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Asymmetric Reflection of Shocks in Baltic Dry Index to Istanbul Freight Index

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ABSTRACT

Since the maritime freight markets have inelastic supply structures in the short run, freight is considered an indicator of trade volume. Freight rates can rise rapidly when fleet utilization is high, as supply, which does not increase in the short run due to time of ship building, cannot respond to increases in demand. In this sense, the relationships between the relevant freight indices can be examined in order to determine the regional reflections of global commercial developments. The aim of this study is to examine the effects of the shocks in Baltic Dry Index (BDI), which is an indicator of dry bulk trade in the global sense and considered as a leading indicator of the world economy by many researchers, on Istanbul Freight Index (ISTFIX), which is an indicator of trade in the Mediterranean and Aegean in the regional sense. The dataset covers the period between 31.12.2007 and 19.02.2018, and consists of 524 weekly observations. Asymmetric causality test is used in order to reveal relationship between variables. According to the findings, a significant causality relationship was determined only from negative shocks in BDI to negative shocks in ISTFIX. This situation shows that the contraction in global trade is immediately reflected in the ISTFIX region, while the expansion in trade is not immediately reflected.

INTRODUCTION

The most important and key market among the maritime markets is the freight market. According to the developments in this market, there are changes in prices and supply-demand balances in the second-hand market, the shipbuilding market and the demolition market. When freight rates tend to increase, second-hand ship prices begin to rise in parallel. Because both the profit from the market has increased and the demand for second-hand ships has increased due to the increase in freight, a reflection of the rise in economic activities. When second-hand prices increase, the demand for constructing new ships increases and the prices here are also positively affected (Buxton, 1991). Since, even old ships can do a profitable business under high freight conditions, there may be a decrease in the number of ships going for demolition, and this may cause an increase in demolition prices (Randers & Göluke, 2007). Then, the situations in other markets are shaped according to the movements of the freights. This condition in freight market continues by forming continuous cycles throughout the history (Metaxas, 1988). Therefore, understanding and analyzing the behavior of freights makes it possible to take a proactive position both in freight market as well as in other maritime markets, and reduces the risks arising from uncertainty (Kavussanos et al., 2010).

In addition to ship owners, cargo owners are also directly affected by the developments in the freight market. Rising freight prices mean increased transportation costs for exporters and importers. Since this situation affects the final prices of the products, the demand for the related products is affected. Therefore, there is an interaction between transportation cost and trade volume (Korinek & Sourdin, 2010). On the other hand, although increasing transportation costs do not cause a decrease in trade in countries with intense foreign trade activities, they cause an increase in the prices of domestic products. This situation results in inflationary pressures in the domestic markets of the countries and becomes a situation that can affect the welfare of all households. Because goods transported by sea are necessary products for both industry and households (Chevallier & Ielpo, 2013). For this reason, the freight market is in an important position for both ship owners, cargo owners and the economies of countries. Consequently, many theoretical and empirical studies to understand their structures take place in the maritime literature. The results obtained from these studies may also differ. The results may vary, as the events occurring in the periods covered may differ. Or the results may change due to the way freight rates are handled. Some studies use spot rates, some studies use time charter rates, and some studies use freight indices to represent freight level in the market. Additionally, the results may differ depending on the method used, regardless of the data type. Some studies use linear methods, while others use nonlinear non-parametric methods. Of course, each method and model should be considered as parts that make up a whole by considering the subject from different angles.

The literature side of the research topic is quite wide, because due to the mentioned importance of freight, many researchers aimed to understand the mechanism and determine the affecting factors. It is difficult to cover all of them in this section and may distract us from the focus of our study. For this reason, the studies on ISTFIX in the literature will be mainly reviewed. Freights move over time by generating cyclical movements. While these cycles sometimes see very low points, sometimes they can reach very high points (Stopford, 2009). These upper peaks can present very profitable opportunities for ship owners. For this reason, it is very important to determine the factors affecting the freight on the way to the summit. In this context, in a study conducted by Açık et al. (2018), price bubbles representing the peaks in ISTFIX freights were determined, and then the factors affecting the formation of these bubbles were selected and their effect levels were examined. Exchange rate and oil price were included in the logit model as the main factors and they found that 1 unit increase in the exchange rate greatly increased the probability of bubble formation in the freight rates. This situation clearly shows the effect of the exchange rate on foreign trade and therefore on the demand of maritime transport.

