Determinants of Freight Rates: A Study on the Baltic Dry Index

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Abstract

The aim of this study is to find out the determinants of the Baltic Dry Index (BDI) which is published by the Baltic Exchange in the period of 2003-2016 by a multiple OLS regression analysis. For this purpose, the most important factors that are considered to have an impact on BDI, are analysed by the help of E-views 9.0 program thereby establishing optimum model. Empirical findings indicate that phosphate rock and barley have the highest impact on BDI. Additionally, the results of the analysis also showed that, while crude oil prices which is the core cost factor has positive effect on the BDI, cement and maize prices have significant but negative effects.

Keywords: Baltic Dry Index, Freight Rates, Main Bulks, Multiple Regression (OLS) Analysis, Seaborne Trade.

Navlun Fiyatlarına Etki Eden Faktörler: Baltık Kuru Yük Endeksi Üzerine Bir Çalışma

Öz

Bu çalışmanın amacı Baltık Borsası tarafından yayınlanan Baltık Kuru Yük Endeksi'ne etki eden faktörlerin tespit edilmesidir.2003-2016 dönemine ilişkin verilerin kullanıldığı çalışmada endekse etkisi araştırılan en önemli faktörler çoklu regresyon analizi yöntemi ile E-views 9.0 programı kullanılarak ile test edilmiştir. Elde edilen bulgulara göre fosfat kaya ile arpa fiyatlarında yaşanan değişimler Baltık Kuru Yük Endeksi'ne etki eden en önemli faktörlerdir. Bununla birlikte, sektörün temel maliyet unsuru olan ham petrol fiyatlarının Baltık Kuru Yük Endeksi üzerinde pozitif

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yönlü bir etkisinin çimento ve mısır fiyatlarındaki değişimin ise negatif yönlü bir etkilerinin olduğu tespit edilmiştir.

Anahtar Kelimeler: Baltık Kuru Yük Endeksi, Navlun Fiyatları, Temel Yükler, Çoklu Regresyon Analizi, Denizyolu Ticareti.

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1. Introduction

Over the past decade before the recent great recession, it has been seen raise in global trade, including a rapid rise in commodity prices, trade volumes, and, consequently, in the cost of transporting goods globally[1]. These raises are the results of the globalization. Accordingly, globalization had removed the especially economic borders with growth in communication, technology, transportation opportunities. Whereby, developments towards simplifying global trade, have supplied the opportunities for integrations and innovations.

Once globalization, global trade has made rapid progress in parallel with global economy and global trade. Global transportation has removed intercountry borders for global trade and has presented efficient network and routes for satisfying macroeconomic demands. For this cause, global transportation offers transport modes which are maritime, road, airway, railway, and pipeline transport. One of these transport modes is maritime transport offers extensive transportation routes and network, and also this one suggests high volume transportation capacity in a lump, thus maritime transport provides cost efficient service. Due to all these benefits, maritime transport has become principal element of global transportation and indirectly global trade.

In the light of all these developments, actors of international trade and macro economies have transitivised due to globalization. And, to understand where global economic and financial trends are heading to, many indicators are presented. One of them is BDI is also the indicator that collects transportation fees of dry bulks by maritime transport mode. For the understanding macroeconomic trends around the world, chasing market trend of dry bulks which mainly consist of raw materials, is key. So BDI provides financial environment to take into account the dynamism or stability in raw material trade thereby presenting daily freight rates of dry bulk carriers which are Capesize, Panamax, Supramax, Handysize.

[1] R. Ready… (et al.), "After the Tide: Commodity Currencies and Global Trade", *Journal of Monetary Economics*, Vol. 85, 2017, pp. 69-86.

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2. Baltic Dry Index

BDI is an index shared daily by the Baltic Exchange in London, and an indicator for global marketplace of brokering shipping. Lin and Sim[2] relayed that BDI is a globally known indicator of freight rates for dry bulk goods which are primary and raw materials such as five main bulk. BDI mainly, provides us to understand trends in the freight rates in dry bulk shipping. Although BDI has gained from mean of shipping prices applied on the 26 different routes, Lin and Sim[3] have revealed that BDI what extends back a long time, effects negatively income level of Sub-Saharan African (SSA) countries which are raw material producers. Besides, according to study of Lin and Sim[4], when reduction has seemed in the BDI, income level of LDCs (Low Developed Countries) which export generally primary goods are crude oil, grains, iron ore, copper, etc., has increased. Bildirici et al.[5] considered that BDI since its establishment has become one of the heading indicator for worldwide shipping, trade and manufacturing markets. In that, BDI is constituted with maritime transport fee of relevant routes under favor of incoming data from members of Baltic Exchange, so it is not suitable for revision, manipulation, and speculation. Because of that freight risk on these routes is included in the scope of market risk.

