains missing data, the Bootstrapping function, which is used in SmartPLS to evaluate the connections between constructs, cannot be computed. The data gathered for this inquiry contain no missing values.

## Normality

Field (2013) defines normality as the statistical distribution of a single variable. In the best-case scenario, Data follow a bell-shaped curve to show a normal distribution (Hair et al., 2016). The normality test is one of the first steps in ensuring that the data gathered are suitable for statistical data analysis. In other words, non-normally distributed data may have an impact on the reliability and validity of statistical data analysis. Researchers such as Kline (2016) proposed two values to quantify the form of data distribution: skewness and kurtosis. Skewness is a measure of the symmetry of data distribution, whereas kurtosis is a measure of the height of the distribution.

Positive skewness values indicate a left-skewed distribution, whereas negative Skewness values indicate a right-skewed distribution. Positive kurtosis implies a too-peaked distribution, while negative kurtosis indicates a too-flat distribution (Kline, 2016). Skewness values of -2 to +2 and kurtosis values of -7 to +7 are regarded acceptable for demonstrating normal distribution (Byrne 2016). Results show the normality test results, which show that the Skewness and kurtosis values for the model elements were within the required range.

## Structural Equation Modeling

In this research, the model was examined using structural equation modeling (SEM) by the researchers. The SEM is a generic approach for determining the connection between exogenous and endogenous variables. The partial least squares SEM analysis (PLS-SEM) is employed in this investigation. PLS is a model for structural equations (SEM) method like covariance-based SEM. This kind of model analysis investigates both the measurement model and the path at the same time, which assists in the construction of more realistic assumptions (Hair et al., 2017). As a result, the focus of this study is on investigating the prediction of the variable, with an emphasis on explaining the endogenous characteristics. The PLS-SEM analysis findings are shown in the subsections that follow. The preceding sections described SEM assumptions and how they were satisfied. The fourth stage includes estimating the PLS path model, and the 5$^{th}$ stage involves assessing the outputs of the measurement model. The sixth step entails assessing the consequences of the structural model. The final stage is to make final interpretations of the results and conclusions.

### *Stage One: Specifying the structural model*

The structural model, often known as the inner model, is built at this stage. The structural model displays the connections of the variables. The structural model is designed using comprehensive literature research, and the arrangement of the components must be based on theory, logic, or observations (Hair et al., 2017). The causal relationship is the relationship in the structural model of this study. Causal links or relationships are those that exist between two elements and predict the other.

### *Stage Two: Specifying the measurement models*

The outer model, also known as the measuring model, specifies the relationships between the constructs and their variables. Measuring models can be reflective

MRT
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or formative. Reflective measurement approaches are frequently used in social science research. The variables in these models reflect the impact of the underlying concept, meaning that the causal effect is launched from the construct to its variables. Because all variables measuring the same construct are caused by the same construct, the correlation between them must be strong. Furthermore, all the variables used to measure a certain construct must be interchangeable, such that removing one of the variables does not affect the meaning of the construct if the reliability is enough (Hair et al., 2017). This research is focused with a model of reflecting measurement.

## *Stage Three: Data Collection and Examination*

After the measurement models have been established, data collection and analysis are necessary. This stage comprises defining the target population and collecting the required data using an appropriate sampling strategy. The information gathered was utilized to validate the structural and measurement models.

## *Stage Four: Path Model Estimation*

Data are utilized to estimate the path model after it has been collected and examined. This stage necessitates the selection of parameter values based on a knowledge of the PLS-SEM method and its statistical properties. The three structural model weighing schemes are the centroid weighting scheme, the factor weighting system and the route weighing scheme are two schemes. Although the results of using both approaches are not statistically different, the route weighing strategy is suggested since it produces the best R2 value for the endogenous construct. In addition, the path weighing method applies to all path model descriptions and estimations (Hair et al., 2017).

## *Stage Five: Assessing the Measurement Model*

Assessing the internal consistency reliability is necessary for evaluating the reflective measurement models in PLS-SEM, there are two types of validity: convergent validity and discriminant validity. After establishing the reliability and validity of the measurement model, the structural model is reviewed. The subsections that follow explore the reliability and validity of the measurement methodology.