Maritime transport has a derived demand structure (Branch & Robarts, 2014). For this reason, developments in the economy and any event affecting the economy may also affect maritime transport. In particular, the effects of major economies in the world on maritime transport are also very large (Efes et al., 2019). Even major economic crises cause crises in the maritime sector and freight market. The 2008 global economic crisis caused a break in the global economy. Whether this break also causes a break in the ISTFIX indices has been examined by Köseoğlu & Mercangöz (2012). As a result of the analyzes they applied with unit root tests with structural breaks, they determined that the 2008 crisis caused a break in the freight rates in the region. This situation reveals once again the dependence of shipping on the global economy. It also reveals the importance of leading indicators for maritime.

Macroeconomic indicators used to measure the economic situation are generally kept on a monthly, quarterly or annual basis. However, even a few days in maritime transport have a great importance on profitability. In this respect, the need for higher frequency indicators representing the economic situation is obvious. Setting off with this research question, Başer & Açık (2018) examined whether the Turkish stock market could be used as a leading indicator for freights in the ISTFIX region. Thus, they aimed to determine a leading indicator for maritime transport by taking advantage of the immediate reflection of the economic situation in the country to the stock market. According to their results using asymmetric causality analysis, negative shocks in the stock market are the cause of negative shocks in the freight index. This shows that the negative news and events in the country are reflected instantly on maritime transport and reveals that the stock market can be used as a leading indicator for possible future demand decreases.

The prices of products in the world are both affected by the demand for them and affect the demand for them. Therefore, there is a possible relationship between demand and price (Radetzki, 2008). As a result of increased demand, the prices of commodities may increase and there may be a slight decrease in demand as a result of this increased price. Or demand may increase as a result of decreasing price. Therefore, there is likely to be a correlation between commodity prices and freight levels. Setting out with this research question, Açık & Başer (2020) aimed to determine whether there are significant asymmetrical relationships between the freights in the ISTFIX region and the prices of the major transported goods in the region. As a result of their analyses using steel, coal and wheat prices, it has been observed that the relationship among wheat prices differed partially. While there is a positive to positive and negative to negative relationship in coal and steel prices, there is a positive to negative and negative to positive relationship among wheat prices. It shows that the interaction may differ according to the type of commodity.

Results of the research study, conducted by Zeren & Kahramaner (2019), are closely corelated with the obtained results of this study. Zeren & Kahramaner (2019) examined the relationship between BDI and ISTFIX using cointegration and causality analysis methods. According to the obtained results, they determined a significant causality relationship from the BDI variable to the ISTFIX variable. The main reason for this is the transportation of large tonnage cargoes in BDI and the transportation of the cargoes coming with these vessels to the distribution points by ISTFIX vessels, which are smaller tonnage vessels. Because large ships cannot carry cargo to every region due to the different demands on parcel sizes and the technical capacity limits of regional ports. For this reason, large parcels should be divided into smaller parcels and to be moved to different regions.

When the literature is examined in general, all studies can be seen as a part of a whole. The study, which is in parallel with our point of view, is the study by Zeren & Kahramaner (2019). However, their results considered the relationship as one-dimensional. There may also be positive and negative dimensions of the relationship. In our study, we aimed to improve the size of the research by using asymmetric analysis, taking into account possible differentiations according to negative and positive situations in the relationship. In this respect, we aimed to make an original contribution to the literature by presenting a complementary study.

In this study, it is aimed to examine the possible impact from global markets to regional markets such as ISTFIX in order to understand the behavior of the index, which has not been the subject of empirical studies much. Although the tonnage of ships in the region is relatively small, the cargoes transported constitute very important added value for the economy of the region. In addition, the transported tonnage is on a scale that cannot be underestimated in terms of economic value. For this reason, any information that provides an understanding of the possible current structure and future movement of freight in the region is an important element that interests many stakeholders. In this respect, it is aimed to determine whether the shocks in the Baltic Dry Index, which is considered to be the most important indicator of the global maritime market, have an effect on ISTFIX, and if so, in what direction. The main reason for this is that since BDI is an indicator on a global scale and represents raw material traffic, it responds more dynamically to macroeconomic events and expectations about the future situation of the economy. Thus, the reaction movements in the BDI may cause and lead the reaction movements in the regional freight markets. When the structure of the data was examined, it was decided to apply the asymmetric causality analysis since it was seen that the dataset was far from linearity and deviated too much from the mean. Thus, the possible relationships between the shocks contained in the variables can be examined with four different combinations by implemented method. According to the findings, negative responses (shocks) in the BDI cause negative responses (shocks) in the ISTFIX index. Negative events in the international market are felt first in BDI and then in ISTFIX. Therefore, BDI can be used as a leading indicator for regional freight markets and relevant stakeholders can take proactive positions for future moves by following BDI. As one of the few studies in the literature that examines the possible relationship between global and regional indices, this study is thought to present an original contribution.

