

EFFECTS OF THE DEVELOPMENTS IN MARITIME TRANSPORTATION ON PRODUCTION SECTOR COMPANIES*

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Abstract

The Baltic Dry Index (BDI) is one of the most important economic indicators that reflects the dynamics of international trade and the global shipping industry. Changes in the index provide information about the changes that may occur in the costs and profitability of the companies through the signals that give about trends in the global economy. Therefore, monitoring the changes in the BDI is of great importance, especially for companies operating in the manufacturing sector. In this context, the aim of the study is to determine relationships between the BDI and the production-based sector indices in Borsa Istanbul in the context of the time dimension. For this purpose, the relationships between the BDI and 22 sector indices were analyzed by the frequency causality test of Breitung and Candelon (2006). The most important finding of the study is that many of the sector indices are related to the BDI. Another important finding of the study is that the relationships change in different time periods, such as short-term and long-term. The findings indicate that companies operating in the manufacturing sector and investors willing to invest in the manufacturing sector should make their decisions by taking into account the effects of fluctuations in maritime transportation on the sector.

Keywords:

Baltic Dry Bulk Index,
Production Sectors,
Frequency Causality
Test.

JEL Codes:

R40, L11,
L16, G10.

Öz

Baltık Kuru Yük Endeksi (BKYE), uluslararası ticaretin ve küresel denizcilik sektörünün dinamiklerini yansıtan en önemli ekonomik göstergelerden biridir. Endeksteki deęişimler, küresel ekonomideki eğilimler hakkında verdiği sinyaller ile řirketlerin maliyet ve karlılıklarında meydana gelebilecek deęişimler hakkında bilgi vermektedir. Bu nedenle BKYE'deki deęişimlerin izlenmesi özellikle imalat sektöründe faaliyet gösteren firmalar için büyük önem taşımaktadır. Bu bağlamda çalışmanın amacı, BKYE ile Borsa İstanbul'daki üretime dayalı sektör endeksleri arasındaki ilişkilerin zaman boyutu bağlamında belirlenmesidir. Bu amaçla BKYE ile 22 sektör endeksi arasındaki ilişkiler Breitung ve Candelon'un (2006) frekans nedensellik testi ile analiz edilmiştir. Çalışmanın en önemli bulgusu, sektör endekslerinin birçoğunun BKYE ile ilişkili olduğudur. Çalışmanın bir dięer önemli bulgusu ise ilişkilerin kısa ve uzun dönem gibi farklı zaman dilimlerinde deęişmesidir. Elde edilen bulgular, imalat sektöründe faaliyet gösteren řirketlerin ve imalat sektörüne yatırım yapmak isteyen yatırımcıların, deniz tařımacılıęındaki dalgalanmaların sektörler üzerindeki etkilerini dikkate alarak karar vermeleri gerektiğini göstermektedir.

Anahtar Kelimeler:

Baltık Kuru Yük
Endeksi, Üretim
Sektörleri, Frekans
Nedensellik.

JEL Kodları:

R40, L11,
L16, G10.

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1. Introduction

After the 1950s, there has been a significant increase in the volume of world trade due to the increase in globalization. The increase in global demand has also led to an increase in the transportation sector. Compared to road, air and railway alternatives, maritime transport is the most preferred alternative in global trade. Maritime transport offers a cost-effective service with its wide transportation networks and high-volume transport capacity (Yıldız and Bucak, 2017). The cost advantage that the maritime transportation provide, makes its share very high in the global transportation volume. Due to its share in transportation and world trade volume, many countries, companies and researchers closely follow and analyze developments in maritime transportation. In this context, one of the indices that can be followed and used in analyses is the BDI. BDI is an index calculated by the London Baltic Exchange and is considered one of the important indicators of global economic and trade activities. The index is accepted as a standard for the daily transportation cost and maritime trade volume.

The London Baltic Exchange uses the average of the ratios generated for 23 major geographical shipping routes to create the BDI (Geman and Smith, 2012: 4). The index measures supply and demand for bulk cargo, which includes metals, minerals, oil, grains, and manufactured goods, which are therefore the main source for the costs of raw materials. Since approximately 90% of global trade activities take place at sea, the index is considered an important indicator for measuring industrial production and overall economic activity, forming an important basis for political and economic decisions (Abakah et al., 2024: 1). The importance of maritime transportation has led to the need for an international calculation system. This need led to the emergence of the BDI, created by the London Baltic Exchange (Barut et al., 2020). The BDI is an economic indicator published daily by the London-based Baltic Exchange. Contrary to its name, when calculating the index, not only dry cargo price changes related to the Baltic Sea countries but also price changes of dry cargo transported to different countries using more than 20 routes are taken into account.

BDI is calculated by taking into consideration the tonnage, number, routes, cargo, and price of dry cargo ships. The index was first created in 1985 by the London Baltic Exchange under the name of The Baltic Freight Index (BFI) and was renamed the BDI in 1999. After 2006, BDI was calculated by multiplying the averages of the Baltic Capesize (125,000-220,000 DWT) Index (BSI), Baltic Panamax (60,000-125,000 DWT) Index (BPI), and Baltic Supramax (40,000-60,000 DWT) Index (BSI) by 0.99800799. However, with the creation of the Baltic Handysize (20,000-40,000 DWT) Index (BHSI), the new BDI started to be calculated by multiplying the averages of the indexes by 1.192621362 in order to ensure the continuity of the index. Because it includes index data from different regions, the BDI has become the reference price index for shipping companies and investors when making transactions in the bulk shipping market (Lin and Wang, 2014).

BDI is a widely used indicator to monitor the global economic situation as it is calculated based on index data from different regions. The index is also used to predict logistics costs, monitor trade volume, and determine investment opportunities. BDI, which is an important indicator especially for the logistics sector, reflects transportation costs, which are one of the most important cost items for companies operating internationally or in need of imported inputs, and the volume of activity in maritime transportation (Lin and Sim, 2013). The index provides signals

regarding the supply and demand balance in maritime transportation and information regarding global trade volume.

There are many benefits for companies operating in the field of maritime transport and foreign trade to follow the BDI. Following the index helps investors and companies understand the costs of raw materials, the status of companies and therefore the direction of the global economy. The index offers clues on opportunities specific to the sectors in which companies operate and portfolio investors wishing to make sector-based investments, provides information on logistics costs, and enables companies to plan their future more robustly. The BDI provides information on the volume of real economic activity, enabling more accurate forecasts and creates a link between financial markets and the macro economy (Apergis and Payne, 2013). The index is one of the indicators frequently used to predict the direction of financial markets, along with other macroeconomic indicators (Özdemir Höl et al., 2022). The BDI is a key economic indicator that takes the pulse of the global shipping industry. The BDI is calculated by combining a number of parameters such as ship freight rates, port capacity utilization, ship occupancy rates and transportation demands, and reflects the dynamics of international trade and logistics processes. Therefore, changes in the BDI are extremely important, especially for companies operating in the manufacturing sector.