In the study of Kim[6], it is revealed that fluctuations in the Chinese economy have strong effect on BDI, after membership of China in World Trade Organisation has been occurred. Bakshi et al.[7] shows that BDI growth rate has predicted the returns of commodity indexes, stock and commodity returns, the growth in global economic activity, and also reveals relationship between the real and financial sectors. BDI is dealt in capital markets as an index, so it is vital chasing this index for capital market investors and investors worked in real economy. It is key that BDI is not daily efficient indicator, contrary it shows leverage in shipping market over the long run. However, recent overhead capacity supply by ships limits this characteristic of BDI.

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[2] F. Lin and N. Sim, "Exports, HIV Incidents and the Baltic Dry Index: Further Evidence from Sub-Saharan Africa", *Economics Letters*, Vol. 126, 2015, pp. 35-39.
[3] F. Lin and N. Sim, "Baltic Dry Index and the Democratic Window of Opportunity", *Journal of Comparative Economics*, Vol. 42, 2014, pp. 143-159.
[4] F. Lin and N. Sim,"Trade, Income and the Baltic Dry Index", *European Economic Review*, Vol. 59, 2013, pp. 1-18.
[5] M. E. Bildirici…(et al.), "Baltic Dry Index as a Major Economic Policy Indicator: The relationship with Economic Growth", Procedia - Social and Behavioral Sciences, Vol. 210, 2015, pp. 416-424.
[6] H. Kim, "Study about How the Chinese Economic Status Affects to the Baltic Dry Index", *International Journal of Business and Management*, Vol. 6, No 3, 2011, pp. 116-123.
[7] G. Bakshi… (et al.), "The Baltic Dry Index as a Predictor of Global Stock Returns, Commodity Returns, and Global Economic Activity", *Chicago Meetings Paper*, 2012, 52 pages.

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Accordingly, in spite of recent raise in transporting dry bulks by vessels (see in Figure 1), BDI has tended to downward trend recently.

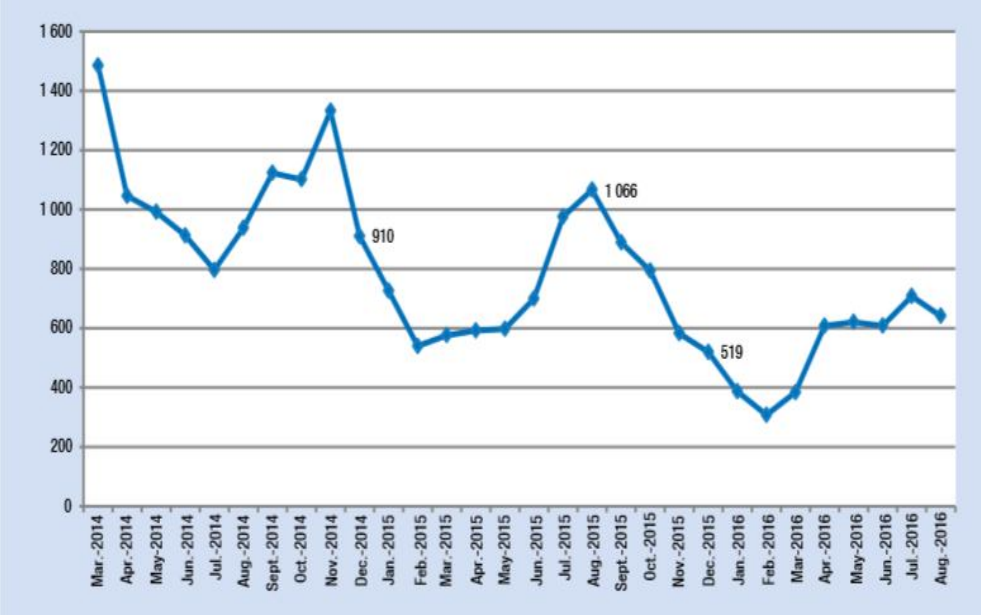
Figure 1: Development in international seaborne trade (Million tonnes)

	Oil and gas	*Main bulk commodities (iron ore, coal, grain, bauxite and alumina and phosphate rock)*	*Dry cargo other than main bulk commodities*	*Total (all cargo)*
1970	1 440	448	717	2 605
1980	1 871	608	1 225	3 704
1990	1 755	988	1 265	4 008
2000	2 163	1 295	2 526	5 984
2005	2 422	1 709	2 978	7 109
2006	2 698	1 814	3 188	7 700
2007	2 747	1 953	3 334	8 034
2008	2 742	2 065	3 422	8 229
2009	2 642	2 085	3 131	7 858
2010	2 772	2 335	3 302	8 409
2011	2 794	2 486	3 505	8 785
2012	2 841	2 742	3 614	9 197
2013	2 829	2 923	3 762	9 514
2014	2 825	2 985	4 033	9 843
2015	2 947	2 951	4 150	10 047

Source: UNCTAD, 2016.

