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DETERMINING THE CAUSAL RELATIONSHIP BETWEEN BALTIC DRY INDEX (BDI) AND MACROECONOMIC VARIABLES BY TODA-YAMAMOTO ANALYSIS

Nesrin ÖZCAN AKDAĞ (Ph.D.C.) *

Assoc. Prof. Turan KOCABIYIK (Ph.D.) *

Prof. Meltem KARAATLI (Ph.D.) *

ABSTRACT

The Baltic Dry Index (BDI) is the most critical indicator taking the pulse of maritime trade. Hence, it is essential to determine the macroeconomic variables that affect the BDI, which is a solid indicator for global economic activities in maritime transport.

This research paper aims to investigate the association between macroeconomic indicators and the BDI. For this purpose, the Toda-Yamamoto approach was performed to examine the causal association between macroeconomic variables and the BDI. The Lee-Strazicich (LS) unit root test was applied based on Model C (break) to determine the stationary of the time series.

The research's findings shed significant light on the causal relationship between the BDI and macroeconomic variables. According to the Toda-Yamamoto causality test results: BDI has a two-way relationship with S&P 500 and MSCI World indexes; besides, there is a one-way causality from €/$ parity and VIX (Cboe) to the BDI. Furthermore, the causality was determined from BDI to BCOM, US10Y, and BRENT variables. The research findings can help BDI Futures contract investors, maritime trade authorities, and policymakers to understand the general nature of BDI. Thus, monitoring the price movements of macroeconomic variables, which have causality with BDI, can minimize economic risks in global trade.

Keywords: *Baltic Dry Index, Lee-Strazicich Unit Root Test, Toda-Yamamoto Approach, Causality Analysis.*

Jel Codes: *C12, C32, C58, E43, R4.*

* Süleyman Demirel University, Department of Business Administration, YÖK 100/2000 Logistic Program, Isparta/ Türkiye. E-mail: nsrnozcan@gmail.com
* Süleyman Demirel University, Faculty of Economics and Administrative Sciences, Department of Business Administration, Isparta/ Türkiye. E-mail: turankocabiyik@sdu.edu.tr
* Süleyman Demirel University, Faculty of Economics and Administrative Sciences, Department of Business Administration, Isparta/ Türkiye. E-mail: meltemkaraatli@sdu.edu.tr

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1. INTRODUCTION

From the 1950s to the present, there is a significant increase in world trade volume with globalization effects. Therefore, an increase in demand will also result in a proportionate increase in transportation activity. Compared to the road, airway, and railway modes seaway is the most preferred transportation option in global trade. Approximately 84% of all freight transported worldwide is shipped by sea. Basically, as stated in the International Chamber of Shipping report (2019), about 50,000 merchant ships are registered in more than her 150 countries and are operated by millions of seafarers (Başer and Açık, 2019; Bandyopadhyay and Rajib, 2021). Maritime transportation provides extensive transport networks and high-volume transport capacity; therefore, maritime transport provides cost-effective service (Yıldız and Bucak, 2017). BDI is the key indicator of the cyclical nature of the shipping market. In light of these advances, the BDI is not only considered the most crucial indicator of sea freight prices but also one of the main determinants of global trade (Cancı and Güngören, 2013; Jurun, Ratkovic, and Moro, 2015). The London-based Baltic Exchange issues the BDI price daily which started as the Baltic Freight Index in 1985 (Laulajainen, 2007; Alizadeh and Talley, 2011; Yıldız and Bucak, 2017). The BDI reflects the changes in freight prices in real-time updates without speculation in maritime trade. Especially in the last few years, the idea that the BDI can be an important indicator of economic dynamics has spread. Besides that, BDI, which appears in global trade, consists of transportation costs, and monitors price offers for transportation, is considered a powerful economic indicator by many economic authorities (Lin and Wang, 2014; Saraç, Zeren and Başar, 2015; Şahin et al., 2018; Açık and Başer, 2021). In addition to indices such as Supramax, Panamax, and Capesize, each of which belongs to a separate field, economists and market investors daily follow the BDI. BDI is a leading economic indicator as it sheds light on the future of economic activities. Briefly, nowadays the BDI has managed to attract the attention of commercial actors in shipping networks and financial investors, as it is the most reliable common measure of the dry cargo freight market (Papailias, Thomakos and Liu, 2017).

Economies that are already fragile can be affected by unpredicted cases easily. Since the World Health Organization declared the pandemic (2019-nCoV) on January 30, 2020 (Wu, Chen and Chan, 2020), global trade has been greatly affected and transportation costs have unexpectedly increased. The slowing maritime traffic in the post-pandemic has led to a shortage of containers (Shamika and Sirimanne, 2021). For example, as stated by UNCTAD (2022) the BDI, which is considered a global benchmark for dry bulk freight rates, increased by % 59 between February 2022 and May 2022. During the COVID-19 pandemic period, the fragility of the global economy has shown the risks in worldwide trade and how countries are affected by these negative results such as container shortages. In addition, the consequences such as unpredictable freight rates in supply chain disruptions show just how serious the global crisis was. Countries, policy makers, businesses and investors are affected by hot tensions, cold wars, pandemics, and all other negative changes while making strategic decisions. Therefore,

analysing the macro environment in detail to make sensible moves is vital. Today, sustainability in maritime trade is very important to prevent supply chain disruptions. For the sustainability of the global supply chain, following such indexes and interpreting them correctly will support this purpose. Therefore, businesses, shipowners, investors, and policymakers need to understand the macroeconomic variables that affect freight rates.

Today's businesses need accurate information to maintain their competitive advantage. The information sources need to be quite valid and reliable, thus BDI is accepted as a critical reference source for understanding the bulk shipping market (Lin & Sim, 2013; Lin & Wang, 2014). Moreover, this indicator is an essential basis for predicting stagnations, growths, and recessions that may occur in the economy. BDI is a strongly representative indicator due to open supply and demand forces, the number of ships using it, and the fact that containers around the world stay within a certain limit (Geman and Smith, 2012; Bildirici, Kayıkçı, and Onat, 2015; Sartorius, Sartorius, and Zuccollo, 2018). BDI is known as a measure of the state of the economy (Bakshi, Panayotov, and Skoulaki, 2011), and it is accepted as an indicator of efficiency in the maritime sector, which is very important for businesses trying to compete in a capital-intensive industry (Açık and Başer, 2018; Açık and Başer, 2021).

This paper aims to investigate the causal relationship between the BDI and macroeconomic variables by applying the Toda-Yamamoto approach. This research not only completes previous empirical papers but also differs from the existing literature in some aspects. Firstly, this study includes variables such as the Twitter-Based Economic Uncertainty Index (TEU), Web Search Based Uncertainty Index (EURQ), and World Trade Volume (USD Billion). Secondly, the data sample is up to date in terms of it covers the post-COVID-19 era and the Russian-Ukrainian Conflict (started on 24 February 2022) which caused disruption to maritime trade (UNCTAD, 2022). Lastly, previous studies mostly used the Granger causality test. However, in this research paper, the Toda-Yamamoto approach was used which guarantees the asymptotic distribution of the Wald statistic (Alimi and Ofonyelu, 2013). Among others in field literature, this paper has similarities and differences with Graham, Peltomäki, and Piljak (2016), Ruan, et al. (2016), Yıldız and Bucak (2017), Cihangir (2018), Eryuzlu (2019), Kiracı and Akan (2020), Gao, Zhao, and Zhang (2021), Bandyopadhyay and Raji (2021)'s paper in terms of obtained results.