Especially in today's world where global supply chains have been increasingly integrated, it would be beneficial for manufacturing companies to closely monitor the rise and fall of the BDI in order to ensure that raw material supply, production planning and distribution processes are carried out in a healthy manner. Fluctuations in the index provide signals about risks such as delays in the supply chain, disruptions in raw material supply and increases in logistics costs for manufacturing companies, and therefore about profitability of companies. On the other hand, during periods when the index fluctuates, producers can gain a competitive advantage and have the opportunity to increase their profitability. The BDI is considered a critical tool for understanding the interaction between global economic fluctuations and manufacturing companies. In this context, it will be useful not only for companies but also for investors to understand the relationships between the index and manufacturing companies. Determining the relationships between the index and the manufacturing sector will provide investors with information that should be evaluated in the portfolio management process. The effects of changes in the BDI on the manufacturing sector may vary over time. In this context, the aim of the study is to determine the relationships between the BDI and the production-based sector indices created from the enterprises listed on Borsa Istanbul, and to reveal the time dimension in the relationships in order to obtain more accurate results.

The study contributes to the literature in terms of examining the relationships between the BDI and production-based sector indices, which were discussed in limited numbers in the literature, in the frequency dimension. While the literature generally analyzes the relationships between BDI and macroeconomic indicators or general market indices, this study examines the relationships between BDI and the production sectors traded on Borsa Istanbul individually. Thus, it is revealed how the responses of each sector to fluctuations in global maritime transport vary over time. In this respect, the study not only makes a methodological contribution to the academic literature but also provides guiding information for companies operating in the manufacturing sector and investors in their decision-making processes. It is also thought that the study will help policy makers assess sectoral vulnerabilities more clearly and develop strategies that will increase resilience against logistics shocks.

2. Literature Review

There are different studies on BDI, which reveals the status of the global economy and commercial activities based on the balance of supply and demand in maritime transportation. While some of these studies aim to explain the factors affecting the BDI, some examine the relationships between the BDI and macroeconomic variables, and some examine the relationships between the BDI and economic growth. On the other hand, there are also studies investigating the effects of BDI, which is an important indicator in terms of international transportation, on foreign trade. When considered with regards to financial markets and in particular to companies, the BDI appears to be an important indicator. It is very important especially for the companies and markets to analyze the possible effects of changes in the BDI, which carry out import-export transactions or use imported inputs intensively in their production processes. In this context, there are many studies in the literature examining the relationships between BDI and many asset classes and markets such as stock markets, commodity markets, stock market indices, etc.

Şahan et al. (2018) aimed to determine the factors affecting BDI by using financial markets, capital markets, commodity markets, and economic indicators. The study concluded that the US 10-year bond yield, gold and silver spot prices, commodity price index consisting of minerals, ores, and metals have effects on BDI. Akkan (2024) studied the effects of the process, which started with trade wars in 2018 and continued with the COVID-19 outbreak, on the BDI, and on the changes that occurred in the index during this process. The results of the study indicated that risks and negativities may decrease with the measures taken in 2024 and beyond, but geopolitical risks still remain valid.

Özcan Akdağ et al. (2023) investigated the relationship between macroeconomic indicators and BDI and determined causal relationships. The study also showed that evaluating the changes in macroeconomic variables can decrease economic risks in global trade. Özdemir Höl et al. (2022) examined the volatility spillovers between BDI, oil prices, gold prices, Dollar Index, and MSCI World Index. As a result of the study, it was determined that BDI, Brent oil price, and MSCI World Index are the variables that are sources of volatility, while gold ounce price and Dollar Index are the variables exposed to volatility. Additionally, it has been concluded that it would be beneficial for investors to follow the price movements that may occur in Brent oil prices, the variable that is the source of most of the volatility. Yurdakul and Şipal (2022) studied the relationships between maritime exports, BDI, and crude oil prices in Turkey and concluded that there is a long-term relationship between the variables. The results also showed that a 1% increase in BDI increased Turkey's maritime exports by 0.43% in the long term, while a 1% increase in crude oil prices decreased maritime exports by 0.18%. Pepur et al. (2022) considered the US S&P 500 stock index, China Shanghai Stock Exchange Composite Index (SSECI), 10-Year Treasury bond yield, Commodity Research Bureau Index (CRB), West Texas Intermediate (WTI) crude oil and gold as global market determinants and leading macroeconomic indicators, and analyzed the effects of these variables on BDI. The study concluded that the S&P 500 and SSECI indices and CRB index have a positive effect on BDI, while Gold and WTI crude oil have a negative effect.

Başer and Açıık (2019) examined the effect of economic growth on the dry bulk cargo market. In the study, the World GDP (Gross Domestic Product) was considered as a measure of global economic activity and the BDI as a measure of freight rates in the dry bulk market. As a result of the study, it was concluded that there is a positive significant relationship between the variables, the response of BDI to World GDP is quite high and the maritime market is a risky

market. Bildirici et al. (2015) investigated the relationships between BDI and economic growth in the USA and found that BDI can be used as a crisis indicator for the USA. Abakah et al. (2024) investigated the asymmetric dependence of BDI on traditional financial markets. As a result of the study, it was determined that there was a significant relationship between the considered variables in the short and medium term, and positive and negative changes were revealed in the long term.

Oğuz (2024) analyzed the role of maritime transportation in global supply chains. The results indicated that Turkey's maritime transportation has an important role in global trade with its strategic location and logistics infrastructure. Eryüzü (2019) focused on world maritime trade and Turkey's foreign trade relations in the study. In the study, BDI and Türkiye's total export and import data were used, and it was determined that Turkey is a country that is both affected by world maritime trade and affects world maritime trade. Zeren and Kahramaner (2019) examined the relationships between BDI and the regional Istanbul Freight Index. As a result of the study, it was determined that BDI and the Istanbul Freight Index move together in the long term and BDI directs the Istanbul Freight Index. Similarly, Kılıç and Gürbüz (2025) studied the effects of BDI and Dollar Index on the Istanbul Freight Index. They concluded that BDI has a positive effect on the Istanbul Freight Index, while Dollar Index has a negative effect on the Istanbul Freight Index, but is a weak determinant. Salar (2022) analyzed the effects of shocks in BDI on the Istanbul Freight Index and found that there was only one causality from BDI negative shocks to negative shocks in the Istanbul Freight Index. In addition, it was found that the contraction in global trade was immediately reflected in the Istanbul Freight Index, but the expansion was not immediately reflected.