Under the skin, BDI values have returned to normal values just as values in the earlier stages of this index. Globalization and its effects are global booms and raise in global transportation activities, had increased index values for a while now. Shipping market as a demand intensive market, had encouraged the investor in those years. Thus, excess vessel supply to shipping market has become the principal reason downward trend in BDI values (see in Figure 2).

Figure 2: Baltic Dry Index, 2014-2016



Source: UNCTAD, 2016.

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3. Literature Review

Duru[8] had constituted a fuzzy time series model for dry bulk shipping index forecasting. Duru et al.[9] suggested a new fuzzy time series method for forecasting freight rates in dry bulk shipping thereby extending previous methods with multi-variate heuristic algorithm. Relationship among the BDI, Chinese economic trend, and ship's space had been analysed in the study of Kim[8], and it had been reached that Chinese economic fluctuation has powerful effect on dry bulk carriers' freight figures. Bakshi et al.[7] had revealed that BDI's growth rate can predict a range of stock markets and the returns of commodity indexes. Ko[10] had fictionalized an alternative index by using probabilistic trend model instead of BDI due to disparity among dry bulk market status and BDI data. Duru and Yoshida[11] presented a new calculation model for constituting long term freight index of dry cargo shipping by using differential method in their formula. Alizadeh and Talley[12] had researched factors of dry bulk shipping freight rates, and had found that vessel deadweight, age and voyage routes are essential for freight rates of dry bulk shipping. Lin and Sim[4] had researched that can trade improve Least Develop Countries' (LDCs) economy? For this purpose, they used BDI as a trade figure due to having ability to transport generally primary goods. Batrinca and Cojanu[13] presented an outlook on relationship between BDI and its components are Baltic Capesize Index (BCI), Baltic Panamax Index (BPI) and Baltic Supramax Index (BSI). Zeng and Zeng and Qu[14] in their study had revealed the volatility of BDI by the help of empirical mode decomposition (EMD) method. Lin and Sim[3] had reflected effects of BDI costs on countries'

[8] O. Duru, "A Fuzzy Integrated Logical Forecasting Model for Dry Bulk Shipping Index Forecasting: An Improved Fuzzy Time Series Approach", *Expert Systems with Applications*, Vol. 37, 2010, pp. 5372-5380.
[9] O. Duru…(et al.), "Bivariate Long Term Fuzzy Time Series Forecasting of Dry Cargo Freight Rates", *The Asian Journal of Shipping and Logistics*, Vol. 26, No 2, 2010, pp. 205-223.
[10] B. Ko,"Dynamics of Dry Bulk Freight Market: Through the Lens of a Common Stochastic Trend Model", *The Asian Journal of Shipping and Logistics*, Vol. 27, No 3, 2011, pp. 387-404.
[11] O. Duru and S. Yoshida, "Long Term Freight Market Index and Inferences", *The Asian Journal of Shipping & Logistics*, Vol. 27, No 3, 2011, pp. 405-422.
[12] A. H. Alizadeh and W. K. Talley, "Microeconomic Determinants of Dry Bulk Shipping Freight Rates and Contract Times", *Transportation*, Vol. 38 No 3, 2011, pp. 561-579.
[13] G. I. Batrinca and G. S. Cojanu,"The Dynamics of the Dry Bulk Sub-Markets", Journal of Knowledge Management, *Economics and Information Technology*, Special Issue December 2013, pp. 13-23.
[14] Q. Zeng and C. Qu, "An Approach for Baltic Dry Index Analysis Based on Empirical Mode Decomposition", *Maritime Policy and Management*, Vol. 41 No 3, 2014, pp. 224-240.