In this context, 12 macroeconomic variables are used in the study. The variables of this research as follows: Baltic Dry Index (BDI), Bloomberg Commodity Index (BCOM), Twitter-Based Economic Uncertainty Index (TEU), Web Search Based Uncertainty Index (EURQ), S&P 500, Index MSCI World Index, €/$ Parity, VIX Cboe (Chicago board options exchange), USA 10 Years Bond Yield (%), Brent oil (USD/Barrel), Global Economic Uncertainty Index (GEPU), and World Trade Volume (WTV USD Billion) series, respectively. BDI provides a price criterion for the transportation of raw materials by sea, as it creates trends according to the fluctuation of supply and demand in international trade. For this reason, the World Trade Volume (USD Billion) variable, which is the leading indicator of global trade,

is included in the study. Conjointly, it is thought that the BDI movements may light on the commodity price fluctuation. In this case, the BCOM variable was involved in the research to clarify this belief. Global supply and demand fluctuations are influential on changes in international stock markets. The companies, which accelerated their exports with the increase in production, revived with the increase in transportation demands, and this positively affects the liquidity in the markets. The upward movement of liquidity is thought to increase the interaction between BDI, the S&P 500 variable, which constitutes approximately 75% of the US stock market, and the MSCI World index. Including these variables in the analysis can provide a better understanding of financial markets. As a main cost for the transportation industry, Brent price is also included in the research. Funding costs are very important for businesses, regardless of the operation field they belong. In this research, USA 10-year bond yields were used as a financing cost. In addition, the Twitter-Based Economic Uncertainty Index (TEU), the Global Economic Risk Index (GEPU), and the VIX Cboe index, which are rarely encountered in the literature, were included in the research. Thus, it was tried to discover whether psychological factors influence the dependent variable BDI. The LS unit root test was applied which calculates the breaks in the time series for data analysis. Afterward, the Toda-Yamamoto causality test was applied to the variables.

The structure of this research is organized as follows: The first section of this research introduced the literature review to present the framework. In the second section, the variables of the dataset analysed in the paper are given in detail and presented in a brief table. The methodology of the research is given right after the data information. The third chapter includes the empirical results and analyses of the research. In the last section conclusion of the paper is given.

2. LITERATURE OVERVIEW

There are many studies on the Baltic Dry Index in the literature. In this section, causality studies about the BDI are given as a brief of the literature. Saraç et al. (2015) revealed the causal relationship between the BDI, the United States Supplementary Nutrition Assistance Program (SNAP), and global gold prices. The data used in the study are from 1988 to 2012. Through the causality analysis, it was detected that global gold prices have a significant and same-sided relationship with SNAP expenditures and a powerful, same-directional but weak association with BDI in the short run (Saraç, Zeren and Başar, 2015). Bildirici et al. (2015) aimed to determine the association between the BDI and economic growth in the United States. The authors applied the MOSIAH (3) -VAR (4) model to analyse the BDI and Gross Domestic Product (GDP). According to the analysis result that there is a significant relationship between the BDI and GDP (Bildirici, Kayıkçı and Onat, 2015). Saraç and Başar (2015) examined the association between global gold prices and the United States (US) National Debt Stock and the BDI as an indicator of economic vitality in the US. The research results showed that there is a significant association between global gold prices, the US National Debt Stock, and the BDI was revealed (Saraç and Başar, 2015).

Graham, Peltomäki, and Piljak (2016) aimed to investigate the long-term relationships between BDI, commodity index, and various MSCI values in their research. The research sample of the study covers the period from November 1997-September 2013. According to the obtained results of the analysis, the authors stated that BDI is an important indicator for economic activities and is a valid source for explaining stock returns in emerging markets. Ruan, et al. (2016) analysed the cross-correlation between the BDI, Brent crude oil, and Intermediate West Texas (WTI) crude oil prices. The empirical analysis was conducted by using the cross-correlation statistical test, and multi-directional reduced cross-correlation analysis (MF-DCCA). The research sample was generated with daily data from October 19, 1988, to February 3. According to the empirical results, it was revealed that the cross-correlations between the BDI and crude oil prices were significantly too fractal (Ruan et al., 2016).

Yıldız and Bucak (2017) inspected the associations between macroeconomic factors and the BDI. BDI was chosen as the dependent variable and independent variables were selected as, barley, corn, crude oil, cement, gross world product, thermal coal, phosphate rock, iron ore, and wheat. Following this, the causal relationship of the series was tested by multiple regression analysis. According to the findings, the changes in phosphate rock and barley prices are the most critical factors affecting the BDI. On the other hand, it has been determined that crude oil prices, which are the main cost factor of the sector, have a positive effect on the BDI, while the change in cement and corn prices have a negative impact (Yıldız and Bucak, 2017).

Cihangir (2018) examined the causality between the BDI and Volatility Index (VIX). The Error Correction Model, Cointegration Test, Kalman Filter approach, and Engle-Granger test were applied to data which covers 06.12.2010 to 30.11.2017. Empirical findings show that the VIX affected BDI positively and statistically significant. Wu et al. (2018) aimed to investigate the recovery time and causality relationship between BDI/BFI (Baltic Dry Cargo indexes), the Newbuilding Bulkcarrier Price index (NBP), and the Bulk Carrier Second-Hand Price index (SHP). The authors applied the Granger Causality test to find out the correlations between shipping markets. According to the test results, a causal relationship was found between these three indices (Wu, Yin and Sheng, 2018).

Zeren and Kahramaner (2019) investigated the relationship between the global scales of the BDI and the regional Istanbul Freight index (ISTFIX) by utilizing the weekly data for the period 05.2009-02.2019. The Carrion-i Sylvestre (2009) unit root test with multiple structural breaks, Maki (2012) multiple structural break co-integration tests, and Fourier (2015) causality tests were employed. The authors concluded a long-run association between the BDI and Istanbul Freight index (Zeren and Kahramaner, 2019). Eryuzlu (2019) pointed out the relationship between the BDI and Turkey's total exports and imports. The research sample was tested through the Toda-Yamamoto test and Hatemi-J asymmetric causality test. Under the light of research findings reveal that the increase in BDI prices causes a decrease in Turkey's export volume and, on the contrary, an increase in imports (Eryuzlu, 2019).

Barut et al. (2020) examined the association between the BDI and Dow Jones Iron-Steel index (DJSIW). According to the Fourier ARDL test and the Rolling Window method result, the long-run association between the BDI and the Dow Jones iron steel index was found out. (Barut, Görgün and Erdoğdu, 2020). Giannarakis et al. (2017), aimed to examine the relationship between the DJSIW and the BDI. The sample dataset covers October 1999 - July 2016 monthly data. Upon the empirical results, there is no causality between DSJIW and the BDI (Giannarakis et al., 2017). Kiracı and Akan (2020) conducted a study examining the association between the BDI, oil prices, and the US Dollar index. The monthly data, which covers the period of January 2000-December 2019, were used for the analysis. To conduct a causality analysis the Hacker and Hatemi-J (2006) symmetric and the Hatemi-J (2012) asymmetric tests were applied to the dataset. According to the empirical analysis findings, it is concluded that the BDI affects oil prices, besides the US Dollar index affects the BDI.

Açık, Okutucu, Efes, and Başer (2021), investigated the association between the BDI and the Federal Fund Rate. In the research, 302 monthly data observations were used. The observations cover the period from 1995 to 2020. The time-varying causality test was chosen as a method. According to analysis results, interest rates affect both the global economy and the dry bulk freight market. Gao, Zhao, and Zhang (2021) focused on the association between the BDI and global economic policy uncertainty (GEPU). For the analysis of the study, the linear Granger causality test was applied first. Following that, the nonlinear Granger causality test was conducted on the research dataset. The data sample has monthly data from January 1997 to October 2019 was used for the analysis. According to the analysis result, only a linear Granger causality relationship between both variables was determined (Gao, Zhao and Zhang, 2021). Bandyopadhyay and Rajib (2021) aimed to find out an asymmetric relationship between BDI and commodity spot prices. The authors used the causality-in-quantiles (CiQ) model in the research. The research dataset covers the period from June 2006 to November 2018. According to the empirical result, there was a causal association between the BDI and commodity spot prices (Bandyopadhyay and Rajib, 2021).