In the second part of the study, the data set and method used in the research are introduced. In the third part, the results of the applied analyzes are presented. In the last part, general evaluations and suggestions for future work are presented.

MATERIAL AND METHOD

BDI and ISTFIX variables are used in the research. BDI variable is one of the most important indicators of dry cargo transportation. It can be stated that it represents the income level for the ship owners and the transportation cost for the cargo owners (Geman, 2009). It can provide signals for possible future production activities by showing the current situation in international raw material transport and demand (Lawson, 2008; Langdana, 2009). It consists of a combination and weighted average of many dry bulk shipping routes on a global scale. In addition to such main indices, there are also local indexes that measure regional maritime traffic. The ISTFIX index is an index developed to monitor the situation in the market of coaster-type ships that trade mainly in the Black Sea, the Marmara, the Mediterranean and the Continent (Ünal & Derindere Köseoğlu, 2014). Such indices are very useful tools for keeping track of both the level of current transport incomes for shipowners and the level of current transport costs for cargo owners. They can also be followed to ensure transport safety for policy makers.

The dataset used covers the period between 31.12.2007 and 19.02.2018 and consists of 524 weekly observations. The ISTFIX variable is an index value published weekly. To match the dataset, analyzes were performed by taking the weekly averages of the daily values for the BDI variable. The movements of the variables in the period under consideration are presented in Figure 1. Although their general trends are similar, differences in their movements can be observed in some periods. In addition, the effects of the 2008 crisis can be seen very clearly in the chart. Both indices, which saw historical peaks, suddenly saw historical lows with the effect of shrinking demand and increasing ship supply.

Descriptive statistics of the variables used in the study are presented in Table 1. The table also includes the return series consisting of the log differences of the series. According to the descriptive statistics of the raw and return series, inferences can be made about the structure of the series. For example, according to the maximum return values, BDI showed a maximum increase of 42% in a week, while ISTFIX showed a maximum increase of 9.5%. According to the minimum return values, while BDI depreciated at most 43% in one week, ISTFIX depreciated at most 23%. According to these results, it can be said that BDI has a much more volatile structure. In addition, variability can be measured according to the ratio of the standard deviation to the mean. When we proportion for BDI values, a value of 105% is obtained, while this ratio is 36% for ISTFIX. The standard deviation of the BDI variable is higher than its mean. This is another important sign that the variability is much greater in BDI. In addition, high Kurtosis values indicate high tail effects in the series. This situation distorts the normal distribution properties of the series and generates a major obstacle to obtaining appropriate results with linear methods. For this reason, the application of a nonlinear method such as asymmetric causality analysis is necessary in order to achieve significant results.