Açık and Başer (2018) aimed to determine the efficiency of freight rates in the dry bulk market within the scope of the efficient market hypothesis. The results indicated that the efficient market hypothesis is not valid for the dry bulk market with BDI data, and hence, there are profit opportunities for investors. Similarly, Işığçok and Tarkun (2023) tested market efficiency within the scope of BDI in their study. In the study, the volatility in the BDI return series was examined with the days when volatility was high and low, and the day-of-the-week anomaly. In the study, it was found that the volatility of the BDI return series increased on Tuesdays and decreased on Fridays. Thus, it was determined that there were price movements that deviated from the Efficient Market Hypothesis, and the market was not efficient.

Li et al. (2017) analyzed the relationships between BDI and the Chinese stock market and found that macroeconomic variables have a significant effect on BDI in the long term. Manoharan and Visalakshmi (2019) studied the relationships between the maritime market and stock markets of India and China using BDI. The results showed that BDI has significant effects on the Indian stock market, but the effect on the Chinese stock market index is low. Yilmaz and Emir (2021) investigated the effect of BDI and crude oil prices on capital markets. The study revealed that BDI data, which recovered as the pandemic weakened, started to decline again with news of new variants. It was also determined that the BDI and USD indexes transmit volatility, while the emerging market indexes and crude oil prices are the variables exposed volatility, thus it was concluded that investors can benefit from the benefits of international portfolio diversification by investing in the examined variables. Sartorius et al. (2018) aimed to determine the primary factors driving BDI dynamics and whether BDI can predict stock price movements in South Africa. The study showed that BDI can be used as an indicator for future economic activities.

Jurun et al. (2015) studied the relationships between BDI and the performance of transportation companies for the period of 1985-2013. Empirical findings indicate a strong positive correlation between annual average of BDI and transportation companies and the index acts as a signal that responds quickly to crisis effects. Barut et al. (2020) investigated the relationships between BDI and Dow Jones Iron and Steel Index and found a long-term relationship between the two indices. However, the results of the causality test applied in the study showed that there is causality from BDI to Dow Jones iron and steel index in some periods, from Dow Jones Iron and Steel index to BDI in some periods and there is no causality relationship between the variables in some periods.

In the literature there are many studies on Borsa Istanbul sector indices. In these studies, the relationships between a specific sector index and macroeconomic indicators or financial indicators were analyzed. Some of studies attempt to determine the factors affecting the sectoral stock returns or to determine market value of the companies operating in a sector, while in some studies sectoral market efficiency was investigated (Meriç et al., 2017; Kamışlı et al., 2019; Özdemir et al., 2019; Çanakkıran et al., 2020; Esen et al., 2020; Garayev et al., 2021). In their study, Çanakkıran et al. (2020) analyzed the short-term relationships between the Borsa Istanbul Textile sector and the revealed comparative advantage index and capacity utilization rate with the VAR Model for the period of 2009Q1-2019Q4. As a result of the study, bidirectional causality was determined between the Borsa Istanbul Textile sector and the capacity utilization rate, and unidirectional causality from the comparative advantage index to the textile index. In their study, Esen et al. (2020) investigated the relationships between the Borsa Istanbul Services index and exchange rate, inflation, unemployment rate, and confidence index for the period of January 2015 to February 2019. The results showed that there is unidirectional causality from unemployment to the Services index, and that there is no causality between the sector index, consumer confidence index, and exchange rate. In their study, Garayev et al. (2021) studied the relationships between the BIST Bank index return and CDS premium and interest rates. The results of the VAR model applied in the study indicated that there are unidirectional causalities from interest rates and CDS premiums to the BIST Bank index. In addition, variance decomposition revealed that interest rates explain more of the changes in BIST Bank index returns than CDS Premium. Kamışlı et al. (2019) tested time-varying weak form efficiency for 18 sector indices in Borsa Istanbul. With the rolling KSS unit root test applied in the study, it was concluded that all non-linear sub-sector indices are weak-form efficient with a time-varying structure. In their study, Meriç et al. (2017) analyzed the short-term relationships between stock prices, price-earnings ratios, and dividend yield ratios of companies traded in the BIST Banking sector for the period of October 2008 and March 2017 with the VAR Model. The study reveals that the relationships between stock returns and financial ratios change in size and direction from bank to bank. Özdemir et al. (2019) evaluated the social media presences, market values, and performances of the companies listed in the BIST Technology index. The findings showed that the market value of companies that actively use social media is higher than others.

As can be seen from the studies reviewed, studies investigating the relationships between BDI and sectors are quite limited. Therefore, the study is expected to make a significant contribution to the literature.

3. Data and Methodology

In the study, the relationships between the BDI and 22 the production-based Borsa Istanbul (BIST) sector index (Automobile-AUTO, Brewers-BRWR, Basic Materials-BSMT, Chemicals-CHMC, Construction and Materials-CNSM, Construction-CONS, Consumer Products and Services-COPS, Commercial Vehicles Parts-COVP, Energy-ENEG, Food, Beverage and Tobacco-FOBT, Food Products-FOPD, Food Retailers and Wholesalers-FORW, Gold Mining-GLDM, Glass-GLSS, Household Goods-HHGS, Industrials-INDT, Industrial Goods and Services-INGG, Iron & Steel-IRST, Mining-MNNG, Oil, Gas, Coal-OLGC, Precious Metals-PRCM, Soft Drinks-SFTD) returns were analyzed by Breitung and Candelon (2006) frequency causality test for the period of in January 4, 1988 and March 17, 2025.

Traditional causality tests test the existence of causal relationship between two variables by considering only the overall effect in the time domain. These tests cannot distinguish in which period the causal relationship exists. Considering the dynamics of financial markets and the real sector, it seems unrealistic to assume that the relationships between financial assets and indicators remain the same throughout the period under review. Especially when it comes to global logistics indicators, since there are many factors affecting global logistics activities, the possibility of changing in the existence and direction of causality relationships seems quite high. For example, while some sectors respond quickly to changes in the freight index in the short term, others price these changes in over a longer term. In this context, the frequency causality test developed by Breitung and Candelon (2006) allows the determination of causality dynamics in different periods and the detection of changes in relationships. Due to this feature, the frequency causality test is widely used in the finance literature to determine periodic relationships (Kamışlı and Temizel, 2019). The main reason why Breitung and Candelon (2006) frequency causality test preferred in the study is that the causality relationships between the BDI and production sectors can emerge in different periods. On the other hand, global logistics shocks affect firms' input costs and profitability in the short term and production planning and investment decisions in the long term differently. The test not only makes a methodological contribution to the academic literature but also provides useful information for investors to evaluate portfolio strategies and policymakers to assess sectoral vulnerabilities by revealing this differentiation in detail.