Furthermore, the paper of Sahan et al. (2018) was taken as a reference of the macroeconomic variables such as US 10-Year Bond yield and Commodity Index. The authors created a benchmarking model with the Box-Jenkins approach, which includes explanatory variables of the US 10-Year Bond yield, Gold Spot Price, Silver Spot Price, and Commodity Index (minerals, ores, and metals) selected to estimate the BDI in their study. The macroeconomic variables of the research model are gold and silver spot prices selected as the US 10-year bond yield and a commodity index consisting of minerals, ores, and metals. It has been interpreted that the model can serve as a reliable analytical tool for decision-makers (Sahan, Memişoğlu and Baser, 2018).

3. DATA AND METHODOLOGY

This study aims to discover the causal relationship between macroeconomic variables and the BDI, which is the leading indicator for shipping costs. The Baltic Dry Index (BDI) has provided a continuous time series since 1985. The BDI is traded on the Baltic Exchange, a London-based stock exchange that provides real-time shipping price information to foreign trade companies for the issuance of physical or other transportation contracts. There is a wrong belief that fluctuations in BDI price will only affect maritime trade in the Baltic countries. In order to change this belief, it should be underlined that the BDI is a reliable actor in the sustainability of the global supply chain. The index is calculated by taking the timer components of the Baltic Capesize Index (40%), Baltic Panamax Index (30%), and Baltic Supramax Index (30%). BDI is an independent answer to naval market information for commercial movements and settling both physical and derivative contracts (Lin and Wang, 2014). Additionally, this research study aims to guide investors, policymakers, and businesses through understanding the BDI movements to make the right investment decisions and prevent unforeseen cost risks. Interpreting macroeconomic flows that affect the BDI helps organizations achieve their strategic competitive goals (Lin, Chang and Hsiao, 2019). As the global trade volume increases, the shipping volume increases accordingly. In this volume, where supply and demand are decisive, the BDI and global marketplaces have a common economic and commercial drive (Bildirici, Kayıkçı and Onat, 2015). Having acknowledgment of those movements provides a competitive advantage in foreign trade and improves their financial health and increases their profitability.

In this research model, the Baltic Dry Index (BDI) represents the dependent variable. Additionally, the independent variables of the research are as follows: The Bloomberg Commodity Index (BCOM) variable, which represents 24 commodities belonging to the group energy, grains, industrial material, precious materials, softs, and livestock, respectively. Moreover, energy is the major group of the index with 29.83 % weight. Additionally, consists of 23 futures traded on physical commodities (Shahzad et al., 2022). Twitter-based Economic Uncertainty Index (TEU), which examines all, messages (tweets) that contain uncertainty-related keywords and Economy-related keywords (Baker et al., 2021). The Web Search Based Uncertainty Index (EURQ) was used in this research sample as the economic uncertainty-related queries index (Bontempi et al., 2021). The S&P 500 Index covers the 500 largest American companies that approximately 75% of the American stock market. The MSCI World Index is a market-based index created by using the prices of the most traded SPX options (Yang & Liu, 2012). Additionally, €/$ Parity, VIX Cboe (Chicago board options exchange) which was included in the research as the representation of the investor's fear and risk perception for the cost-related association. Moreover, USA 10 Years Bond Yield (%) is used as an indicator of global interest rates, besides, Brent oil (USD/Barrel), and Global Economic Uncertainty Index (GEPU) were also used in this research model. For centuries, it is known that commodity price volatility can affect to freight rates and trade volumes in shipping markets (Bandyopadhyay and Rajib, 2021) thus, the final indicator of the research

sample was selected as World Trade Volume (USD Billion). A comprehensive data set was used in the analysis to create a rich research model. Detailed information about the variables is shown in Table 1 and time-series graphics created with raw data are presented in Figure 1.