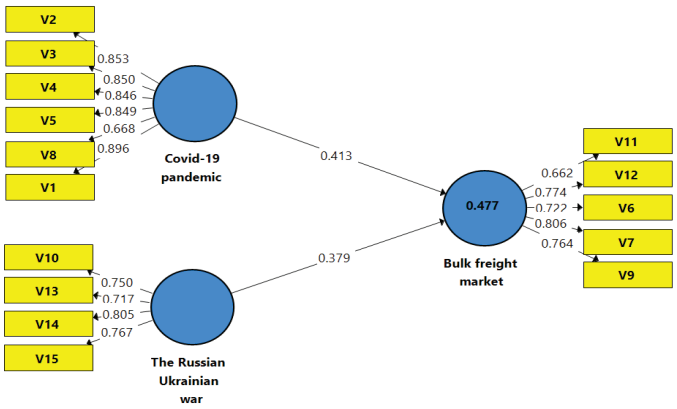


Fig. 5. Measurement model assessment

## *Stage Six: Assessing the structural model*

After determining the validity and reliability of the measurement model, it is time to evaluate the structural model. This entails investigating the predictive capability of the model as well as the relationships between the components. The structural model, also known as the inner model, describes the interactions between the structures and its evaluation comprises assessing the links between the constructs of the model (Henseler and Sarstedt, 2013; Henseler et al., 2009).

## Internal Consistency Reliability

Internal consistency dependability investigates whether all the indicators linked with a concept truly measure it (Pallant, 2010). Internal consistency may be measured in a variety of ways. Cronbach's alpha is the most often used statistical metric for this purpose. Cronbach's alpha calculates the average correlation between all indicators that belong to the same construct.

Table 1: Analysis of Measurement Model Reliability

| Construct | Cronbach's Alpha | rho_A | Composite Reliability | Remark |
|---|---|---|---|---|
| Bulk freight market | 0.8 | 0.803 | 0.863 | Reliability attained |
| Covid-19 pandemic | 0.908 | 0.915 | 0.93 | |
| The Russian Ukrainian war | 0.758 | 0.761 | 0.846 | |

Despite its popularity, Cronbach's alpha is criticized for presuming that all indicators have equal outer loadings and that the number of indicators influences Cronbach's alpha calculation in that fewer items result in a lower value, particularly on scales with items less than ten. Due to the limits of Cronbach's alpha, researchers are advised to use other metrics of internal

MRT
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consistency, such as rho A and composite reliability (CR), which evaluate internal consistency while taking into consideration the fact that each indication has a different outer loading. The accepted value of reliability is 0.7; however, values more than 0.6 are also accepted (Fornell and Larcker, 1981; Taber, 2018). The results in Table 2 show that all constructs had reliability scores greater than 0.6.

## Convergent Validity

Convergent validity evaluates the link between variables measuring the same construct. The item outer loadings and the extracted average variance (AVE) are frequently used to test the convergent validity of reflective measurement models.

Table 2: Convergent Validity Analysis (AVE)

| Construct | Average Variance Extracted (AVE) | Remark |
|---|---|---|
| Bulk freight market | 0.558 | Convergent validity attained through AVE values |
| Covid-19 pandemic | 0.689 | |
| The Russian Ukrainian war | 0.578 | |

Common statistics used to prove convergent validity is the AVE, which reflects the grand meaning of the squared loadings of the indicators measuring a concept. AVE values greater than 0.5 are acknowledged. The convergent validity in Table 2 was obtained using the prior principles. Another indicator of dependability is item loading, the outer loadings needed are 0.70 (Hair et al., 2014). The requirement for an outside loading of at least 0.70, since the square of the outside loadings of a standardized item - also known as communality - reveals the degree of variation shared by the build and the item. The square of 0.70 will equal 0.50. This implies that if an item has an outside loading of 0.70, the construct may explain half of the variance in the item. However, the authors indicated that if the outer loading is between 0.4 and 0.7, the influence of indication deletion on internal consistency reliability should be investigated in this study. If deletion does not raise the measure(s) above the threshold, the reflecting indication must remain in place.