In the Breitung and Candelon (2006) test, frequency-based causality is tested based on the studies of Geweke (1982) and Hosoya (1991). In the causality test developed by Geweke (1982);

$$M_{X \rightarrow Y}(\omega) = \log \left[1 + \frac{|\psi_{12}(e^{-i\omega})|^2}{|\psi_{11}(e^{-i\omega})|^2} \right] \quad (1)$$

If $|\psi_{12}(e^{-i\omega})| = 0$ then there is no causality from X_t to Y_t at frequency ω . The null hypothesis that X_t does not cause Y_t at frequency ω is;

$$M_{X \rightarrow Y}(\omega) = 0 \quad (2)$$

Linear constraints in testing the hypothesis shown in the 2nd equation are;

$$\sum_{k=1}^p \theta_{12,k} \cos(k\omega) = 0 \quad (3)$$

$$\sum_{k=1}^p \theta_{12,k} \sin(k\omega) = 0 \quad (4)$$

Depending on the linear constraints specified in the 3rd and 4th equations, the null hypothesis $M_{X \rightarrow Y}(\omega) = 0$ can be written as follows;

$$H_0 = R(\omega)\beta \quad (5)$$

Here, β is the vector of coefficients Y_t .

$$R(\omega) = \begin{bmatrix} \cos(\omega) & \cos(2\omega) & \dots & \cos(p\omega) \\ \sin(\omega) & \sin(2\omega) & \dots & \sin(p\omega) \end{bmatrix} \quad (6)$$

Thus, the null hypothesis, depending on the restrictions specified by the standard F test that there is no causality at the ω frequency can be tested. The F test is distributed approximately as $F(2, T - 2p)$ for $\omega \in (0, \pi)$. Here 2 represents the number of constraints, T represents the number of observations, and p represents the lag number of the VAR model (Breitung and Caldelon, 2006).

4. Empirical Findings

In the first step of the analysis, descriptive statistics of the BDI and production-based BIST sectors index returns were calculated, and the results are given in Table 1. As can be seen from Table 1, the construction, brewers and industrial goods and services sectors have the highest average returns, while the gold mining, precious metals and soft drinks sectors have the lowest average returns. Standard deviation values show that the chemicals, food products and construction sectors have the highest returns, while the construction and materials, soft drinks and basic materials sectors have the lowest returns. The findings also show that the returns of chemicals, food products and construction sectors have the highest standard deviation values while the returns of construction and materials, soft drinks and basic materials sectors have the lowest standard deviation values. Standard deviation values indicate that the returns of the chemicals, food products and construction sectors have the highest risk levels, while the construction and materials, soft drinks and basic materials sectors have the lowest risk levels. According to descriptive statistics, all series have high kurtosis values and they are not normally distributed according to the Jarque-Bera Normality test results. The ADF and PP unit root test results show that all series considered are stationary.

Table 1. Descriptive Statistics

	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera	ADF	PP
BDI	7.3673	0.0148	0.81	4.06	305.94*	-4.471*	-3.892*
AUTO	0.0013	0.0134	0.09	6.17	814.63*	-42.84*	-42.95*
BRWR	0.0015	0.0119	0.62	8.90	2945.7*	-45.86*	-45.84*
BSMT	0.0012	0.0169	0.11	7.55	1675.5*	-41.38*	-41.46*
CHMC	0.0011	0.0100	-0.12	9.47	3392.1*	-27.75*	-42.48*
CNSM	0.0011	0.0156	0.13	6.74	1138.3*	-41.92*	-42.02*
CONS	0.0017	0.0126	0.97	10.1	4410.7*	-43.37*	-43.38*
COPS	0.0013	0.0142	0.16	7.56	1693.1*	-28.81*	-43.39*
COVP	0.0013	0.0143	0.35	8.13	1741.4*	-36.19*	-36.41*
ENEG	0.0012	0.0125	0.16	9.62	3232.3*	-39.23*	-39.14*
FOBT	0.0013	0.0132	0.62	9.42	3193.6*	-28.08*	-43.26*
FOPD	0.0012	0.0164	-0.12	14.1	7680.5*	-38.20*	-38.45*
FORW	0.0013	0.0134	1.02	18.1	1727.6*	-40.55*	-40.60*
GLDM	0.0009	0.0142	0.24	6.90	507.02*	-27.08*	-27.19*
GLSS	0.0013	0.0136	0.23	7.02	1328.3*	-41.60*	-41.82*
HHGS	0.0014	0.0140	0.08	7.29	1492.9*	-28.91*	-43.57*
INDT	0.0014	0.0142	0.90	19.9	2337.3*	-40.69*	-40.84*
INGS	0.0014	0.0152	0.77	17.1	1623.5*	-41.42*	-41.57*
IRST	0.0013	0.0152	0.13	7.86	1914.2*	-40.62*	-40.59*
MNNG	0.0013	0.0149	0.13	7.86	1913.9*	-40.62*	-40.59*
OLGC	0.0011	0.0134	0.16	8.75	2435.0*	-39.49*	-39.41*
PRCM	0.0009	0.0108	0.24	6.89	506.12*	-27.08*	-27.19*
SFTD	0.0010	0.0148	0.81	12.1	3492.9*	-35.57*	-35.75*

Note: *, ** and *** indicate 1%, 5% and 10% significance levels, respectively.

In the next step of the study, unconditional correlations between BDI and production-based BIST sector index returns were calculated, and the results are given in Table 2.

Table 2. Unconditional Correlations

AUTO	0.001	FORW	0.015
BRWR	0.045	GLDM	0.003
BSMT	0.012	GLSS	0.027
CHMC	-0.002	HHGS	0.017
CNSM	0.053	INDT	0.050
CONS	0.067***	INGS	0.049
COPS	0.005	IRST	0.004
COVP	-0.033	MNNG	0.004
ENEG	0.047	OLGC	0.033
FOBT	-0.007	PRCM	0.003
FOPD	-0.064***	SFTD	0.055

Note: *, ** and *** indicate 1%, 5% and 10% significance levels, respectively.

As can be seen from Table 2, there are significant correlations between BDI and only returns of the food products and construction sectors. The results show that BDI is negatively related to food products sector returns and positively related to construction sector returns. In the next step of the study, the causality from BDI to production-based BIST sectors index returns was analyzed first with the traditional causality test and then with the frequency causality test. The results of the traditional causality tests are given in Table 3.