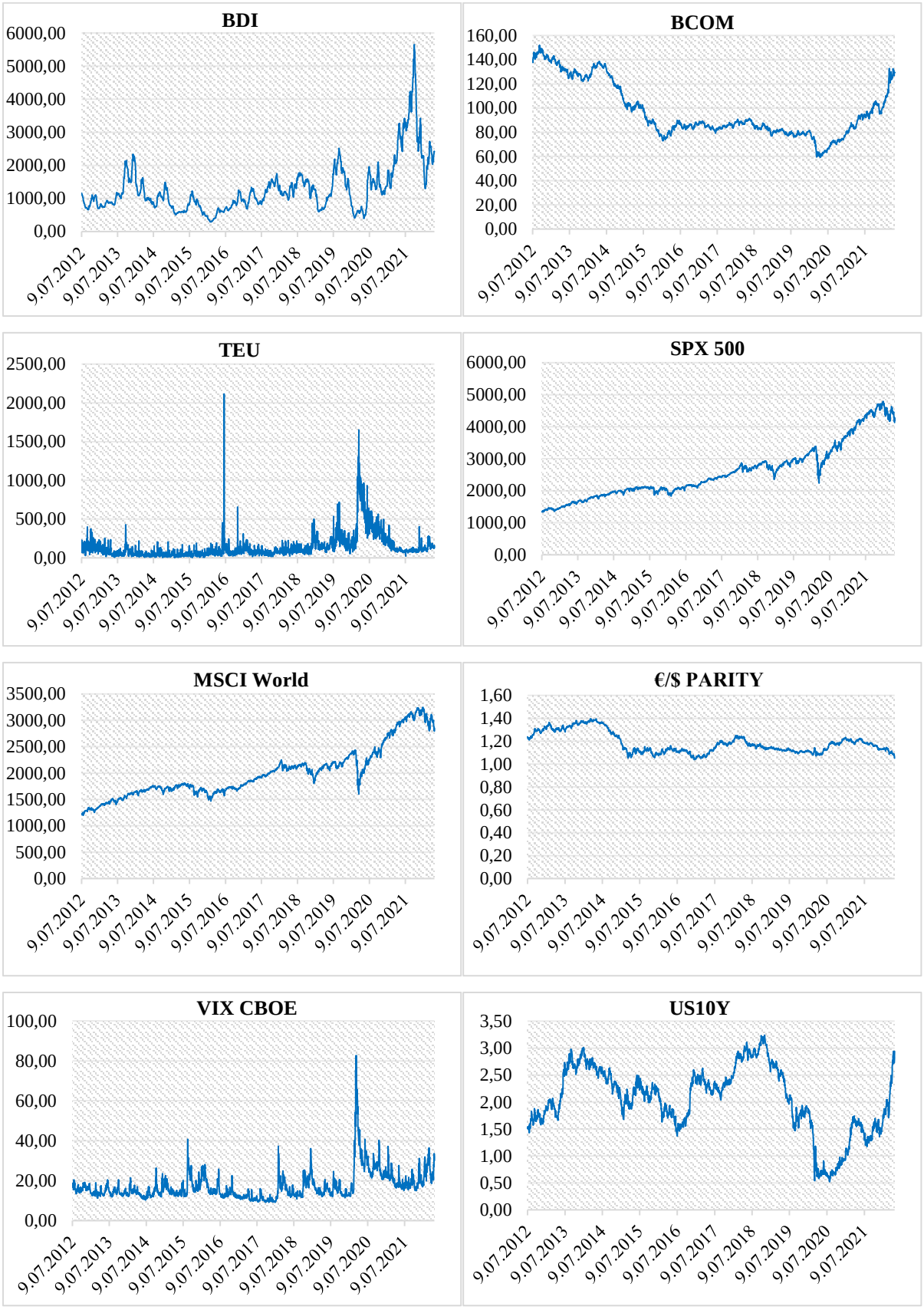
Table 1. The Data Set of Variables

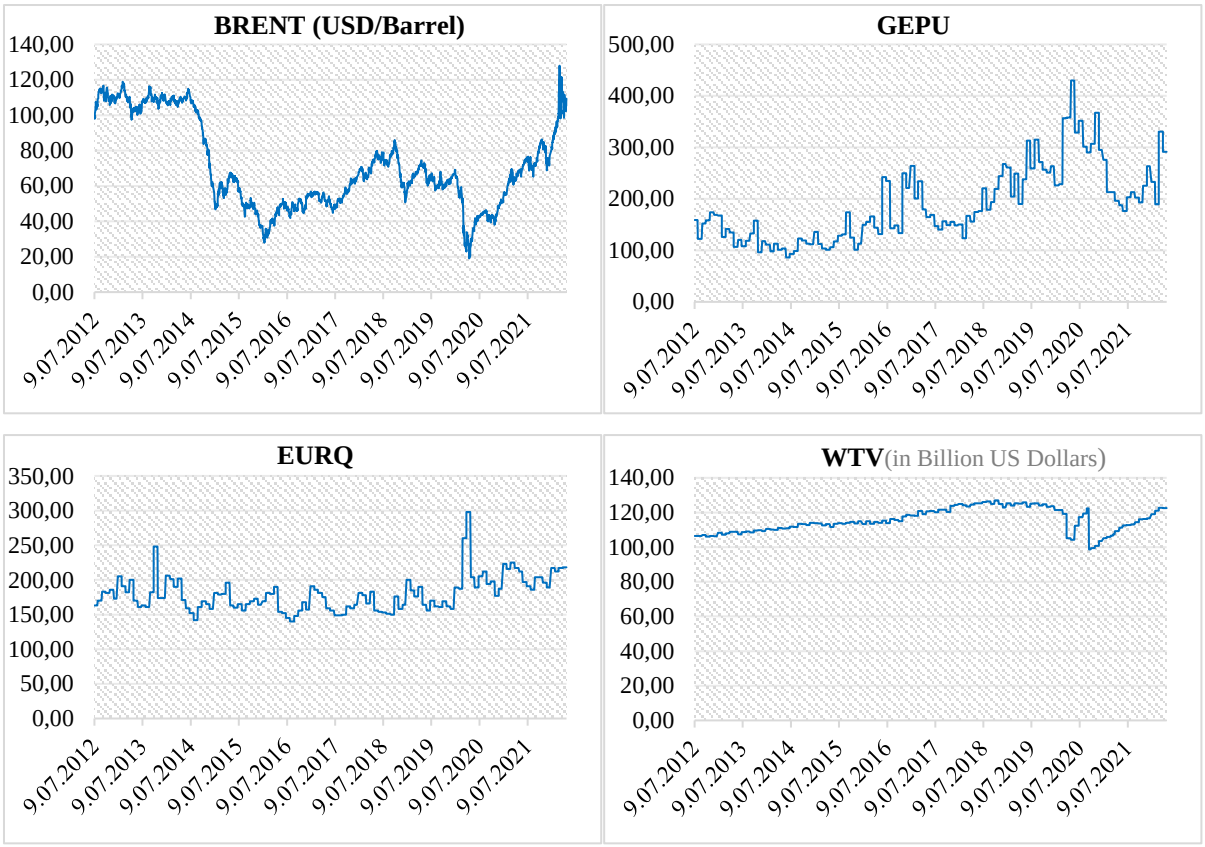
Data	Link	Access Date	Access Resource	Date Range of Data Set
Baltic Dry Index (BDI)	https://tr.investing.com/indices/baltic-dry-historical-data	09.05.2021	investing.com	9 July 2012-29 April 2022
Bloomberg Commodity Index (BCOM)	https://tr.investing.com/indices/bloomberg-commodity-historical-data	09.05.2021	investing.com	
Twitter-Based Economic Uncertainty Index (TEU)	https://www.policyuncertainty.com/twitter_uncert.html	09.05.2021	policyuncertainty.com	
S&P 500 Index (SP500X)	https://tr.investing.com/indices/us-spx-500-historical-data	12.05.2021	investing.com	
MSCI (Morgan Stanley Capital International) World Index	https://finance.yahoo.com/quote/MSCI/history?period1=1195171200&period2=1616112000&interval=1d&filter=history&frequency=1d&includeAdjustedClose=true	18.05.2021	yahoofinance.com	
€/$ Parity	https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket	09.05.2021	TCMB	
VIX (Cboe)	https://tr.investing.com/indices/volatility-s-p-500-historical-data?cid=1096487	19.05.2021	investing.com	
US 10-Year Bond Yield (US10Y %)	https://tr.investing.com/rates-bonds/u.s.-10-year-bond-yield-historical-data	18.05.2021	investing.com	
Brent Oil (USD/Barrel)	https://www.matriksdata.com/website/kurumsal-urunler/matriks-prime	18.05.2021	Matriks Prime Program	
Web Search Based Uncertainty Index (EURQ)	https://www.policyuncertainty.com/EURQ_monthly.html	20.05.2021	Economic Policy Uncertainty Web Page	
Global Economic Uncertainty Index (GEPU)	https://www.policyuncertainty.com/global_monthly.html	14.05.2021	Economic Policy Uncertainty Web Page	
World Trade Volume (WTV USD Billion)	https://www.cpb.nl/en/worldtrademonitor	12.05.2021	The Netherlands - Centraal Planbureau (CPB) - Bureau for Economic Policy Analysis (Web Page)	

Source: Author's Own work.

The main limitation of the research is chiefly about variables. This constraint is that Web Search Based Uncertainty Index (EURQ), Global Economic Uncertainty Index (GEPU), and World Trade Volume (WTV USD Billion) variables are published as monthly data. Due to the fact that these three variables were converted to daily data, as can be clearly seen in Figure 1.

Figure 1. Time Series Graph of Variables





Source: Author's Own work.

The line graphs of the variables are presented in Figure 1. The time series of the variables covers between 09.07.2012 and 29.04.2022. BDI, Bloomberg Commodities Index (BCOM), Twitter-Based Economic Uncertainty Index (TEU), S&P 500 Index, MSCI World Index, €/$ parity, VIX (Cboe), US 10-Year Bond Yield (%), Brent oil variables are published daily, while EURQ, TEU and World Trade Volume (WTV) data are published monthly.

When the graphics of the variables used in the research are examined, it is possible to clearly observe the traces of the COVID-19 period. In the BDI graph, a very significant decrease is seen starting with March 2020, when the lockdowns started in the world. In the following period, as the effects of COVID-19 decreased, a movement back to the old levels was detected. When the stock markets and indices are examined, a very significant decrease is seen in the charts of BCOM, SPX 500, and MSCI World in March 2020. The upward trend that started in the summer of 2020 has continued until today. Lockdowns are at the forefront of the effects of COVID-19 on social life. The mobility of people, both regionally and globally, is restricted. In addition, many enterprises have either completely stopped or reduced their production. All these have brought down Brent consumption in the world and increased uncertainty and concerns. Their traces can be easily seen on the Brent chart and TEU, GEPU, EURQ, and VIX Cboe charts. As a natural consequence of all these, the world trade volume also decreased in the same period. Nowadays, it is seen that these drastic graphic movements have become more normal.

The increases in commodity prices and interest rates due to the increase in inflation seen almost all over the world in the recent period are also seen in the charts.

The descriptive statistics of each variable are given in Table 2. As stated in Table 2 the values of the median and mean are close to each other. Furthermore, the S&P 500 variable has the highest standard deviation value.