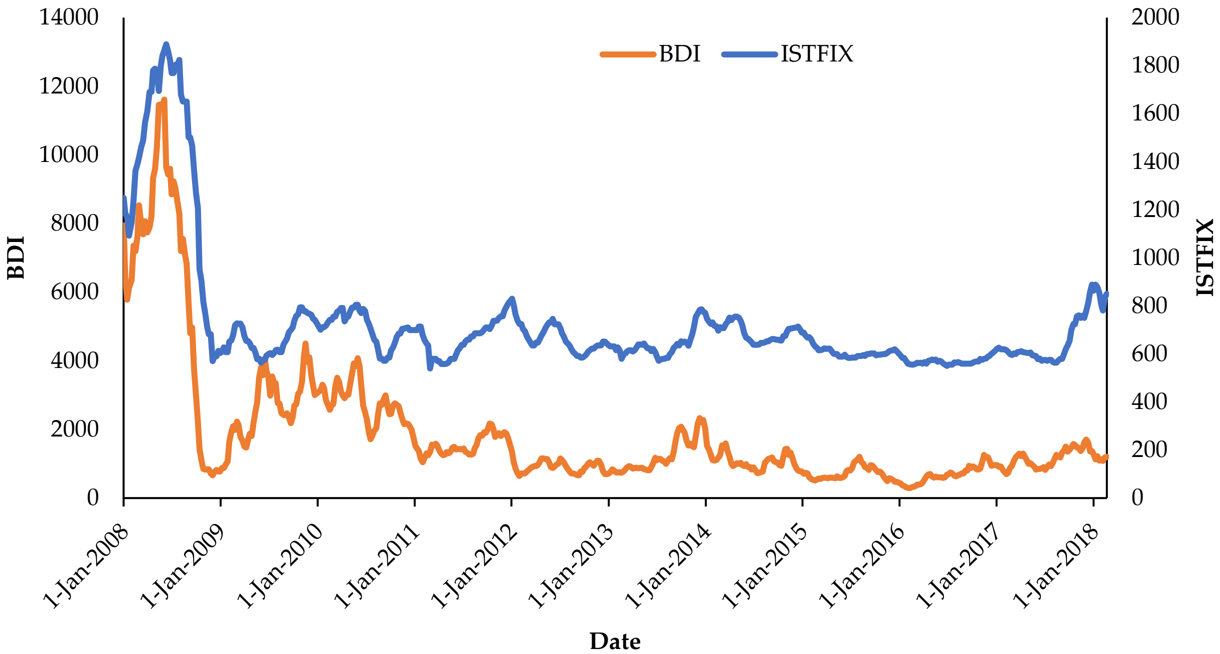

Figure 1. Graphical display of the variables (Bloomberg, 2018; ISTFIX, 2018)

Table 1. Descriptive statistics of the variables (Bloomberg, 2018; ISTFIX, 2018)

Variables	BDI	ISTFIX	R BDI	R ISTFIX
Mean	1879.7	724.8	-0.003	-0.000
Median	1155.5	646.0	-0.001	0.000
Maximum	11612.0	1889.0	0.428	0.095
Minimum	291.0	539.4	-0.434	-0.236
Std. Dev.	1975.7	262.0	0.095	0.027
Skewness	2.79	3.08	-0.122	-2.19
Kurtosis	11.01	11.98	4.49	18.3
Jarque-Bera	2086.5	2591.1	49.9	5558
Probability	0.00	0.00	0.00	0.00
Observations	524	524	523	523

It is decided to apply the asymmetric causality test proposed by Hatemi-J (2012) to determine the relationship between the BDI and ISTFIX indices in this study. The method used distinguishes shocks in variables as positive and negative. It then tests the relationship between shocks with four combinations (Shahbaz et al., 2017). Thus, any negative shock or positive shock does not have to stay in a relationship only with its own kind. In other words, significant relationships can be detected between positive shocks and negative shocks, and positive and negative shocks can also enter into statistical relationships among themselves. Considering that the players or variables in the market may react differently to the shocks they are exposed to, these findings are quite compatible with the market realities. This makes the findings of the method used valuable. There is no requirement for stationarity in the series in which the asymmetric causality test is applied. Instead, the maximum degrees of integration are determined (Umar & Dahalan, 2016), and it is decided whether an extra lag should be added to the estimated VAR models (Hatemi-J & Uddin, 2012). This is mainly because the method follows a Toda & Yamamoto (1995) process.

In the asymmetric causality test, the cumulative sums of the positive and negative shocks in the series are obtained, so that the relationships between different combinations can be tested. The cumulative shocks in BDI and ISTFIX can be expressed mathematically as equations (1) and (2):

$$BDI_t^+ = \sum_{i=1}^{+} \varepsilon_{1i}^+ , BDI_t^- = \sum_{i=1}^{-} \varepsilon_{1i}^- \tag{1}$$

$$ISTFIX_t^+ = \sum_{i=1}^{+} \varepsilon_{2i}^+ , ISTFIX_t^- = \sum_{i=1}^{-} \varepsilon_{2i}^- \tag{2}$$

In the next process, the null hypothesis of non-causality is tested by using Wald statistics in the analyzes applied using the cumulative sums of shocks (see Hatemi-J (2012) for detailed information).

The maximum degree of integration can be determined by unit root or stationarity tests. If a unit root is detected in one or both series, the maximum integration degree is determined as 1 and analyzes are performed considering this value. To determine this, it is preferred to apply augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) tests.