Table 3. Traditional Causality Test Results

	Prob.		Prob.
BDI $\nRightarrow$ AUTO	0.513	BDI $\nRightarrow$ FORW	0.530
BDI $\nRightarrow$ BRWR	0.598	BDI $\nRightarrow$ GLDM	0.669
BDI $\nRightarrow$ BSMT	0.975	BDI $\nRightarrow$ GLSS	0.701
BDI $\nRightarrow$ CHMC	0.428	BDI $\nRightarrow$ HHGS	0.752
BDI $\nRightarrow$ CNSM	0.354	BDI $\nRightarrow$ INDY	0.924
BDI $\nRightarrow$ CONS	0.744	BDI $\nRightarrow$ INGS	0.675
BDI $\nRightarrow$ COPS	0.530	BDI $\nRightarrow$ IRST	0.981
BDI $\nRightarrow$ COVP	0.521	BDI $\nRightarrow$ MNNG	0.981
BDI $\nRightarrow$ ENEG	0.688	BDI $\nRightarrow$ OLGC	0.345
BDI $\nRightarrow$ FOBT	0.378	BDI $\nRightarrow$ PRCM	0.670
BDI $\nRightarrow$ FOPD	0.058	BDI $\nRightarrow$ SFTD	0.209

Note: Bold hypotheses indicate that the null hypothesis of no causality is rejected.

According to the results of the traditional causality tests, there is a causality from BDI to only food products sector returns. However, it is unrealistic to assume that BDI has no effect on the production-based BIST sectors index returns or that there is no causality from BDI to production-based BIST sectors index returns the entire analysis period. When the global shocks that occurred during the period covered in the study are considered, the need to analyze these relationships in more detail at the frequency level can be understood. In this context, in the last step of the analyses, the causality from BDI to production-based BIST sectors index returns were analyzed with the frequency causality test and the summary results are shown in Table 4.

Table 4. Results of Frequency Causality Test

	Long-term	Mid-term	Short-term
BDI $\nRightarrow$ AUTO	+	+	-
BDI $\nRightarrow$ BRWR	-	-	+
BDI $\nRightarrow$ BSMT	+	-	-
BDI $\nRightarrow$ CHMC	+	-	-
BDI $\nRightarrow$ CNSM	-	-	+
BDI $\nRightarrow$ CONS	-	+	+
BDI $\nRightarrow$ COPS	+	-	-
BDI $\nRightarrow$ COVP	-	-	-
BDI $\nRightarrow$ ENEG	-	-	+
BDI $\nRightarrow$ FOBT	+	-	-
BDI $\nRightarrow$ FOPD	+	-	+
BDI $\nRightarrow$ FORW	-	-	+
BDI $\nRightarrow$ GLDM	-	-	-
BDI $\nRightarrow$ GLSS	-	-	-
BDI $\nRightarrow$ HHGS	+	-	-
BDI $\nRightarrow$ INDY	+	-	-
BDI $\nRightarrow$ INGS	-	+	+
BDI $\nRightarrow$ IRST	-	-	-
BDI $\nRightarrow$ MNNG	-	-	-
BDI $\nRightarrow$ OLGC	+	-	-
BDI $\nRightarrow$ PRCM	-	-	+
BDI $\nRightarrow$ SFTD	-	+	+

Note: The “+” sign indicates that there is a causal relationship from BDI to the relevant BIST sector index return in the specified period, while the - sign indicates that there is no causal relationship.

According to the results of the frequency causality test, there is causality from BDI to 17 sector returns in different periods. In other words, there are causal relationships from BDI to all of the sector index returns at different frequencies, except for gold mining, glass, iron and steel, mining, and commercial vehicles parts sectors. As can be seen from Table 4, there is only short-run causality from the BDI to the brewers, construction and materials, energy, food retailers and wholesalers, and precious metals sectors, and only long-run causality to the basic materials, chemicals, consumer products and services, food, beverage and tobacco, household goods, industrials, and oil, gas, and coal sectors. The study also identified causal relationships from the BDI to specific sectors across multiple periods. According to the frequency causality test results, there is a causal relationship from the BDI to the automobile sector in both the long and medium term, to the food products sector in both the long and short term, and to the construction, industrial goods and services, and soft drinks sectors in both the short and medium term. This finding reveals that BDI, which generally reflects global freight costs, is an effective external indicator for many of the production-based sectors in Turkey.

The gold mining industry is sensitive to factors such as global commodity prices, geopolitical risks, inflation expectations, and financial uncertainties in terms of production processes and market valuation. Since gold is a high-value, low-volume commodity, transportation costs play a relatively minor role in this sector. Therefore, fluctuations in freight prices do not significantly affect sectoral performance. The glass industry is a sector that generally has a production structure based on domestic inputs. Glass products are high-volume but low-value-added products, and generally, land transportation is preferred in the sector. For this reason, the effect of changes in maritime transportation costs on the glass industry is quite limited. The iron and steel sector is directly dependent on many of the raw materials, such as iron ore and coal. However, long-term contracts are preferred for the supply of these raw materials, and transportation costs are fixed at a certain level, in general. Additionally, the iron and steel sector is more sensitive to global demand and pricing than to short-term fluctuations in transportation costs. This may be the reason why there is no causality from the BDI to the sector. The mining sector is a sector that generally requires fixed investment and long-term production planning. The transportation of products in this sector is often done by land transport in the domestic market, or large volume exports are based on long-term freight contracts. Therefore, changes in the BDI do not have immediate effects on the mining industry. The commercial vehicle parts sector is affected by factors such as domestic demand, automotive sub-industry production, technological developments, and trade policies. Also, since the sector is more dependent on regional supply chains, the impact of changes in BDI remains indirect.

As can be seen from Table 4, there are only short-run causal relationships from BDI to returns of brewers, precious metals, energy, food retailers and wholesalers, and construction materials sectors. This finding indicates that these sectors respond more quickly to short-term changes in global transportation costs and that freight-related shocks have temporary effects on the pricing of these sectors. In sectors that are dependent on imports for agricultural inputs and packaging materials, such as brewers, sudden changes in freight prices quickly reflect in the cost structure. However, the permanence of this effect remains limited due to low demand elasticity in the sector and strong inventory management practices. Similarly, the profitability of the precious metals industry is dependent on transportation processes. On the other hand, the effect of short-term transportation shocks is limited because precious metals are indexed to global commodity prices, and the share of logistics costs in total costs is low. As for the energy sector,

it can be said that although the sector is affected by fluctuations in transportation costs in the short term, it can absorb these shocks over time through price regulations. In sectors based on the trade of fresh and perishable products, such as food retailers and wholesalers, short-term transportation delays and cost increases are directly reflected in pricing. However, due to the mandatory consumption nature of the products and high stock turnover rates, these effects are generally temporary. In the construction materials sector, which has a project-based costing feature, transportation costs are important with regards to especially for heavy and bulky construction inputs. However, short-term freight shocks can be offset by project-based price revisions. Although these sectors, for which only short-term causality has been determined, are highly sensitive to volatility in global transportation costs, the duration of this effect is limited. Short-term freight shocks can be compensated by the internal dynamics of the sectors, demand characteristics and the flexibility of the supply structure. Therefore, BDI-originated shocks in these sectors are temporary and do not create a long-term structural effect.