Table 2. The Descriptive Statistics of Each Variable

Variables	Mean	Median	Std. deviation	Skewness	Kurtosis
BDI	1285.243	1095.000	777.856	2.164	6.320
BCOM	97.478	87.570	22.733	0.746	-0.731
TEU	137.048	91.106	160.662	4.164	26.350
S&P 500	2590.228	2400.670	856.547	0.864	-0.053
MSCI w	2000.121	1881.140	485.437	0.915	0.116
€/$	1.183	1.159	0.090	0.759	-0.561
VIX Cboe	17.229	15.260	7.123	3.222	17.407
US10Y	2.051	2.120	0.616	-0.479	-0.298
BRENT	70.968	64.696	24.575	0.453	-0.977
GEPU	187.582	168.668	72.288	0.839	0.090
EURQ	179.402	176.000	24.890	1.428	3.718
WTV	115.577	114.518	6.792	-0.101	-0.886

Source: Author's Own work.

Additionally, the skewness and kurtosis values are given in Table 2. According to Table 2, the skewness distribution ranges of the series are between (-0.479) -(4.164). The skewness value represents the negative/positive distributions. If experimental values have a long tail to the right, it indicates that the variables are skewed positively. If the variables are skewed negatively that indicates observed values have a long tail to the left (Doane and Seward, 2011). If the kurtosis coefficient is less than 3, it is understood that the series is flat, and if it is greater than 3, the series shows a sharp distribution (Kallner, 2018). It is known that if the kurtosis value of the series is greater than 3 (leptokurtosis), the values are concentrated in the extreme region, that is, it has a fat tail feature. When the kurtosis and skewness coefficients are examined, it is seen that the skewness coefficients are greater than "0" and the series are positive and skewed to the right, except for the US10Y and WTV series. US10Y and WTV series are skewed to the left because they are less than "0". Since the kurtosis values of the kurtosis coefficients of the BDI, TEU, VIX Cboe, and EURQ series are >3, these series have the feature of a thick tail. On the other hand, BCOM, S&P 500, MSCI w, €/$, US10Y, BRENT, GEPU, and WTV series are 3< therefore these series have thin tail features.

3.1. Research Methodology

In this research paper, the time series analysis was conducted to examine any causal association between the BDI and the other variables. In the first step, the Lee Strazicich break unit root test (Lee and Strazicich, 2003; Lee and Strazicich, 2013) was applied to conclude the stationarity of the variables. The Lee-Strazicich break unit root test was applied independently for each variable. Finally, by applying the Lee Strazicich test the maximum stationarity levels of variables were obtained. Following that, the

optimal lag length (k) of the variables was selected through the Akaike Information Criteria (AIC). The Toda-Yamamoto causality analysis was applied to find out the relationship between the BDI and some macroeconomic variables. Finally, the empirical results were evaluated.

Toda and Yamamoto (1995) developed a method based on the estimation of the augmented VAR model (k+dmax) to investigate Granger causality (Granger, 1961; Granger; 1969); the first step of the model is to determine the appropriate lag length (k) for the VAR model by using information criteria. Then, a VAR model of size (k+dmax) for country pairs is estimated by adding the maximum degree of integration (dmax) determined by unit root tests to the appropriate lag length. The representation of the model is in Equation 1 and Equation 2. The VAR model of Toda-Yamamoto causation is set up as follows (Toda & Yamamoto, 1995).

$$y_{t=\mu_0} + \left(\sum_{i=1}^{k} \alpha_{1t}\, y_{t-i} + \sum_{i=k+1}^{d_{max}} \alpha_{2t}\, y_{t-i}\right) + \left(\sum_{i=1}^{k} \beta_{1t}\, x_{t-i} + \sum_{i=k+1}^{d_{max}} \beta_{2t}\, x_{t-i}\right) + \varepsilon_{1t} \qquad (1)$$

$$x_{t=\emptyset_0} + \left(\sum_{i=1}^{k} \gamma_{1t}\, x_{t-i} + \sum_{i=k+1}^{d_{max}} \gamma_{2t}\, x_{t-i}\right) + \left(\sum_{i=1}^{k} \delta_{1t}\, y_{t-i} + \sum_{i=k+1}^{d_{max}} \delta_{2t}\, y_{t-i}\right) + \varepsilon_{2t} \qquad (2)$$

The hypothesis of this research are stated below:

H_0: There is no significant causal relationship between the macroeconomic variables and the BDI.

H_1: There is a significant causal relationship between the macroeconomic variables and the BDI.

If the calculated "P" (probability) value of the obtained analysis findings is below the determined statistical significance limits, the H_0 hypothesis is not supported. Thus, the H_1 alternative hypothesis is accepted. If the "P" value is above the determined statistical significance level, the H_0 hypothesis is supported.

4. EMPIRICAL RESULTS AND ANALYSIS

In this section of the paper, the empirical results of the analysis reveal the relationship between the BDI and macroeconomic variables. Toda and Yamamoto's VAR model performed in the study helps to detect the direction of causality (Dritsaki, 2017). In the section, the results of the Lee-Strazicich (LS) unit root test with Model C (break) which was conducted to find out the breaks in the time series of variables are given. Additionally, the Toda-Yamamoto analysis results were given in the following subsections.

4.1. Lee-Strazicich Unit Root Test Results

In this research article, the Lee-Strazicich (LS) unit root test was conducted based on Model C (break) to detect the breakdown of the series. Following this phase, the stationarity of the variables was determined. The first difference procedure was applied to the non-stationary series. The stationarity of the series, whose first difference was taken, was re-tested through the LS unit root test. BCOM, €/$,

US10Y and BRENT variables are non-stationary at the level, therefore stationarity at first difference was tested. The empirical analysis results are presented in Table 3.

Table 3. Lee–Strazicich Unit Root Test Results of Variables Data

Lee Strazicich (Model C)								
Variables	Level				First Differance		First Diff.	
	Lag Length	Test Statistic	Break-point Date	Critical Value	Lag Length	Test Statistic	Break-point Date	Critical Value
BDI	5	-5.18546**	3/02/2021	-3.92489	-	-	-	-
BCOM	8	-2.18256	2/28/2020	-3.94702	7	-17.1254**	3/17/2021	-3.92583
TEU	4	-6.85865**	9/05/2019	-3.97751	-	-	-	-
S&P 500	8	-4.53057**	10/28/2020	-3.91950	-	-	-	-
MSCI w	8	-3.93647**	10/30/2020	-3.91938	-	-	-	-
€/$	7	-2.60674	3/16/2015	-3.97795	5	-20.3493**	5/05/2020	-3.93361
VIX Cboe	8	-5.88275**	11/07/2016	-4.04582	-	-	-	-
US10Y	7	-2.66132	2/18/2020	-3.94947	6	-19.5141**	11/10/2016	-4.04630
BRENT	7	-2.52555	10/30/2014	-3.95529	8	-16.4801**	2/03/2015	-3.97188
GEPU	0	-4.72978**	5/30/2019	-3.98998	-	-	-	-
EURQ	0	-5.64161**	12/24/2019	-3.95927	-	-	-	-
WTV	0	-4.22129**	2/28/2020	-3.94702				

Source: Author's Own work.

Note: ** represents significance at the 5% level.

Table 3 shows the Lee Strazicich (Model C) test results. Since the series is known to be stationary when the absolute value of the test statistic is greater than the critical value, so it is clearly seen that most of the variables are stationary at the level. BDI, Twitter-Based Economic Uncertainty Index (TEU), S&P 500 Index, MSCI World Index, VIX (Cboe) Volatility Index, Global Economic Uncertainty Index (GEPU), Web Search-Based Uncertainty Index (EURQ), and World Trade Volume (USD Billion) variables are stationary at the level. Besides that, Bloomberg Commodity Index (BCOM), US 10-Year Bond Yield (%), Euro Dollar Parity, and Brent oil (USD/Barrel) variables are stationary at the first difference.