## Validity of Discrimination

After establishing convergent validity, discriminant validity is investigated, which examines how much a construct differs from other constructs. Typically, discriminant validity is determined by evaluating the Fornell-Larcker criterion, which ensures that the indicator only loads heavily on the concept to which it is linked. An indication is often loaded to many constructs; nevertheless, the indicator's loading on its associated construct must be larger than its correlation with other constructs.

Table 3: Validity of Discrimination (Fornell-Larcker criterion)

| | Bulk freight market | Covid-19 pandemic | The Russian Ukrainian war |
|---|---|---|---|
| Bulk freight market | **0.747** | | |
| Covid-19 pandemic | 0.61 | **0.83** | |
| The Russian Ukrainian war | 0.594 | 0.52 | **0.761** |
| **Remark:** *Discriminant validity through Fornell-Larcker criterion attained* | | | |

The square root of AVE is compared to the correlations of the concept when employing the Fornell-Larcker criterion. The AVE square root of the construct ought to be greater than any of its connections with other constructs. In accordance with these guidelines, the discriminant validity was built because, as shown in Table 3, The AVE square root of the construct values were bigger than any of its correlations with other constructs. The Hetrotrait-Monotrait ratio (HTMT) is another method for determining discriminant validity. Hair et al. (2017) define HTMT as "the ratio of between-trait correlations to within-trait correlations" (page number). Its value must be less than one. The discriminant validity was built using these guidelines because all the constructs have HTMT values less than the stated threshold. Table 4 presents the HTMT values of the Constructs.

Table 4: Discriminant Validity (HTMT Ratio)

| | Bulk freight market | Covid-19 pandemic | The Russian Ukrainian war |
|---|---|---|---|
| Bulk freight market | | | |
| Covid-19 pandemic | 0.7 | | |
| The Russian Ukrainian war | 0.759 | 0.624 | |
| **Remark:** *Discriminant validity through HTMT criterion attained* | | | |

## Descriptive Statistics

Following the determination of the reliability and validity of the variables, it is necessary to offer some descriptive statistics for the selected constructs, as shown in Table 5. In the same table, the mean (M) and standard deviation (SD) were computed and reported. The independent variable of the descriptive statistics

MRT
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*"Covid-19 pandemic"* was *(M=4.425,SD=0.709)*, for the other independent variable *"The Russian Ukrainian war"* were *(M=4.545,SD=0.508)*, and for the dependent variable *"Bulk freight market"* were *(M=4.534,SD=0.511)*.

Table 5: Selected Variables Descriptive Statistics

| Construct | N | Mean | Std. Deviation |
|---|---|---|---|
| Covid-19 pandemic | 472 | 4.4251 | 0.70905 |
| The Russian Ukrainian war | 472 | 4.5445 | 0.50751 |
| Bulk freight market | 472 | 4.5339 | 0.51148 |

## Pearson Multiple Correlations

To examine correlations between constructs, Pearson's correlation (r) was utilized. Pearson's correlation is a popular method for validating the strength of an existing linear relationship between variables, and it evaluates the linear relationship between quantitative variables. This coefficient represents the degree of linear dependency between two quantitative variables and spans from -1 to 1.

If it is negative, one variable reduces while the other increases; if it is positive, one variable grows while the other decreases. The following r values are distributed: r = 0-0.3, low correlation; r = 0.3-0.7, moderate correlation; and r = 0.7-1, high or strong correlation. Correlation coefficients denoted with three stars (***) were statistically significant at 0.001, i.e. 99.9% confidence level, correlation coefficients marked with two stars (**) were significant at 0.01, indicating 99% confidence level, coefficients marked with one star (*) were significant at 0.05, indicating 95% confidence level, and coefficients NOT marked were not significant at 0.05, indicating P-values greater than 0.05.