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income and democracy level. Lin and Wang[15] had expressed fuzzy set theory and grey system for prediction of BDI, and had run the ARIMA model for calibration. Batrinca and Cojanu[15] tried to determine factors have an impact on BDI, and they found that dry bulk demand and world GDP have a positive influence on BDI while dry bulk supply has a negative impact on BDI. Bildirici et al.[5] studied on relationship between BDI and US economic growth, and reached that BDI and GDP are indissociably interwoven for US economy. Lin and Sim[16] forecasted effects of sub-Saharan African countries' export volume on HIV incidence by the help of BDI data, and found that reduplication of exports per capita has ability to raise HIV incidence by nearly 55%. Ruan et al.[17] examined the cross correlation characteristics of crude oil expenses and BDI, and found that the cross-correlations between BDI and crude oil expenses are considerably multifractal. Uyar et al.[18] have proposed dry cargo freight rates forecasting method which has better accuracy than previous ones, includes a generic algorithm based upon recurrent fuzzy neural network.

4. Methodology

4.1. Data and Methodology

In this study, sector specific factors affecting the BDI, which is published by the Baltic Exchange, the independent data provider of the maritime sector, and which guide the investors' preference criteria of the savers, were examined by means of a multiple OLS regression analysis and the extent to which these factors affected the index price was tried to be determined. Thus, the monthly data series of the dependent variable, namely the BDI and independent variables, namely; barley, cement, maize, crude oil, gross world product, iron ore, phosphate rock, thermal coal and wheat for the period January 2002- December 2016 were used for the study. Data were obtanied from the offical websites of the Chicago Board of Trade (CBOT), the International Monetary Fund (IMF), the World Bank, the Bank of Japan and the U.S. Energy Information Adsministration (EIA) databases and analysis was performed with Eviews 9.0 program. The values of the dependent and the independent variables are calculated by the formula as below, except one of the independent variable namely the gross world product. The quaterly value of the gross world product variable is converted to a monthly data by the interpolation method:

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[15] Y. Lin and C. Wang,"The Dynamic Analysis of Baltic Exchange Dry Index", *International Mathematical Forum*, Vol. 9 No 17, 2014, pp. 803-823.

[16] F. Lin and N. Sim,"Exports, HIV Incidents and the Baltic Dry Index: Further Evidence from Sub-Saharan Africa", *Economics Letters*, Vol. 126, 2015, pp. 35-39.

[17] Q. Ruan, Y. Wang, X. Lu, and J. Qin, "Cross-Correlations between Baltic Dry Index and Crude Oil Prices", *Physica A*, Vol. 453, 2016, pp. 278-289.

[18] K. Uyar…(et al.), "Long Term Dry Cargo Freight Rates Forecasting by Using Recurrent Fuzzy Neural Networks", *Procedia Computer Science*, Vol. 102, 2016, pp. 642-647.

$$\frac{P_1 - P_0}{P_0} * 100 \quad (1)$$

4.2. Model

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A multiple OLS regression is concerned with the relationship between a dependent variable and a series of "k" independent variables. This type of regression is useful because it allows the analyst to control for the multiple factors that simultaneously affect a dependent variable. Mathematically, a multiple OLS regression can be represented as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + e \quad (2)$$

where the coefficient β_0 is the intercept and the "k" coefficients β_1 to β_k are the slope coefficients. Each coefficient β_k for k>0 represents the change in y induced by a change in variable x_k holding all other variables constant.

For achieving to the aim of the reserarch analysis, the following multiple OLS regression was build based upon the dependent variable represented by the BDI and independent variables as above:

$$BDI = \beta_0 + \beta_1 * barley + \beta_2 * cement + \beta_3 * maize + \beta_4 * crude + \beta_5 * d_{gwp} + \beta_6 * iron + \beta_7 * phrock + \beta_8 * tcoal + \beta_9 * wheat + \varepsilon \quad (3)$$

Primarily, the main summary statistics of monthly return series of dependent variable, namely the BDI data, and the series of independent variables are presented in Table 1 and then the results of the covariance analysis between dependent and independent variables are shown in Table 2 as below:

Table 1. Descriptive Statistics

	BDI	BARLEY	CEMENT	MAIZE	CRUDE	D_GWP	IRON	PHROCK	TCOAL	WHEAT
Mean	0.028595	0.002910	0.002666	0.006579	0.006846	-8.86E-05	0.015273	0.010943	0.011343	0.005623
Median	0.023580	0.005728	0.000495	-0.002654	0.011527	0.000000	0.000000	0.000000	0.004918	-0.004313
Maximum	0.956327	0.260987	0.058198	0.221905	0.196406	0.034890	0.715070	0.700658	0.438759	0.423346
Minimum	-0.735468	-0.239825	-0.046286	-0.265366	-0.269083	-0.060130	-0.173646	-0.405660	-0.280007	-0.252477
Std. Dev.	0.245443	0.066663	0.011681	0.094170	0.086950	0.006125	0.106972	0.107805	0.077737	0.098461
Skewness	0.481142	0.069512	1.273316	-0.050562	-0.656295	-4.330824	3.084372	3.411315	0.989173	0.594624
Kurtosis	4.898159	5.263643	8.604469	2.941939	3.592647	64.67974	20.13058	24.71004	9.170146	4.497676
Jarque-Bera	31.51427	35.78954	263.6889	-0.050562	14.43243	26994.26	2306.757	3603.540	292.1425	25.44904
Probability	0.000000	0.000000	0.000000	0.000000	0.000735	0.000000	0.000000	0.000000	0.000000	0.000003
Sum	4.775383	0.485979	0.445177	1.098675	1.143262	-0.014790	2.550627	1.827513	1.894284	0.939056
Sum Sq. Dev.	10.00021	0.737702	0.022649	1.472095	1.255015	0.006228	1.899542	1.929246	1.003144	1.609309
Observations	167	167	167	167	167	167	167	167	167	167

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Table 2. Covariance Analysis

Correlation Probability	**BDI**	**BARLEY**	**CEMENT**	**CORN**	**CRUDE**	**D_GWP**	**IRON**	**PHROCK**	**TCOAL**	**WHEAT**
BDI	1.000000									

BARLEY	0.192564	1.000000								
	0.0127	-----								
CEMENT	-0.168593	-0.025673	1.000000							
	0.0294	0.7419	-----							
MAIZE	0.068872	0.203653	-0.067812	1.000000						
	0.3765	0.0083	0.3839	-----						
CRUDE	0.200756	0.319181	0.003088	0.063774	1.000000					
	0.0093	0.0000	0.9684	0.4129	-----					
D_GWP	0.048972	-0.002502	0.022888	0.117069	-0.046226	1.000000				
	0.5297	0.9744	0.7691	0.1319	0.5530	-----				
IRON	0.030926	-0.001977	0.141074	0.018787	0.161092	0.044894	1.000000			
	0.6916	0.9798	0.0690	0.8096	0.0375	0.5646	-----			
PHROCK	-0.200631	0.172685	-0.062584	0.199936	0.070809	0.157467	0.117241	1.000000		
	0.0093	0.0256	0.4217	0.0096	0.3632	0.0421	0.1313	-----		
TCOAL	0.068276	0.280010	-0.005788	0.053350	0.380454	-0.092664	0.171149	0.033581	1.000000	
	0.3806	0.0002	0.9408	0.4935	0.0000	0.2336	0.0270	0.6666	-----	
WHEAT	0.102872	0.127104	-0.096064	0.620705	0.053266	0.116462	-0.026000	0.069146	0.068312	1.000000
	0.1859	0.1017	0.2168	0.0000	0.4942	0.1339	0.7387	0.3746	0.3804	-----

The hypothesis for both tests is as follows:

H_0 : Series are not stationary.

H_a: Series are stationary.

As can be seen from Tables 3 and 4, the H_0 hypotheses denying that the series contain unit roots were rejected, as the p values calculated for all variables used in the analysis were smaller than the critical value of 0.05. In other words, both the Augmented Dickey Fuller (ADF) and Phillips-Perron

(PP) unit root test statistics for the all series were higher than the Mac-Kinnon critical values as absolute values in a multiple OLS regression model, so in a model serial 1%, 5% and 10% significance respectively. This means that there are no common unit root processes and unit root processes for each unit in the series.

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Table 3. Results of the ADF Unit Root Test Statistics