The ADF test is a unit root test, and the null hypothesis indicates that the series contains a unit root. The ADF test, which is simply an improved version of the DF test, can be shown as follows (equation 3):

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \beta_1 y_{t-1} + \beta_2 y_{t-2} + .. + \beta_p y_{t-p} + \upsilon_t \qquad (3)$$

Then, using the t statistic presented in equation (4), it is tested whether there is a unit root in the series:

$$t_\alpha = \hat{\alpha}/\big(se(\hat{\alpha})\big) \qquad (4)$$

According to the final result obtained by calculating t stat, the null of unit root hypothesis is tested (see Dickey & Fuller (1979) for detailed information). The KPSS test, on the other hand, is the stationarity test and the null hypothesis shows that the series are stationary. The calculation process can be expressed simply as equation (5):

$$y_t = x_t'\delta + \upsilon_t \qquad (5)$$

Then, unlike the ADF test, the test statistic is calculated using the LM test in order to determine whether the series is stationary or not (equation 6):

$$LM = \sum_t S(t)^2/(T^2 f_0) \qquad (6)$$

According to the obtained LM statistics, the null hypothesis that the series are stationary is tested (see Kwiatkowski et al. (1992) for detailed information). Considering these two tests as supportive and complementary tests, they have included in the analysis.

In the method used, bootstrap simulation technique is used to calculate the critical values, and this eliminates the necessity of having a normal distribution of the data used in the analysis. Considering that the structure of most financial series is subject to many unexpected events and shocks, this provides a great advantage (Hatemi-J, 2012). GAUSS statistical software and codes are used for the analysis.

RESULTS AND DISCUSSION

For the asymmetric causality test to be applied, the series do not have to be stationary. The maximum integration degrees need to be known. Accordingly, ADF and KPSS tests were applied to the series and presented the results in Table 2. The null hypothesis of the ADF test states that the series contains a unit root. The null hypothesis of the KPSS test states that the series is stationary. According to the results obtained, the ADF test shows that both variables do not contain unit roots at the level at 90% confidence level, while the KPSS test shows that both variables are not stationary at the level. When the results of the ADF test were considered at the 95% confidence level, the null hypothesis can only be rejected for the BDI variable. According to these results, based on the results of the KPSS series, it was decided that the series are not stationary, and their integration degree is 1. The analyzes were conducted in the next process accordingly.

GAUSS codes were used while performing the asymmetric causality test. The maximum number of lags was set as 12. Akaike information criterion (AIC) was chosen as the information criterion used to determine the most appropriate lag. It was also applied 1000 bootstrap simulations to calculate critical values. The maximum integration degree was determined as 1 as a result of the stationarity test. The test results applied as a result of all these values are presented in Table 3. According to the test results presented for 4 combinations, the null hypothesis of non-causality was rejected for only 1 result. According to this result, negative shocks in BDI are the cause of negative shocks in ISTFIX. Negative news in the BDI is also reflected in the ISTFIX index. However, no causal relationship was found between positive shocks.

Table 2. Results of unit root and stationarity test

Test	Variable	Level		First Difference	
		Intercept	*Trend and Intercept*	*Intercept*	*Trend and Intercept*
ADF	BDI	-2.9662**	-3.5904**	-14.505***	-14.511***
		(0.048)	(0.0315)	(0.000)	(0.000)
	ISTFIX	-2.6545*	-2.6107	-8.0441***	-8.0817***
		(0.082)	(0.275)	(0.000)	(0.000)
KPSS	BDI	1.7545	0.2427	0.0894*	0.0198*
	ISTFIX	0.9412	0.2189	0.1458*	0.0302*

Note: ADF critical values: -2.57 for *10%, -2.87 for **5%, -3.44 for ***1% at Intercept; -3.13 for *10%, -3.42 for **5%, -3.98 for ***1% at Trend and Intercept. KPSS critical values: 0.34 for *10%, 0.46 for **5%, 0.74 for ***1% at Intercept; 0.11 for *10%, 0.14 for **5%, 0.21 for ***1% at Trend and Intercept. P-values for ADF were included in parentheses.