Table 6: Correlation between the Main Variables

| | | Covid-19 pandemic | The Russian Ukrainian war | Bulk freight market |
|---|---|---|---|---|
| **Covid-19 pandemic** | Pearson Correlation | -- | | |
| | N | 472 | | |
| **The Russian Ukrainian war** | Pearson Correlation | .524*** | -- | |
| | Sig. (2-tailed) | 0.000 | | |
| | N | 472 | 472 | |
| **Bulk freight market** | Pearson Correlation | .598*** | .595*** | -- |
| | Sig. (2-tailed) | 0.000 | 0.000 | |
| | N | 472 | 472 | 472 |

Table 6 displays the Pearson correlation coefficient matrix for the major variables. The findings demonstrate a significant moderate association between Covid-19 epidemic and the Russian-Ukrainian conflict since (r(472)=.524, P0.001). Furthermore, since (r(472) =.598,P0.001), there is a significant moderate association between Covid-19 epidemic and the Bulk freight market. Moreover, there is a significant moderate relationship between the Russian Ukrainian war and Bulk freight market since *(r(472)= .595,P<0.001)*.

Table 7: Criteria of Structural Model Assessment

| Criteria | Guidelines | References |
|---|---|---|
| Collinearity | VIF < 5 | Hair et al., 2017 |
| Path coefficients | Significance: p ≤ 0.05 | Hair et al., 2017 |
| Coefficient of determination ($R^2$) | $R^2$ < 0.1, Negligible<br>$R^2$ >= 0.1, Adequate | Falk and Miller, 1992 |
| Effect Size ($f^2$) | $f^2$ between 0.02-0.14, small;<br>$f^2$ between 0.15-0.34, moderate;<br>$f^2$ ≥ 0.35, High. | Cohen, (1988 |
| Cross-validated redundancy ($Q^2$) | Predictive Relevance Using blindfolding $Q^2$ > 0 | Chin, 1998 |
| Goodness of Fit (GoF) | GoF less than 0.1, no fit; GoF between 0.1 to 0.25, small; GoF between 0.25 to 0.36, medium; GoF greater than 0.36, large. | Wetzels, et al., 2009 |

Researchers recommended collinearity, path coefficients, coefficient of determination (R2), Effect Size (f2), and Predictive Relevance (Q2) for evaluating and presenting the structural model (Hair et al., 2017). Review studies on PLS-SEM (Ringle and Straub, 2012) and many others observed that when studying the structural model, researchers often report those criteria. The results of such evaluations are reported in the following subsections based on those criteria and standards.

MRT
ISSN 2812-5622
http://dx.doi.org/10.21622/MRT.2024.03.1.833

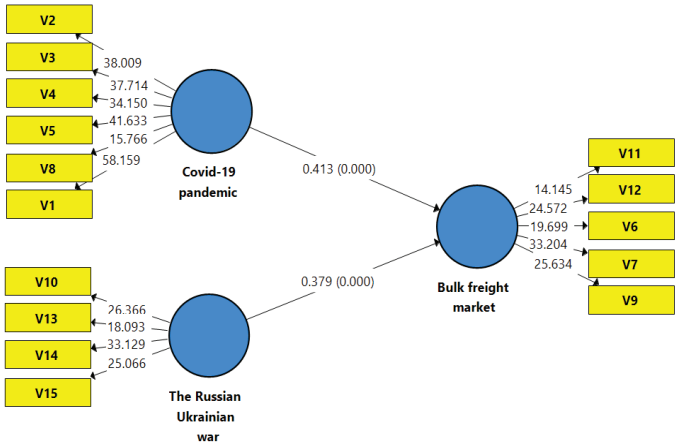


Fig. 6. Structural model for the research hypotheses

## Collinearity

High correlation between two constructs is known as collinearity, and it can lead to problems with interpretation. Collinearity occurs when more than two conceptions are involved.

Table 8: Variance Inflation Factor

| Path | VIF | Remark |
|---|---|---|
| Covid-19 pandemic -> Bulk freight market | 1.37 | NO collinearity problem exists |
| The Russian Ukrainian war -> Bulk freight market | 1.37 | |

Collinearity may be investigated using the variance inflation factor (VIF). It is computed by dividing one by tolerance and relates to the variance described by one independent construct that the other independent constructs do not explain. A VIF value of Five or higher indicates a high collinearity. All VIF values in Table 8 were below the cut-off point; providing evidence that the collinearity between independent constructs has no existence (Hair et al., 2017).