If the breaking dates of the time series are examined; the BDI breakpoint date is March 2, 2021, which may have been caused by the steepest drop in the last six months for both the Capesize and Panamax indices. The value of these indexes fluctuates based on a market event, the replacement or delisting of a commodity contract, or any other force. From time to time, investors can roll over the commodity futures contracts, which expire in January to a longer-dated contract for delivery in March. That may have caused the BCOM's break in March. Following that, the breakpoint date of the €/$ series gives an important message about improving the U.S. trade balance and the effective interventions to reduce the economic shock effects of COVID-19. Besides that, at that time the demand booming from investors for U.S. Dollars was high. Considering the break-point dates of the TEU and GEPU, the withdrawal of the United Kingdom from the European Union and high tensions about the world trade balance between the U.S. and China may have led to a break in May 2019. The ongoing Ukraine conflict in 2015 and the excess supply of shale oil may have caused a break in the BRENT series at that time. The U.S. shale oil production played a significant role in the oil price plunge about this oversupply.

COVID-19, which began in Wuhan, Hubei Province, China in November 2019, began to affect the entire world. Given that situation, an increase in web searches owing to uncertainty and panic and a decline in import and export volumes due to the global trade turmoil may have caused the interruption of the EURQ and WTV series. The MSCI w and S&P 500 indices, which fell dramatically after the COVID-19 pandemic, recovered in April 2020, and started an upward trend, following that experienced a great depreciation in November 2020. The reflection of the concerns arising from COVID-19 on the markets may have caused breakouts. Finally, it is thought that increasing market uncertainties due to the U.S. Presidential elections held in November 2016 affected both the fear index and interest rates. This uncertainty in markets had pushed investors to safe havens, therefore the US10Y fell rapidly. Consequently, this situation could cause a break in the VIX Cboe and US10Y series.

4.2. Toda-Yamamoto Causality Test Results

The Toda-Yamamoto approach which was advanced by Toda and Yamamoto in 1995 is an improved version of the Granger causality test (Toda & Yamamoto, 1995; Fattah and Kocabıyık, 2020). In this paper the Toda-Yamamoto test was performed as follows: In the first phase, the maximum integration degree (dmax) of the variables was determined according to the Lee-Strazicich (LS) unit root test. After that, in the Var (k) model the lag length (k) of the variables was selected according to the Akaike Information Criteria (AIC). Following that, the detection of the optimal lag length (k) and the maximum integration degree (dmax); the Wald tests were applied to the k-lagged coefficient matrixes for obtaining the Granger causality results, respectively. The modified Wald test (MWald) follows the Chi-square ($\chi 2$) distribution asymptotically and the degrees of freedom are equal to the number of time delays (k+dmax) (Dritsaki, 2017). Table 4 shows the causal relationship results observed through the Toda-Yamamoto approach.

Table 4. Toda-Yamamoto Causality Test Results of BDI As the Independent Variable

Independent Variables	Dependent Variable	Dmax	k	Chi-Square Test Statistic	Chi-Square P-value	Causality Direction
BCOM	BDI	1	9	5.027780	0.8319	None
TEU		0	7	5.287213	0.6250	None
S&P 500		0	8	29.33868	0.0003***	S&P 500 →BDI
MSCI w		0	8	28.16677	0.0004***	MSCI w→BDI
€/$ Parity		1	4	9.599201	0.0477**	Euro/Dollar→BDI
VIX Cboe		0	10	17.80215	0.0584*	VIX Cboe →BDI
US10Y		1	8	11.61708	0.1691	None
BRENT		1	12	11.47960	0.4883	None
GEPU		0	4	6.123613	0.1901	None
EURQ		0	4	3.653895	0.4549	None
WTV		0	4	2.738242	0.6025	None

Source: Author's Own work.

Note: (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance level, respectively. "The optimal lag length was determined in accordance with AIC criteria, dmax= maximum stationarity level according to Lee Strazicich unit root test, k=VAR lag length."

Table 4 presents the Toda-Yamamoto test results of the variables. It is seen that the Chi-Square P-value is significant at the % 1 level for S&P 500 Index and MSCI World Index. There is a causality

from €/$ parity to BDI at the % 5 significance level. Additionally, there is one-way causality from VIX Cboe to BDI at the % 10 significance level. However, as it stated in Table 4, the null hypothesis cannot be rejected for the rest of the series. Non-causality has been obtained between the BDI and Bloomberg Commodity Index (BCOM), TEU, US10Y, Brent oil (USD/Barrel), GEPU, Web Search Based Uncertainty Index (EURQ), and World Trade Volume (USD Billion), respectively. The Toda-Yamamoto test results of the BDI as the independent variable are given in Table 5.

Table 5. Toda-Yamamoto Causality Test Results of the BDI as Independent Variable

Independent Variables	Dependent Variable	Dmax	k	Chi-Square Test Statistic	Chi-Square P-value	Causality Direction
BDI	BCOM	1	9	19.62547	0.0204**	BDI→BCOM
	TEU	0	7	4.377098	0.7355	None
	S&P 500	0	8	15.73509	0.0463**	BDI→ S&P 500
	MSCI w	0	8	15.69060	0.0470**	BDI→ MSCI w
	€/$ Parity	1	4	1.501663	0.8263	None
	VIX Cboe	0	10	14.72627	0.1424	None
	US10Y	1	8	14.02090	0.0812*	BDI→ US10Y
	BRENT	1	8	19.50613	0.0770*	BDI→ BRENT
	GEPU	0	4	1.664273	0.7972	None
	EURQ	0	4	3.974958	0.4094	None
	WTV	0	4	3.164117	0.5307	None

Source: Author's Own work.

Note: (***), (**) and (*) indicate significance at the 1%, 5%, and 10% significance levels, respectively. "The optimal lag length was determined in accordance with AIC criteria, dmax= maximum stationarity level according to Lee Strazicich unit root test, k=VAR lag length."

The Toda-Yamamoto causality test results between the dependent variables and the BDI are presented in Table 5. It is clearly seen in Table 5, there is an association between Bloomberg Commodity Index (BCOM), S&P 500 Index, MSCI World Index, and BDI at the 5% significance level. According to Table 5, the one-way causal relationship was determined from BDI to BCOM. At the 10% significance, there is a one-way causality from BDI to US10Y and BRENT. Furthermore, it is evidently seen in Table 4 and Table 5, the two-way causal relationship is observed not only between BDI and S&P 500 Index but also between BDI and MSCI World Index. However, it is seen from Table 5, that there is no causality from BDI to TEU, €/$ parity, VIX (Cboe), GEPU, Web Search Based Uncertainty Index (EURQ), and World Trade Volume (USD Billion), respectively.

5. CONCLUSION

Maritime transport acts as a rudder in the global supply chain. BDI is considered the most important and basic indicator of shipping price in sea freight. Many factors such as social conflicts, economic or political crises deeply affect the trade dynamics and macroeconomic structure of the world, the global village. Due to the uncertainty of the new world order, businesses, investors, and policymakers need to use the right indicator to prevent or minimize possible risks in their strategic decision-making processes.

The main concern of this research is to determine the causal relationship between the BDI and some macroeconomic variables. To do so, the Toda-Yamamoto approach procedure was performed. Firstly, the stationarity of the variables was tested through the Lee Strazicich unit root test. Akaike Information Criteria (AIC) were used to determine the optimal lag length. Finally, the Toda-Yamamoto causality test was applied to determine the causality and relationship directions between the variables.