According to the results of the frequency causality test, there are only long-term causal relationships from BDI to the returns of the household goods, food, beverage and tobacco, basic materials, chemicals, oil, gas and coal, industrials and consumer products and services sectors. This finding shows that energy and commodity-based sectors in particular are permanently affected by global logistics trends. The production processes of energy and commodity-based sectors are largely based on international supply chains and high-volume transportation activities. The inputs used in these sectors are generally high-volume products such as crude oil, natural gas, coal, chemical compounds, etc. Long-term increases in transportation costs are directly and permanently reflected in the supply costs of these inputs, which can cause structural changes in the cost structure of sectors. Similarly, production activities in sectors such as food, beverage, and tobacco are affected by permanent changes in global logistics in the long term due to both the dependence on agricultural raw material imports and the sensitivity to international distribution networks. In sectors such as household goods, industrial, consumer products, and services, production is generally made in high volume, for long-lasting products and international markets. Long-term trends in freight prices, due to their nature, play a determining role in the competitiveness, pricing strategies, and investment decisions of these sectors. These results reveal that structural trends in transportation costs have long-term effects on the cost structure, profitability level, and strategic decisions of the sectors in question. Therefore, long-term changes in the BDI have the feature of being important indicators in the context of sectoral transformation and strategic planning, beyond short-term changes for these sectors.

In some of the sectors covered in the study, causality relationships at multiple frequency levels were observed. Causality relationships were found between BDI and returns of industrial goods and services, soft drinks, and construction sectors in both the medium and short term. This finding reveals the sensitivity of these sectors to both temporary and medium-term trends in the freight index. The soft drinks sector has a structure integrated into international logistics processes in terms of both the supply of agricultural raw materials and the distribution of finished products. Therefore, while short-term fluctuations in freight prices cause temporary disruptions in the supply chain, medium-term trends in freight prices shape the cost dynamics by affecting decision areas such as production planning and inventory management. Similarly, the industrial goods and services sector has a production structure based on the high-volume transportation of machinery, equipment, and semi-finished inputs. Short-term changes in freight prices affect stocking and supply speed in this sector, limiting operational flexibility. Medium-term trends are determinants

in the diversification of supply sources, the use of alternative transportation routes, and the determination of cost strategies. In terms of the construction sector, the transportation of both construction materials and project-based imported equipment and technological products makes the sector directly dependent on maritime transportation. In this context, it is inevitable that the construction sector will be exposed to both short-term freight shocks and medium-term transportation cost trends.

Empirical findings show that there are causalities from BDI to automotive sector returns in the long and medium term, and from food products sector returns in the long and short term. The automotive industry is a sector that has a production structure integrated into the global supply chain and requires the supply of high-tech components from different countries. While production processes in this sector are often based on long-term supply agreements and specific production cycles, medium-term logistics trends directly affect production planning, stock levels, and cost projections. Therefore, while medium-term structural trends in the freight index necessitate the re-evaluation of supply routes, long-term trends can reshape investment decisions, production geography, and global strategic partnerships. The food products sector has shorter-term production and distribution cycles, but is also affected by long-term structural logistics trends. For the sector, short-term freight fluctuations create direct cost pressure, especially in terms of transportation of seasonal products and supply continuity, and cause rapid effects that are reflected in shelf prices. In addition, long-term transportation trends are one of the determining factors in the location selection of production centers in the sector, international supply chain design, and cost management strategies. In an environment where structural factors such as climate change, geopolitical risks, and global supply shocks continuously affect transportation costs, the sector's sensitivity to long-term transportation costs is also of critical importance in terms of food security and price stability. When the results are evaluated in general, it is seen that BDI creates different effects on production-based sectors depending on the frequency, and that real sector pricing in Turkey is in an integrated structure with global logistics costs.

5. Conclusion

In the study, the relationships between the BDI, representing the global maritime transport sector, and the return of 22 production-based sectoral stock indexes traded in BIST were analyzed by a frequency causality test. The analysis results show that there are causal relationships from the BDI to the stock market, similar to the studies of Liv d. (2017), Özdemir Höl et al. (2022), Sartorius et al. (2018), Yılmaz and Emir (2021), and Abakah et al. (2024). However, in the study, the relationship between BDI and returns of the stock index has been investigated on a sectoral basis, unlike the studies in the literature. The most important finding of the study is that there are causal relationships from BDI to the majority of BIST production-based sector index returns in different periods.

The results obtained from the analyses on frequency separation basis revealed that BDI has a short-term relationship with some sector returns, a long-term relationship with some sector returns, and a relationship with some sector returns at multiple frequency levels (short, medium, and long term). This shows that the responses of sectors to logistics shocks differ in time and that sectoral dynamics shape these differences. With the study, causal relationships were determined from BDI to the returns of brewers, precious metals, energy, food retailers and wholesalers, and construction materials sectors only in the short-term. In these sectors where short-term causal

relationships are observed, sensitivity to rapid changes in BDI is quite high. In other words, these sectors tend to be affected by sudden fluctuations in logistics costs in a short time. For this reason, investors following short-term investment strategies may be advised to be more careful about sudden price movements in these sectors and implement hedging strategies in their portfolios. For this reason, it can be advised to investors following short-term investment strategies to be more careful about sudden price movements in these sectors and implement hedging strategies in their portfolios.

The results show that there are only long-term causalities from BDI to returns of the household goods, food, beverage and tobacco, basic materials, chemicals, oil, gas, coal, industrials and consumer products and services sectors. This indicates that the mentioned sectors are more sensitive to structural and permanent changes in the BDI. The production processes of companies operating in these sectors are affected by long-term trends in freight costs. Therefore, investors who want to invest in these sectors for the long-term should closely monitor transformations in global trade flows and trends in transportation costs and shape their strategic positions accordingly.

Another result that the study indicates is the presence of causal relationships at multiple frequencies from BDI to the returns of the soft drinks, industrial goods and services, construction, automotive, and food products sectors. These sectors are affected by both temporary and permanent changes in freight costs and offer various opportunities to active traders and long-term investors. Investors who want to invest in these sectors may be advised to use both short-term technical analysis and long-term fundamental analysis together. Finally, it is evaluated that alternative sectoral or non-sectoral indicators, such as exchange rates, commodity prices, domestic demand indices, etc., can be more decisive for the investors investing in sectors where no causalities are detected at any frequency, such as gold mining, glass, iron and steel, mining, and commercial vehicle parts. When the results are evaluated as a whole, it can be recommended to the investors investing in the BIST sector indices to take into account the sectoral effects of global logistics indicators such as BDI, differentiate their portfolio strategies in line with these sensitivities and optimize them according to time frequency.