## Path Coefficients

Path coefficients are estimates of the relationships between the components of the model. These coefficients vary from +1 to -1, with +1 representing a strong positive association, zero representing a weak or non-existent link, and -1 representing a large negative relationship (Garson, 2016). When evaluating PLS paths, research should provide path coefficients in addition to the significance level, t-value, and p-value. To establish the signs, magnitude, and statistical significance of the estimated route coefficients between the constructs, hypothesis testing was performed. Path coefficients with higher values suggest a greater association between the predictor and the predicted variables. The significance of the alleged correlations was established by calculating the significance of the p-values for each path with a p-value threshold of 0.05, p 0.01 being used to measure the importance of the path coefficient estimations (Henseler et al., 2009). Later, conclusions for all hypotheses were made based on the significance of p-values at the previously specified conventional levels. Table 9 shows the p-values, hypothesis inferred, and confidence level for each estimate.

Table 9: Hypothesis Testing Results

| *Path* | *B* | *t-value* | *P-value* | *Ninety-five percent Bias-Corrected CI* | | Remark |
|---|---|---|---|---|---|---|
| | | | | *LB* | *UB* | |
| **H1:** Covid-19 pandemic -> Bulk dry freight market | 0.413 | 7.1 | 0 | 0.293 | 0.519 | Supported |
| **H2:** The Russian Ukrainian war -> Bulk dry freight market | 0.379 | 5.484 | 0 | 0.252 | 0.518 | Supported |

The results of hypothesis testing in Table 9 showed that:

- Covid-19 pandemic had a significant impact on Bulk dry freight market as *(β=0.413, t=7.1, P<0.001,95% CI for β=[0.293,0.519])*, consequently, the first hypothesis is confirmed.
- The Russian Ukrainian war had a significant effect on Bulk dry freight market as *(β=0.379, t=5.484, P<0.001,95% CI for β=[0.252,0.518])*, consequently, the second hypothesis is confirmed.

## Coefficient of Determination

The influence of independent factors on dependent latent variables expressed by the coefficient of determination (R2) (Hair et al., 2012), which is one of the quality measurements of the structural model. R2 estimates range from 0 to 1, with zero representing little explained variation and 1 representing large, explained variance.

MRT
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Table 10: R Square Values

| | R Square | R Square Adjusted |
|---|---|---|
| **Bulk freight market** | 0.477 | 0.475 |
| ***Remark:*** Moderate accepted values | | |

The researchers used a different cut-off number for R2. Hair et al. (2011), for example, stated in marketing research that R2 values of 0.25, 0.50, or 0.75 are low, moderate, or high, respectively. Chin (1998) proposed in business research that R2 values of 0.19, 0.33, or 0.67 are low, moderate, or high, respectively. According to the results of Table 10, the fluctuation in both Covid-19 epidemic and the Russian Ukrainian war accounts for about 48% of the volatility in the Bulk freight market.

## Effect Size ($f^2$)

The f2 effect size quantifies the amount of impact that an inherent structure would have if an exogenous construct is eliminated from the model. A construct is deemed to have a modest influence if its f2 value is between 0.02 and 0.14, a medium effect if it is between 0.15 and 0.34, and a big effect if its f2 value exceeds 0.35. An f2 value of 0.02 indicates that the construct has no influence on the endogenous construct (Hair et al., 2017).

Table 11: $f^2$ Effect Size

| *Path* | f-Square | *Remark* |
|---|---|---|
| Covid-19 pandemic -> Bulk freight market | 0.237 | Moderate |
| The Russian Ukrainian war -> Bulk freight market | 0.201 | Moderate |

Table 11 shows the $f^2$ the structures' effect size, all values were moderate and accepted. The results of effect size indicate that *Covid-19 pandemic* Moderately Affects *Bulk freight affected. market* since $(f^2=0.237)$, also, *The Russian Ukrainian War* Moderately affects *Bulk freight market* since $(f^2=0.201)$.

## Predictive Relevance ($Q^2$)

The model's out-of-sample prediction ability is shown by the Q^2 value. A model can accurately anticipate data that were not employed in the model estimate process if it is said to have a predictive power or a predictive relevance. One method of calculating the Q^2 value is to blindfold someone. An omission distance (D) needs to be supplied before this process may be executed. The researchers advise choosing a D between 5 and 10, but they must be cautious to ensure that the sample size divided by the chosen D does not result in an integer.