				Test Critical Values		
	Include test equation	t-Statistics	Prob.*	Level %1	Level %5	Level %10
BDI	Constant	-11.67394	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-11.64115	0.0000	-4.013946	-3.436957	-3.142642
	None	-11.57135	0.0000	-2.578883	-1.942745	1.615438
BARLEY	Constant	-9.364005	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-9.358231	0.0000	-4.013946	-3.436957	-3.142642
	None	-9.383818	0.0000	-2.578883	-1.942745	-1.615438
CEMENT	Constant	-13.50745	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-13.50341	0.0000	-4.013946	-3.436957	-3.142642
	None	-1.225722	0.2016	-2.579870	-1.942883	-1.615351
MAIZE	Constant	-13.41488	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-13.42799	0.0000	-4.013946	-3.436957	-3.142642
	None	-13.38277	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-9.776886	0.0000	-3.469691	-2.878723	-2.576010
CRUDE	Constant, Linear Trend	-9.827915	0.0000	-4.013946	-3.436957	-3.142642
	None	-9.750821	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-13.55666	0.0000	-3.469933	-2.878829	-2.576067
D_GWP	Constant, Linear Trend	-13.66221	0.0000	-4.014288	-3.437122	-3.142739
	None	-13.60050	0.0000	-2.578967	-1.942757	-1.615431
	Constant	-11.62835	0.0000	-3.469691	-2.878723	-2.576010
IRON	Constant, Linear Trend	-11.71811	0.0000	-4.013946	-3.436957	-3.142642
	None	-11.44928	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-4.147731	0.0011	-3.470179	-2.878937	-2.576124
PHROCK	Constant, Linear Trend	-4.193412	0.0057	-4.014635	-3.437289	-3.142837
	None	-4.119654	0.0001	-2.579052	-1.942768	-1.615423
TCOAL	Constant	-8.877166	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-8.937044	0.0000	-4.013946	-3.436957	-3.142642
	None	-8.799077	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-14.46762	0.0000	-3.469691	-2.878723	-2.576010
WHEAT	Constant, Linear Trend	-14.51158	0.0000	-4.013946	-3.436957	-3.142642
	None	-14.44836	0.0000	-2.578883	-1.942745	-1.615438

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Table 4. Results of the PP Unit Root Test Statistics

				Test Critical Values		
	Include test equation	t-Statistics	Prob.*	Level %1	Level %5	Level %10
BDI	Constant	-12.00610	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-11.97248	0.0000	-4.013946	-3.436957	-3.142642
	None	-11.60947	0.0000	-2.578883	-1.942745	-1.615438
BARLEY	Constant	-9.554029	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-9.557724	0.0000	-4.013946	-3.436957	-3.142642
	None	-9.568396	0.0000	-2.578883	-1.942745	-1.615438
CEMENT	Constant	-13.70238	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-13.68740	0.0000	-4.013946	-3.436957	-3.142642
	None	-13.39564	0.0000	-2.578883	-1.942745	-1.615438
MAIZE	Constant	-13.41543	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-13.42647	0.0000	-4.013946	-3.436957	-3.142642
	None	-13.38764	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-9.819504	0.0000	-3.469691	-2.878723	-2.576010
CRUDE	Constant, Linear Trend	-9.758814	0.0000	-4.013946	-3.436957	-3.142642
	None	-9.780282	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-12.80896	0.0000	-3.469933	-2.878829	-2.576067
D_GWP	Constant, Linear Trend	-12.77513	0.0000	-4.014288	-3.437122	-3.142739
	None	-12.84523	0.0000	-2.578967	-1.942757	-1.615431
	Constant	-11.57960	0.0000	-3.469691	-2.878723	-2.576010
IRON	Constant, Linear Trend	-11.65771	0.0000	-4.013946	-3.436957	-3.142642
	None	-11.42665	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-9.684665	0.0000	-3.469691	-2.878723	-2.576010
PHROCK	Constant, Linear Trend	-9.716155	0.0000	-4.013946	-3.436957	-3.142642
	None	-9.653372	0.0000	-2.578883	-1.942745	-1.615438
TCOAL	Constant	-8.877166	0.0000	-3.469691	-2.878723	-2.576010
	Constant, Linear Trend	-8.937044	0.0000	-4.013946	-3.436957	-3.142642
	None	-8.799077	0.0000	-2.578883	-1.942745	-1.615438
	Constant	-14.53025	0.0000	-3.469691	-2.878723	-2.576010
WHEAT	Constant, Linear Trend	-14.63280	0.0000	-4.013946	-3.436957	-3.142642
	None	-14.50384	0.0000	-2.578883	-1.942745	-1.615438

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After unit root tests, we continued the study with the LM test. Because one of the characteristics of a regression model is that residuals of the series shouldn't have any serial correlation. So we test the serial correlation in the residuals of the series by the Breusch-Godfrey Serial Correlation LM test as shown in the Table 5.

Table 5. Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.792481	Prob. F(2,154)	0.4546
Obs*R-squared	1.691060	Prob. Chi-Square(2)	0.4293

The hypothesis for testing of the serial correlation in the residuals are as follows:

H^0 : Residuals are not serially correlated.

H_a : Residuals are serially correlated.

As can be seen from Tables 5, we can't reject the null hypotheses, because the p values calculated for all variables used in the analysis were bigger than the critical value of 0.05. This means that there are no serial correlation in the residuals. So then, we check whether, the residual has heteroscedasticity or not for achieving the best regression model.