The study results point to the necessity of strategic policies that will increase resilience to logistics shocks at the sectoral level, in addition to economic policies that aim to ensure macroeconomic stability. In energy and food-based sectors, where short-term causalities are identified and which are highly sensitive to logistics shocks, short-term disruptions in the supply-demand balance may rapidly be reflected in prices. It is important to develop early warning systems in these sectors and to establish public support mechanisms that provide short-term flexibility. Tools such as temporary tax arrangements, import facilities, or strategic stockpiling programs may be useful, especially for protecting critical supply chains and reducing the effects of short-term shocks. The macroeconomic effects of freight fluctuations can be reduced by encouraging investments that will reduce the dependency of companies, which operate in sectors where a long-term causality relationship has been identified, on the logistics chains. In this context, it is very important to strengthen domestic transportation capacity, increase railway and port infrastructure investments, and develop regional supply chain strategies within the scope of long-term policies. In summary, the frequency-based sectoral differences revealed by this study indicate that economic management and sectoral policy makers should focus on time-dynamic and sector-specific policies rather than one-dimensional ones. In summary, the frequency-based sectoral differences revealed by this study indicate that economic management and sectoral policy

makers should focus on time-dynamic and sector-specific policies rather than one-dimensional ones. If decision makers develop policies that are sensitive to these differences, this will contribute to sustainable economic growth by increasing the resilience of Turkey's production structure against external shocks.

The study is conducted based on indices for manufacturing sectors traded on the Borsa Istanbul. Therefore, the results are limited to the Turkish sample, and it would be beneficial to conduct analyses for markets in other countries in order to make generalization for the results. Additionally, the study used frequency causality test, but positive/negative shocks or permanent/temporary effects were not taken into account. Therefore, more detailed results can be obtained in future studies with asymmetric causality tests, structural break models or wavelet-based methods. Also, the BDI was used as the maritime transport indicator in the study. In future studies, the differences between sectors can be revealed more comprehensively by including container transportation indices or other indicators of the freight market in the analysis.

Declaration of Research and Publication Ethics

This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher's Contribution Rate Statement

I am a single author of this paper. My contribution is 100%.

Declaration of Researcher's Conflict of Interest

There is no potential conflicts of interest in this study.

References

- Abakah, E.J.A., Abdullah M., Dankwah, B. and Lee, C. (2024). Asymmetric dynamics between the Baltic Dry Index and financial markets during major global economic events. *North American Journal of Economics and Finance*, 72, 102126. <https://doi.org/10.1016/j.najef.2024.102126>
- Açık, A. and Baser, S.O. (2018). Is Baltic Dry Index efficient? *Journal of Yasar University*, 2018, 13(50), 140-149. <https://doi.org/10.19168/jyasar.368149>
- Akkan, M.M. (2024). Ticaret savaşları, koronavirüs salgını ve jeopolitik risklerin denizyolu taşımacılığına ve dünya ticaretine etkisi: Baltık Kuru Yük Endeksi verilerinin incelenmesi. *Fivezero*, 4(2), 82-101. <https://doi.org/10.54486/fivezero.2024.37>
- Apergis, N. and Payne, J.E. (2013). New evidence on the information and predictive content of the Baltic dry index. *International Journal of Financial Studies*, 1(3), 62–80. <https://doi.org/10.3390/ijfs1030062>
- Barut, A., Görgün, M. and Erdoğan, A. (2020). Baltık kuru Yük Endeksi ve Dow Jones Demir- Çelik Endeksi arasındaki ilişki. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi*, 9(3), 3019-3033. <https://doi.org/10.15869/itobiad.700223>
- Başer, S.Ö. and Açık, A. (2019). The effects of global economic growth on dry bulk freight rates. *Uluslararası Ticaret ve Ekonomi Araştırmaları Dergisi*, 3(1), 1-17. <https://doi.org/10.30711/utead.507566>
- Bildirici, M.E., Kayıkçı, F. and Şahin Onat, I. (2015). Baltic Dry Index as a major economic policy indicator: The relationship with economic growth. *Procedia – Social and Behavioral Sciences*, 210, 416-424. <https://doi.org/10.1016/j.sbspro.2015.11.389>
- Breitung, J. and Candelon, B. (2006). Testing for short and long-run causality: A frequency-domain approach. *Journal of Econometrics*, 132(2), 363-378. <https://doi.org/10.1016/j.jeconom.2005.02.004>
- Çanakçıran, F., Çelik Keçili M., Esen, E. and Temizel, F. (2020). Açıklanmış karşılaştırmalı üstünlükler endeksinin ve kapasite kullanım oranının hisse senedi fiyatları üzerindeki etkisi: Tekstil sektörü üzerine inceleme. *Business & Management Studies: An International Journal*, 8(3), 2600-2616. <http://dx.doi.org/10.15295/bmij.v8i3.1518>
- Eryüzlü, H. (2019). Dünya deniz ticareti ve Türkiye dış ticareti ilişkileri: Ekonometrik bir analiz. *The Journal of Social Sciences*, 3(3), 152-162. <https://doi.org/10.30520/tjsosci.524826>
- Esen, E., Yıldırım, S., Temizel, F. and Kütükcüler, G. (2020). Makroekonomik değişkenlerin Borsa İstanbul Hizmetler Endeksi (XUHI) üzerine etkileri. *Girişimcilik ve Kalkınma Dergisi*, 15(2), 15-33. Retrieved from <https://dergipark.org.tr/tr/pub/girkal/issue/60057/780634>
- Garayev, B., Çelik Keçili, M., Esen, E. and Temizel, F. (2021). CDS primi ve faiz oranının BİST Banka Endeksine etkisi: Türkiye üzerine ampirik bir inceleme. *Alanya Akademik Bakış*, 5(1), 231-244. <https://doi.org/10.29023/alanyaakademik.749032>
- Geman, H. and Smith, W.O. (2012). Shipping markets and freight rates: An analysis of the Baltic dry index. *Journal of Alternative Investments*, 15(1), 98–109. <https://doi.org/10.3905/jai.2012.15.1.098>
- Geweke, J. (1982). Measurement of linear dependence and feedback between multiple time series. *Journal of the American Statistical Association*, 77, 304-324. <https://doi.org/10.1080/01621459.1982.10477803>
- Hosoya, Y. (1991). The decomposition and measurement of the interdependence between second order stationary processes. *Probability Theory and Related Fields*, 88(4), 429-444. <https://doi.org/10.1007/BF01192551>
- Işığçık, E. and Tarkun, S. (2023). Estimation of world maritime trade volatility with day of the week anomaly: Baltic Dry Index application. *Dokuz Eylül University Maritime Faculty Journal*, 15(2), 166-188. <https://doi.org/10.18613/deudfd.1279863>
- Jurun, E., Ratkovic, N. and Moro, F. (2015). The Baltic Dry Index and performance excellence in a crisis environment. *Croatian Research Review*, 6(2), 335-346. Retrieved from <https://ojs.srce.hr/>