Table 12: Predictive Relevance

| | SSO | SSE | $Q^2$ (=1-SSE/SSO) |
|---|---|---|---|
| Bulk freight market | 2360 | 1744.888 | 0.261 |
| Covid-19 pandemic | 2832 | 2832 | |
| The Russian Ukrainian war | 1888 | 1888 | |
| ***Remark:*** Predictive Relevance established | | | |

During the blindfolding process, the x data point of each item are excluded and then predicted, with x being the specified D value. This is shown by the exclusion distance. A D of five for each blindfolding cycle indicates that around 20% of the data points were eliminated. A D of ten, on the other hand, indicates that around 10% of the data points were eliminated during each blindfolding session. A Q^2 value greater than zero for an endogenous construct signifies the predictive significance of the model for that construct (Hair et al., 2017). Seven was chosen as the omission distance to evaluate the prediction ability of the model. The study yielded Q^2 values, which are shown in Table 12. It is reasonable to say that the study model has substantial predictive significance because Q^2 is greater than zero.

## Goodness of Fit of the Model

The Goodness of Fit (GoF) is the geometric mean of the average R^2 and the average variance derived from the endogenous variables. The goal of GoFs is to evaluate the research model at every level, including the structural and measurement models, with a focus on the overall performance of the model (Henseler and Sarstedt, 2013). One way to compute the GoF index is as follows:

$$GOF = \sqrt{\overline{R^2} \times \overline{AVE}} = \sqrt{0.477 \times 0.608} = 0.539.$$

Table 12 lists the GoF criterion for determining if a given set of GoF values is too little, too large, or too acceptable to be considered a globally adequate PLS model. Based on these standards and the value of GoF (0.539), it is reasonable to say that the GoF model fits the data better enough to be regarded as a genuine global PLS model.

MRT
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### Questionnaire Results

The statistical analysis showed that the data are valid, analyzable, and achieved normality. since all the responds came between 1-5 as per Likert scale, they must be minimum one maximum five so no outliers found in the data. Also, there is no missing data at all and normality has been achieved as all skewness results came in between (2 to -2) and kurtosis results came in between (7 to -7), therefore the data are valid and analyzable. Since the SD value is low, (close to zero), then there is no discrepancy between the answers, and Harman's single factor evaluating the result shows 44% which is less than 50%, thus there is no bias in the collected data which proves that the questionnaire is valid and dependable. According to the rules of goodness of fit, evaluation and model estimates and all tests reveal that the internal consistency and reliability are satisfactory. All the tests reveal that the internal consistency and reliability, convergent validity, and discriminant validity are all in order, according to the principles of goodness of fit evaluation and model estimations. Also, the relationships between the independent variables and the dependent variable are correct, and dependable, as indicated by the statistical results of the questionnaire.

The search offered two hypotheses. Due to the results of the questionnaire and the Baltic dry index analysis Also in the previous studies, the first hypotheses have been evaluated and approved that there is a negative impact on the dry bulk freight market due to Covid-19 pandemic. As the coefficient of determination (R2) of the effect of the independent variables on the dependent variable R2 (greater than 0.1) was 0.413, which is considered an acceptable result. The second hypothesis evaluated and shows a negative impact on the dry bulk fright market at due to the Russian Ukraine war and the effectiveness of the questionnaire statistical analyses outcomes was enhanced due to its consistency with the stoical analyses of the Baltic dry bulk index for the years between 2018 till 2023.

The coefficient of determination of the effect of the independent variables on the dependent variables R2 (greater than 0.1) was 0.379, which is considered an acceptable result. Also, the results show that the predictive power of the model Q2 is fair since the result is greater than zero, as it reached 0.261. The goodness of fit of the model (GOF) reached 0.539 which is more than 0.36 so it is safely concluded that the GOF model has a higher level of fit to be considered as a sufficient valid global PLS model. Therefore, based on the tested results of the questionnaire, Baltic dry index analysis (2018-2023) and the previous studies, it was found that there is a negative impact on the dry bulk freight market due to Covid-19 pandemic and the Russian Ukrainian war in the entire world.