Table 3. Results of asymmetric causality test

Parameters		B+I+	B+I-	B-I-	B-I+
Optimal Lag; VAR(p)		4	4	9	4
Additional Lags		1	1	1	1
Test Stat (MWALD)		6.33	2.70	78.0	6.44
Asym. chi-sq. p-value		0.17	0.60	0.00*	0.16
Critical Val.	1%	13.8	14.5	23.5	15.5
	5%	10.0	10.2	18.4	11.0
	10%	8.13	8.18	15.4	8.57

Note: *B* indicates the BDI; *I* indicates the ISTFIX; * indicates the null of noncausality hypothesis is rejected.

GAUSS codes were used while performing the asymmetric causality test. The maximum number of lags was set as 12. Akaike information criterion (AIC) was chosen as the information criterion used to determine the most appropriate lag. It was also applied 1000 bootstrap simulations to calculate critical values. The maximum integration degree was determined as 1 as a result of the stationarity test. The test results applied as a result of all these values are presented in Table 3. According to the test results presented for 4 combinations, the null hypothesis of non-causality was rejected for only 1 result. According to this result, negative shocks in BDI are the cause of negative shocks in ISTFIX. Negative news in the BDI is also reflected in the ISTFIX index. However, no causal relationship was found between positive shocks.

CONCLUSION

Maritime transport is a sector that requires huge investments, since the capital costs of ships are very high in parallel with their sizes. Naturally, the expectations of investors are to obtain high returns. When the historical course of the freight markets is followed, it is seen that these earnings expectations are met in some periods. However, it is seen that there are ship owners who do business at a loss during the periods of very long stagnation. For this reason, possible variables and predictive indicators that affect freight prices are of vital importance for ship owners. It is the dream of every ship owner to minimize the risk of loss and increase the probability of gain by taking a position in the market according to signals given by these variables and indicators. Additionally, since freights constitute important transportation costs for cargo owners, leading indicators are needed to predict the present and future costs, and to take a commercial position accordingly. In this direction, it has been examined the possible effect of BDI, one of the global indicators for both ship owners and cargo owners, on freight rates in the ISTFIX region by causality analysis during this study. Thus, it is aimed to determine which changes in the BDI might cause and what kind of changes occur in the future ISTFIX index values. As can be seen from the descriptive statistics, the series have non-normal distribution characteristics. This shows that the variability of the series is very high and they are exposed to a lot of unexpected circumstances, especially, the volatility of the BDI variable is very high. It was decided that asymmetric causality analysis would be appropriate in order to determine the relationships between variables that are far from such a normal distribution characteristic and the analyzes are applied in this regard. According to the results of this study, the negative shocks in the BDI are the cause of the negative shocks in the ISTFIX index. Considering the basic logic of causality analysis, it is examined whether the present and past values of a single one variable explain the present and future values of other variable in a meaningful way. In this direction, the causality between negative shocks can be understood that negative shocks in the BDI variable will cause negative shocks in the ISTFIX variable in future. In this respect, both ship owners and cargo owners engaged in commercial activities in the ISTFIX region can be prepared for future changes by determining their own positions according to present negative developments in BDI. The relationship between negative shocks may be due to differences in cargo types. While cargoes transported in BDI, mostly, consist of cargoes such as iron ore, coal and wheat; processed products such as steel are also transported in ISTFIX. Therefore, decreases in raw material demand may indicate that there will be decreases in future economic activities. This may cause a decrease in ISTFIX freight levels. Another reason may be the effect from oil prices. The decrease in costs may be reflected as a decrease in freight, and this may occur primarily on large ships in the BDI region. Of course, in order to speak more clearly, it is necessary to analyze empirically by including oil prices in the model.

In future studies, the relationship between the variables can be examined with different methods. Since the cargoes of the ships used in the BDI index and the ships used in the ISTFIX index are different, the demand structures for these cargoes are also different. For this reason, developments that affect one index may not affect the other index or may affect it less. Methods that can include the characteristics of the cargoes in the analysis can provide more comprehensive results. In addition, while the relationship between the index is significant in some periods of time, it may not exist in some periods. This situation can be analyzed by methods such as the time-varying approach. Furthermore, it can be discussed which factors developed in periods of causality and what the possible effects of these factors might be. Thus, inferences can be made about how the freights will react against similar circumstances that are likely to develop in future.

Compliance With Ethical Standards

Conflict of Interest

The author declares that there is no conflict of interest.

Ethical Approval

For this type of study, formal consent is not required.

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