According to the results of the Toda-Yamamoto causality test, there is a mutual causality association between the BDI, S&P 500, and MSCI World indexes. Considering the two-way relations of BDI, S&P 500, and MSCI World indexes, S&P 500 variable covers the 500 major U.S. companies that formed approximately 75% of the U.S. stock market, and the MSCI World index represents large and mid-cap across 23 Developed Markets (DM) countries. It is clearly seen that the fluctuations in supply and demand together with the growth in global markets cause a mutual causality relationship. This causality result between BDI and MSCI World index is similar to Graham, Peltomäki and Piljak (2016)'s paper. On the other hand, there is a one-way causality from €/$ parity to BDI. This causality was an expected result, as the Euro (€) and US Dollar ($) currencies are the most used currencies in world trade. Additionally, the one-way causality was determined between VIX (Cboe) and BDI. The Chicago board options exchange (Cboe) volatility index (VIX) shows the degree of fear in the markets, can guide the shipowners that play an active role in maritime transportation while determining transportation prices. On the other hand, considering this fear index by exporting companies may contribute to developing strategic approaches to transportation costs. These obtained causalities have similarities with Kiracı, Akan (2020) and Cihangir (2018)' papers. Considering the relationship between BDI and BCOM; BCOM is a calculation base on the prices of futures contracts on physical commodities on the commodity markets. In this sense, naturally, the BDI can affect the BCOM due to the cost of shipping. This obtained result is similar to Bandyopadhyay and Rajib's (2021) paper. Brent is the essential cost item of transportation, which is affected by BDI. BDI's causality over the BRENT series is related to the demand for transport. Furthermore, the obtained result which was about the association between interest rates and BDI differs from Açık et al. (2021)' paper. The changes in interest rates do not affect BDI, however, it was seen that BDI has a one-way relationship with US10Y.

Revealing the causal relationship between BDI, the dependent variable of the research, and the independent variables can primarily facilitate the decision-making of maritime transport companies in their business processes. Similarly, the monitoring of some macroeconomic trends is effective in preventing investors who invest or in the decision-making process of investing in the IMAREX (International Maritime Exchange) BDI Index Futures contract (BDI Futures), policymakers, and businesses from experiencing myopia problems. In addition, those who produce and transport these products to distant geographies by sea transport can use these data to make cost analyses. From the point of view of those who invest in the capital markets; for BDI-based products, the findings can be used to take long or short positions. Based on the movements in the prices of the variables with a causal

relationship, the decisions to buy and sell investment instruments can be made more easily. Profitability is an important variable that affects the price of stocks. The transportation costs of enterprises that sell iron and steel, cement, and high-tonnage products, which carry the goods they produce far away by sea transportation, may also have a positive or negative impact on their share prices. As the BDI decreases, the share price may be positively affected, as the costs will decrease, while the stock prices may decrease when the BDI rises. Therefore, the variables affecting BDI and BDI are also important for stock investors.

One of the aspects that makes this study different from the literature, the variables of the Twitter-Based Economic Uncertainty Index (TEU), Web Search Based Uncertainty Index (EURQ), and World Trade Volume (USD Billion) are discussed.

In addition to this study, causality analysis can be applied separately for the Baltic Capesize Index (40%), Baltic Panamax Index (30%), and Baltic Supramax Index (30%), which are used to calculate BDI values in future studies.

REFERENCES

Açık, A., and Başer, S.O. (2018) "Baltık Kuru Yük Endeksi Etkin Mi?", Journal of Yasar University, 13(50): 140-149. doi: https://doi.org/10.19168/jyasar.368149

Açık, A., and Başer, S.Ö. (2021) "Interaction Between Commodity Prices and Freight Rates: Content Analysis of the Dry Bulk Market Reports", İzmir Sosyal Bilimler Dergisi, 3(1): 39-48. doi: 10.47899/ijss.20213104

Açık, A., Okutucu, Ö., Efes, K.Ö., Başer, S.Ö. (2021) "Analyzing The Impact of Interest Rate on Dry Bulk Freight Market with Time-Varying Causality Method", Journal of Research in Economics, Politics & Finance, 6(2): 403-417. doi: 10.30784/epfad.798092

Alimi, S.A., and Ofonyelu, C.C. (2013) "Toda-Yamamoto Causality Test Between Money Market Interest Rate and Expected Inflation: The Fisher Hypothesis Revisited", European Scientific Journal, 9(7): 125-142.

Alizadeh, A.H., and Talley W.K. (2011) "Microeconomic Determinants of Dry Bulk Shipping Freight Rates and Contract Times", Transportation, 38(3): 561-579. doi: https://doi.org/10.1007/s11116-010-9308-7

Baker, S.R., Bloom, N., Davis, S.J., and Renault, T. (2021) "Twitter-Derived Measures of Economic Uncertainty", 13 May, 1-14.

Bakshi, G., Panayotov, G., and Skoulaki, G. (2011) "The Baltic Dry Index as a Predictor of Global Stock Returns, Commodity Returns, and Global Economic Activity", AFA 2012 Chicago Meetings Paper, 1-51. doi:10.2139/ssrn.1747345

Bandyopadhyay, A., and Rajib, P. (2021) "The Asymmetric Relationship Between Baltic Dry Index and Commodity Spot Prices: Evidence From Nonparametric Causality-in-Quantiles Test", Miner Econ. doi: https://doi.org/10.1007/s13563-021-00287-y

Barut, A., Görgün, M., and Erdoğdu, A. (2020) "Baltık Kuru Yük Endeksi ve Dow Jones Demir-Çelik Endeksi Arasındaki İlişki", İnsan ve Toplum Bilimleri Araştırmaları Dergisi, 9(3): 3019-3033. doi: 10.15869/itobiad.700223

Başer, Ö.S., 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. doi:10.30711/utead.507566

Bildirici, M.E., Kayıkçı, F., and Onat, Ş.I. (2015) "Baltic Dry Index as A Major Economic Policy Indicator: The Relationship with Economic Growth", Procedia Social and Behavioral Sciences, 210: 416 – 424. doi: 10.1016/j.sbspro.2015.11.389.

Bontempi, E.M., Frigeri, M., Golinelli, R., and Squadrani, M. (2021) "EURQ: A New Web Search-Based Uncertainty Index", Economica, 88(9): 69–1015. doi: https://doi.org/10.1111/ecca.12372

Cancı, M. and Güngören, M. (2013) "İktisadi Yaşamda Taşımacılık Sektörü", Elektronik Sosyal Bilimler Dergisi, 12(45): 198-213.

Cihangir, Ç.K. (2018) "Küresel Risk Algısının Küresel Ticaret Üzerindeki Etkisi", İşletme ve İktisat Çalışmaları Dergisi, 6(1): 1-10.

Doane, D.P., Seward, L.E. (2011) "Measuring Skewness: A forgotten Statistic?", Journal of Statistics Education, 19(2): 1-18.

Dritsaki, C. (2017) "Toda-Yamamoto Causality Test between Inflation and nominal Interest Rates: Evidence from Three Countries of Europe", International Journal of Economics and Financial Issues, 7(6): 120-129.

Eryuzlu, H. (2019) "Dünya Deniz Ticareti ve Türkiye Dış Ticareti Ilişkileri: Ekonometrik bir Analiz", The Journal of Social Science, 3(5): 152-162. doi: 10.30520/tjsosci.524826

Fattah, A., and Kocabıyık, T. (2020) "Makroekonomik değişkenlerin Borsa Endeksleri Üzerine Etkisi: Türkiye ve ABD Karşılaştırması", Finansal Araştırmalar ve Çalışmalar Dergisi, 12(22): 116–151. doi: https://doi.org/10.14784/marufacd.691108

Gao R., Zhao, Y., and Zhang, B. (2021) "Baltic Dry Index and Global Economic Policy Uncertainty: Evidence from The Linear and Nonlinear Granger Causality Tests", Applied Economics Letters, 1-6. doi: https://doi.org/10.1080/13504851.2021.1985720

Geman, H., and Smith, W.O. (2012) "Shipping Markets and Freight Rates: An Analysis of The Baltic Dry Index", The Journal of Alternative Investments, 15: 98–109.

Giannarakis, G., Lemonakis, C., Sormas, A. and Georganakis, C. (2017) "The Effect of Baltic Dry Index, Gold, Oil and USA Trade Balance on Dow Jones Sustainability Index World", International Journal of Economics and Financial Issues, 7(5): 155-160.