Table 6. Breusch-Pagan-Godfrey Heteroscedasticity Test Statistics

F-statistic	0.973336	Prob. F(9,156)	0.4643
Obs*R-squared	8.825955	Prob. Chi-Square(9)	0.4535
Scaled explained SS	10.89729	Prob. Chi-Square(9)	0.2828

After the Breusch-Pagan-Godfrey test we found that the p-values of the residuals are bigger than the value of 0.05 as shown in the Table 7, which means that we can't reject the null hypotheses. In other words, residuals are not heteroscedastic, they are homoscedastic. So we proceed our study with checking the residuals. Because the other characteristics of a best regression model is that residuals should be normally distributed. The findings in Figure 3 showed that not only the result of the Jarque-Bera test but also the p value confirmed that residuals of the model are normally distributed.

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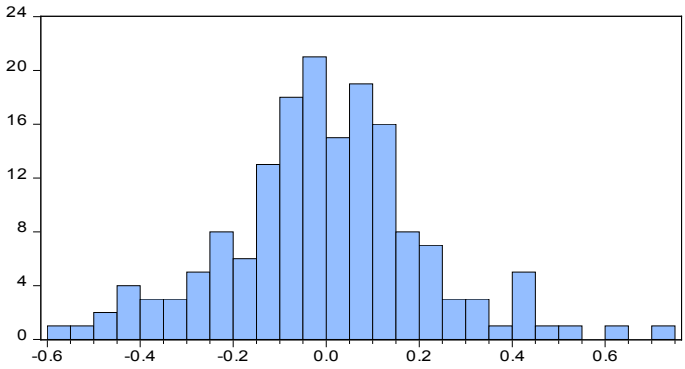
Figure 3. Normality Test Histogram



In consequence of the tests, we reached the model results of the BDI which is shown in Table 7 as below:

Table 7. Model Results with Dependent Variable BDI

Dependent Variable: BDI

Method: Least Squares

Date: 02/17/17 Time: 10:50

Sample (adjusted): 2003M02 2016M11

Included observations: 166 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.035326	0.018131	1.948330	0.0532
BARLEY	1.063356	0.311947	3.408769	0.0008*
CEMENT	-3.393996	1.507536	-2.251354	0.0258**
MAIZE(-1)	-0.579716	0.259247	-2.236152	0.0268**
CRUDE(-1)	0.479888	0.219997	2.181338	0.0307**
D_GWP	4.899571	2.941526	1.665656	0.0978***
IRON(-1)	0.241554	0.170043	1.420548	0.1574
PHROCK	-0.726649	0.183187	-3.966713	0.0001*
TCOAL(-1)	0.289256	0.268676	1.076598	0.2833
WHEAT(-1)	0.386744	0.225512	1.714962	0.0883***
R-squared	0.224584	Mean dependent var		0.029488

Adjusted R-squared	0.179849	S.D. dependent var	0.245913
S.E. of regression	0.222704	Akaike info criterion	-0.107593
Sum squared resid	7.737166	Schwarz criterion	0.079876
Log likelihood	18.93024	Hannan-Quinn criter.	-0.031498
F-statistic	5.020271	Durbin-Watson stat	1.936895
Prob(F-statistic)	0.000006		

*, **, ***: 1%, 5% and 10% levels of significance, respectively. (-1) denotes the first-difference of variables.

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Conclusion

Global trade is done by maritime transportation at the rate of 90%, so course of maritime freight rates is vital for global transportation. Global investors especially ship brokers, fleet owners, and investors, follow BDI closely due to forecast direction of global trade over raw material transport and minimize investment risks. Accordingly in this study, sector-specific factors which affect BDI are analysed by the Multiple OLS Regression method. Thus, it is studied on that relevant factors effect freight rates to what extent.

This study tries to contribute to literature by focusing on the relationship between the BDI and main dry bulks. Therefore, independent variables within this study are developed over cost elements effect shipping and over retaining the most transporting cargoes. Since therefore, the most important factors that are considered to have an impact on BDI, are analysed by the help of Eviews 9.0 program thereby establishing optimum model. Analysed data set is obtained from official web sites of the Chicago Board of Trade (CBOT), the International Monetary Fund (IMF), the World Bank, the Bank of Japan and the U.S. Energy Information Adsministration (EIA). The monthly data set consists of of the years of 2003 and 2016.