- Kamışlı, M. and Temizel, F. (2019). Finansal korku endeksleri arasındaki ilişkilerin analizi. *Giriřimcilik ve Kalkınma Dergisi*, 14(2), 167-176. Retrieved from <https://dergipark.org.tr/pub/girkal>
- Kamışlı, M., Kamışlı, S. and Temizel, F. (2019). Globalization and time-varying market efficiency: An innovative approach. In H. Dinçer and S. Yüksel (Eds.), *Handbook of research on managerial thinking in global business economics* (pp. 480-499). <https://doi.org/10.4018/978-1-5225-7180-3.ch027>
- Kılıç, M. and Gürbüz, A. (2025). Baltık Kuru Yük Endeksi ve dolar endeksinin İstanbul Navlun Endeksi üzerindeki etkisi: VAR analizi ile incelenmesi. *Trakya Üniversitesi Sosyal Bilimler Dergisi*, 27(Özel Sayı), 227-252. <https://doi.org/10.26468/trakyasobed.1515540>
- Li, S., Wei, L. and Wu, H. (2017). *Stock market and the Baltic dry index: Volatilities and correlations in China's business cycle*. Papers presented at the European Financial Management Symposium. Retrieved from <https://www.efmaefm.org/0EFMSYMPOSIUM/2017/papers/paper%20for%20conference.pdf>
- Lin Y.J. and Wang C.C. (2014). The dynamic analysis of Baltic exchange dry index. *International Mathematical Forum*, 2014(9), 803-823. <https://dx.doi.org/10.12988/imf.2014.4473>
- Lin, F. and Sim, N.C.S. (2013). Trade, income and the Baltic dry index. *European Economic Review*, 59, 1-18. <https://doi.org/10.1016/j.eurocorev.2012.12.004>
- Manoharan, M. and Visalakshmi, S. (2019). The interrelation between Baltic Dry Index a practical economic indicator and emerging stock market indices. *Afro-Asian J. Finance and Accounting*, 9(2), 213-224. <http://dx.doi.org/10.1504/AJFA.2019.099483>
- Meriç, E., Kamışlı, M. and Temizel, F. (2017). Interactions among stock price and financial ratios: The case of Turkish banking sector. *Applied Economics and Finance*, 4(6), 107-115. <http://dx.doi.org/10.11114/aef.v4i6.2755>
- Oğuz, Y.A. (2024). Denizyolu taşımacılığının küresel tedarik zincirlerindeki önemi. *Tam Akademi Dergisi*, 3(1), 86-103. <https://doi.org/10.58239/tamde.2024.01.006.x>
- Özcan Akdağ, N., Kocabıyık, T. and Karaatlı, M. (2023). Determining the casual relationship between Baltic Dry Index (BDI) and macroeconomic variables by Toda-Yamamoto analysis. *Journal of Management and Economic Research*, 21(1), 59-80. <http://dx.doi.org/10.11611/yead.1173114>
- Özdemir Höl, A., Akyıldırım, E., Kılıçaslan, Ş. and Çınar, K. (2022). Baltık Kuru Yük Endeksi, petrol, altın, dolar, MSCI Dünya Endeksi arasındaki volatilité yayılımı. *Ekonomi, Politika & Finans Arařtırmaları Dergisi*, 7(2), 386-406. <https://doi.org/10.30784/epfad.1089836>
- Özdemir, A., Temizel, F. and Esen, E. (2019). Borsa İstanbul Teknoloji Endeksi (XUTEK) řletmelerinin sosyal medya kullanımları ile finansal performanslarının deęerlendirilmesi. *Business & Management Studies: An International Journal*, 7(4), 1173-1187. <https://doi.org/10.15295/bmij.v7i4.1132>
- Pepur, P., Peronja, I. and Laca, S. (2022). Global market factors that impact Baltic Dry Index. *Multidisciplinary Scientific Journal of Maritime Research*, 36(2022), 242-248. <https://doi.org/10.31217/p.36.2.8>
- Salar, A. (2022). Asymmetric reflection of shocks in Baltic Dry Index to Istanbul Freight Index. *Acta Natura et Scientia*, 3(1), 15-23. <https://doi.org/10.29329/actanatsci.2022.351.02>
- Sartorius, K., Sartorius, B. and Zuccollo, D. (2018). Does the Baltic Dry Index predict economic activity in South Africa? A review from 1985 to 2016. *South African Journal of Economic and Management Sciences*, 21(1), 1-9. <https://doi.org/10.4102/sajems.v21i1.1457>
- Şahan, D., Memişoğlu, R. and Bařer, S.Ö. (2018). Predicting Baltic Dry Index with leading indicators. *Dokuz Eylöl University Maritime Faculty Journal*, 10(2), 233-248. <https://doi.org/10.18613/deudfd.495820>
- Yıldız, B. and Bucak, U. (2017). Determinants of freight rates: A study on the Baltic dry index. *Istanbul Gelisim University Journal of Social Sciences*, 4(2), 17-32. <https://doi.org/10.17336/igusbd.317006>

- Yılmaz, T. and Emir, S. (2021). Petrol fiyatları ve Baltık Kuru Yük Endeksinin sermaye piyasaları üzerindeki etkilerinin incelenmesi: Ekonometrik bir araştırma. *Uluslararası İşletme, Ekonomi ve Yönetim Perspektifleri Dergisi (IJBEMP)*, 5(2), 861-876. <http://dx.doi.org/10.29228/ijbemp.54935>
- Yurdakul, E.M. and Şipal, Y.Z. (2022). Deniz yoluyla ihracat, Baltık Kuru Yük Endeksi ve ham petrol fiyatları ilişkisi: Türkiye örneği. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 3(44), 351-368. Retrieved from <https://dergipark.org.tr/tr/pub/sbe>
- Zeren, F. and Kahramaner, H. (2019). Baltık Kuru Yük Endeksi ile İstanbul Navlun Endeksi arasındaki etkileşimin incelenmesi: Ekonometrik bir uygulama. *Journal of International Management, Educational and Economics Perspectives*, 7(1), 68-79. Retrieved from <https://dergipark.org.tr/en/pub/jimeep>