## CONCLUSION AND RECOMMENDATIONS

The results of this research, as it came throw the answers on the electronic questionnaire which was distributed to the ship owners, ship brokers, ship operators, charterers, exporters and importers of dry bulk cargos, show that Covid-19 pandemic had a negative impact on the dry Bulk freight market as the freight decreased all over the world. The results also show that the Russian Ukrainian war had a negative impact on the dry bulk freight market as the freight increases all over the world. Also, the results came from the statistical analysis of the Baltic dry bulk freight index for the years between (2018-2023) which also matches the result of the statistical analyses of the questionnaire results for the market. The effectiveness of the questionnaire statistical analyses outcomes was enhanced due to their consistency with the stoical analyses of the Baltic dry bulk index for the years between 2018 and 2023. The researcher distributed about seven hundred questionnaires and received 472 answers. As The questionnaire result shows that 79 % of the answers came from males only, which gives an indication that the dry bulk shipping and trading business is mostly controlled by males. Since 42.4% of the questionnaire answers came from almost middle-aged people (35-45), this indicates that almost half of the answers came from people who have sufficient experience in the dry bulk shipping and trading field, thus the age of the participant in the questionnaire had a significant impact on the results of analysis. The effect of Covid-19 pandemic on the dry bulk freight market as per the statistical analysis is about 41%, while the effect of Russian Ukrainian war was almost 38 % and the dry bulk freight market was effected by other factors.

As this research aimed to find the impact of Covid-19 and the Russian Ukrainian war on the dry bulk freight market as such crises had an immediate effect on all the related parties, so the recommendations were divided into many segments based on the following categories:

Recommendations to Ship Owners, Managers, Operators, Ship Brokers

- Any waiting or delays due Covid-19 or any health disease at the loading or discharging port are to be on charterers time /acct.
- In case the loading or discharging operations stopped due to Covid-19 pandemic or any health disease then all-time lost and expenses

are to be on charterers account.
- In case of any additional war risk premium that is being forced by the insurance companies or owner of P&I club is to be shared 50% between owners and charterers.
- The owners are to include the contracts with the insurance companies and P&I club as a term or condition to increase the insurance to cover the hidden losses that can occur due to similar health or war crises.
- While getting loans from banks to buy a ship, ship owners should include in the load terms and conditions that if any world crises affect the freight negatively, then banks should postpone their instalments till the crises end up.
- When ship owners and operators do a future hedging on freight for the charterers, then a cancelation term should be included in the charter party.

## Recommendations to Charterers

- Charterers must form tenders of long terms hedging on the freight with highly reputable ship owners and operators so they make sure that they will perform the agreed charter party terms in case future crises happen.
- Charterers must make the agreements with well-known ship owners and operators who own a big shipping fleet and have a stable financial status to make sure that such owners and operators will not be bankrupted or will not fulfill their obligations against the charter party agreement.
- The charterers of dry bulk cargos all over the world should add a special term to protect themselves from such crises that may cause them big losses, especially if they signed long term contracts as following, if any delay stoppages etc. due to Covid-19 to be on owners 'account and time.
- Any delays arising due to quarantine imposed on account of the vessel's/crew's previous trading or nationality or contagious disease including but not limited to Covid-19 virus shall be on owners' account together with any expenses incurred and all the time lost thereby.
- Any delays arising due quarantine imposed on vessel account, crew, previous trading, or contagious diseases including but not limited to Covid-19 virus same shall be on owners account and time.
- Owners are to confirm that the vessel and the crew are to comply with all orders, requests, directions, rules, and regulation of port authorities of port of call and if the vessel or vessel crew failed to execute the instructions, then all-time lost and all expenses that may occur will be on the owner/vessel account.

## Recommendations to Cargo importers and exporters

- Dry bulk cargo sellers should try to sell of FOB basis so they avoid the impact of freight change, especially if they sell a huge quantity that should be shipped in many vessels for an extended period.
- Dry bulk cargos sellers should include in their contracts that in case any similar crises that increased the freight rates, then the same should be reflected in the prices.
- Dry bulk cargo buyers should be on CFR or CIF basis so they avoid involving themselves in the freight matter and in such a case they will be under less risk of expenses increment.
- When forming the contract, a clear term should be inserted there to clarify the rights of both the seller and the buyer in the event of a pandemic, wars and any other expected crises.

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