The empirical findings indicate the highest statistically significant and positive relationship between BDI and the price of phosphate rock (p=0.0001) and price of barley (p=0.0008) which can provide information to the investors. On the other hand, prices of cement (p=0.0258), maize (p=0.0268) and crude oil (p=0.0307) have statistically significant and negative effects on the BDI, except crude oil prices. However, these variables' significance is low in comparison with previous variables. Besides, there is positive correlation between BDI and wheat prices (p=0.0883) and Gross World Product (p=0.0978). But we didn't find a relationship between the price of iron ore and thermal coal with the BDI.

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The findings point out that not only barley, which is a kind of cereal grown for malting and livestock on land too poor and too cold for wheat but also the phosphate rock which is used for fertilizer and animal feed supplement and the balance for industrial chemicals are the most effective factors on the BDI prices. In other words, both barley and phosphate rock bulks are using for a feeding supplement as whole world and for this reason they are effecting the BDI and freight rates. In addition to that growth of the world production is also one of the core effects for the determinants of the BDI.

Besides, there are negative correlation between cement prices and BDI and it is statistically significant. Price collapses in world cement demand have also effected cement prices. However, drop of the prices have an effect upon cement demand of countries with high purchasing power such as China and India, especially in between the years of 2013 and 2016. Today 80% of world cement production is consumed by China and India. As it was expected that there is positive correlation between crude oil prices which is prime cost of shipping and BDI or between world GWP and BDI.

In this study, a model to explain factors that affect BDI has been established. Main dry bulks, factors related with costs of shipping, and world dry bulk carrier supply as a freight determinant, were handled. But, non-linear data or missing statistical significance while converting monthly data to annual data, exclude principal factors have impact on BDI such as ship supply. So, this model is developable. As a suggestion for future researches, factors on BDI may be approached by investigating each vessel type index.

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Özet

Dünya ticaretinin yaklaşık %9o'ı deniz yolu taşımacılığı ile yapılmaktadır. Dolayısıyla deniz yolu ile yapılan taşımacılık faaliyetlerinin fiyatlandırılması, bir başka deyişle, navlun fiyatlarının belirlenmesi ve navlun fiyatlarında yaşanan değişimler başta gemi brokerleri, filo sahipleri ve finans çevreleri olmak üzere küresel boyutta herkesi yakından ilgilendirmektedir. Söz konusu ihtiyacın giderilmesi amacıyla kurulmuş olan ve yaklaşık 200 yıllık bir geçmişi bulunan Baltık Borsası, bağımsız bir veri sağlayıcısı niteliği ile günlük olarak navlun fiyatlarını Baltık Kuru Yük Endeksi aracılığıyla yayımlamaktadır. Günlük olarak belirlenen fiyatlar, borsaya kayıtlı taşımacılık işletmelerinin bildirdikleri fiyatlar üzerinden gerçekleşmekte olup, bu nedenle piyasalarda oldukça itibar görmekte ve yapılan taşımacılık sözleşmelerinde Baltık Borsası'nın yayımladığı veriler bilgi kullanıcıları tarafından refererans olarak alınmaktadır. Ayrıca navlun fiyatlarındaki değişimler dünya ticaret hacmindeki artış veya azalışlara paralel olarak taşımacılık taleplerini etkilemekte bunun sonucu olarak da dünya ekonomisinin yönü, büyüme hızı ve ticaret hacmi hakkında piyasalara önemli sinyaller vermektedir.

Bu çerçeveden hareketle, deniz yolu taşımacılığının önemli bir yapı taşı olan kuru dökme yükler, literatürde beş temel kuru yük olarak geçen yükler, kapsamında spesifik olarak bir analiz yapmak amacıyla bu çalışmanın yapılmasına karar verilmiştir.

Bu çalışmanın amacı Baltık Borsası tarafından yayınlanan Baltık Kuru Yük Endeksi'ne etki eden faktörlerin tespit edilmesidir. 2003-2016 dönemine ilişkin verilerin kullanıldığı çalışmada endekse etkisi araştırılan en önemli faktörler çoklu regresyon analizi yöntemi ile E-views 9.0 programı kullanılarak ile test edilmiştir. Elde edilen bulgulara göre fosfat kaya ile arpa fiyatlarında yaşanan değişimler Baltık Kuru Yük Endeksi'ne etki eden en önemli faktörlerdir. Bununla birlikte, sektörün temel maliyet unsuru olan ham petrol fiyatlarının Baltık Kuru Yük Endeksi üzerinde pozitif yönlü bir etkisinin; çimento ve mısır fiyatlarındaki değişimin ise negatif yönlü bir etkilerinin olduğu tespit edilmiştir.