Granger, C.W. (1969) "Investigating Causal Relations by Econometric Models and Cross-Spectral Method", Econometrica: Journal of the Econometric Society, 37(3): 424-438. doi: https://doi.org/10.2307/1912791

Jurun, E., Ratkovic, N., and Moro, F. (2015) "The Baltic Dry Index and performance Excellence in A Crisis Environment", Croatian Operational Research Review CRORR, 6(2015): 335–346. doi: 10.17535/crorr.2015.0026

Kallner, A. (2018) ''Laboratory Statistics, Methods in Chemistry and Health Sciences'', Second Edition, 1–140. doi:10.1016/b978-0-12-814348-3.00001-0

Kiracı, K. and Akan, E. (2020) "İşletme ve Finans Yazıları-IV: Baltık Kuru Yük Endeksi (BDI) ile Seçilmiş Makroekonomik Değişkenler Arasındaki Nedensellik Ilişkisi", İstanbul: Beta Press.

Laulajainen, R. (2007) "Dry Bulk Shipping Market Inefficiency, The Wide Perspective", Journal of Transport Geography, 15(3): 217–224. doi: 10.1016/j.jtrangeo.2006.05.003

Lee, J., and Strazicich, M.C. (2003) "Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks", The Review of Economics and Statistics, 85(4): 1082-1089.

Lee, J., and Strazicich, M.C. (2013) "Minimum LM Unit Root Test with One Structural Break", Economics Bulletin, 33(4): 2483-2492.

Lin, A.J., Chang, H.Y., and Hsiao J.L. (2019) "Does the Baltic Dry Index Drive Volatility Spillovers in The Commodities, Currency, or Stock Markets?", Transportation Research Part, E (127): 265–283. doi: https://doi.org/10.1016/j.tre.2019.05.013

Lin, F., and Sim, N.C.S. (2013) "Trade, Income and the Baltic Dry Index. European Economic Review", 59: 1–18. doi: https://doi.org/10.1016/j.euroecorev.2012.12.004

Lin, Y.J., and Wang, C.C. (2014) "The Dynamic Analysis of Baltic Exchange Dry Index", International Mathematical Forum, 9(17): 803-823. doi: http://dx.doi.org/10.12988/imf.2014.4473

Papailias, F., Thomakos, D.D., and Liu, J. (2017) "The Baltic Dry Index: Cycliacalities, Forecasting and Hedging Strategies", Empir Econ, 52: 255–282. doi: 10.1007/s00181-016-1081-9

Ruan Q., Wang Y., Lu X., and Qin J. (2016) "Cross-Correlations Between Baltic Dry Index and Crude Oil Prices" Physica A, 453: 278–289. doi: 10.1016/j.physa.2016.02.018

Sahan, D., Memişoğlu, R., and Baser, S.Ö. (2018) "Predicting Baltic Dry Index with Leading Indicators", Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi, 10(2): 233-248. doi: 10.18613/deudfd.495820

Şahin, B., Gürgen, S., Ünver, B. and Altin, I. (2018) "Forecasting the Baltic Dry Index by Using An Artificial Neural Network Approach", Turkish Journal of Electrical Engineering & Computer Sciences, 26(3): 1673-1684. doi: https://doi.org/10.3906/elk-1706-155

Saraç, M., and Başar, R. (2015) "Amerikan Ekonomisindeki Borçluluğun Altın Fiyatlarına Etkisi", Düzce Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 5(2): 1-21.

Saraç, M., Zeren, F., and Başar, R. (2015) "Küresel Altın Fiyatlarıyla ABD Ek Beslenme Yardımı Harcamaları ve Baltık Kuru Yük Endeksi Arasındaki Etkileşim", İstanbul Üniversitesi İşletme Fakültesi Dergisi, 44(1): 12-20.

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): a1457. doi: https://doi.org/10.4102/sajems.v21i1.1457

Shahzad, U., Jena, S. K., Tiwari, A. K., Doğan, B. and Magazzino, C. (2022) "Time-Frequency Analysis Between Bloomberg Commodity Index (BCOM) and Wti Crude Oil Prices", Resources Policy, 78: 1-8. doi:https://doi.org/10.1016/j.resourpol.2022.102823

Shamika, M., and Sirimanne, N. (2021) "Container Shipping in Times of COVID-19: Why Freight Rates Have Surged, and Implications for Policymakers", United Nations Conference on Trade and Development, April, 2(84): 1-4.

Toda Y.H., and Yamamoto T. (1995) "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes", J Econom, 66: 225–250.

UNCTAD. (2022, 28 June) ''The War in Ukraine and Its Effects on Maritime Trade Logistics, Maritime Trade Disrupted'', United Nations Conference on Trade and Development Report, 1-10. Retrieved from: https://unctad.org/system/files/officialdocument/osginf2022d2_en.pdf, (02.07.2022)

Wu Y. C., Chen C. S., Chan Y. J. (2020) "The Outbreak of COVID-19: An Overview", J Chin Med Assoc., 83(3): 217-220. doi: 10.1097/JCMA.0000000000000270

Wu, Y., Yin J., and Sheng P. (2018) "The Dynamics of Dry Bulk Shipping Market Under the Shipping Cycle Perspective: Market Relationships and Volatility". Transportation Research Record, 2672(11): 1 – 9. doi: https://doi.org/10.1177/0361198118756622

Yang, M.J., and Liu, M. Y. (2012) "The Forecasting Power of the Volatility Index in Emerging Markets: Evidence from The Taiwan Stock Market", International Journal of Economics and Finance, 4(2): 217- 231. doi: 10.5539/ijef.v4n2p217

Yıldız, B., and Bucak, U. (2017) "Determinants of Freight Rates: A Study on the Baltic Dry Index", IGU J. Soc. Sci., Spec. Iss. of ICEFM, 4(2): 17-32. doi: http://dx.doi.org/10.17336/igusbd.317006

Zeren, F., and Kahramaner, H. (2019) "Baltık Kuru Yük Endeksi ile İstanbul Navlun Endeksi Arasındaki Etkileşimin İncelenmesi: Ekonometrik Bir Uygulama", Journal of International Management, 7(1): 68 – 79.

KATKI ORANI / *CONTRIBUTION RATE*	**AÇIKLAMA / *EXPLANATION***	**KATKIDA BULUNANLAR / *CONTRIBUTORS***
Fikir veya Kavram / *Idea or Notion*	Araştırma hipotezini veya fikrini oluşturmak / *Form the research hypothesis or idea*	Nesrin ÖZCAN AKDAĞ (Ph.D.C.) Assoc. Prof. Turan KOCABIYIK (Ph.D.) Prof. Meltem KARAATLI (Ph.D.)
Tasarım / *Design*	Yöntemi, ölçeği ve deseni tasarlamak / *Designing method, scale and pattern*	Nesrin ÖZCAN AKDAĞ (Ph.D.C.) Assoc. Prof. Turan KOCABIYIK (Ph.D.) Prof. Meltem KARAATLI (Ph.D.)
Veri Toplama ve İşleme / *Data Collecting and Processing*	Verileri toplamak, düzenlenmek ve raporlamak / *Collecting, organizing and reporting data*	Nesrin ÖZCAN AKDAĞ (Ph.D.C.) Assoc. Prof. Turan KOCABIYIK (Ph.D.) Prof. Meltem KARAATLI (Ph.D.)
Tartışma ve Yorum / *Discussion and Interpretation*	Bulguların değerlendirilmesinde ve sonuçlandırılmasında sorumluluk almak / *Taking responsibility in evaluating and finalizing the findings*	Nesrin ÖZCAN AKDAĞ (Ph.D.C.) Assoc. Prof. Turan KOCABIYIK (Ph.D.) Prof. Meltem KARAATLI (Ph.D.)
Literatür Taraması / *Literature Review*	Çalışma için gerekli literatürü taramak / *Review the literature required for the study*	Nesrin ÖZCAN AKDAĞ (Ph.D.C.) Assoc. Prof. Turan KOCABIYIK (Ph.D.) Prof. Meltem KARAATLI (Ph.D.)

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