Should Be Frightened of Change in Freight Rates? A Casuality Analysis Between International Maritime Transportation Costs and Industrial Stock Market Returns

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Taşıma Ücretlerindeki Değişimden Korkulmalı mı? Uluslararası Deniz Taşımacılığı Maliyetleri ve Borsa Getirileri Arasında Bir Nedensellik Analizi

Özet

Bu çalışmada, borsa endeksleri ile uluslararası taşıma maliyetleri arasındaki ilişki ele alınmaktadır. Bu nedenle çalışmada, Dow Jones Birleşik Ortalama endeksi (DJA) ve Borsa İstanbul Sınai endeksinin (BIST-Ind.) Baltık Kuru Yük endeksi (BDI) ile 2007 küresel finansal kriz döneminde nedensellik ilişkilerini Toda-Yamamoto (1995) testi yardımıyla olup olmadığını ortaya koymaya çalışılmaktadır. Çalışmanın verileri endekslerin haftalık getirileri üzerinden hesaplanmıştır. Çalışmanın sonucunda BIST'ten BDI'ya ve BIST Sınai endeksinden BDI'ya doğru tek yönlü bir nedensellik bulunurken DJA ve BDI arasında karşılıklı bir nedensellik ilişkisi bulunmaktadır. Çalışmanın bulguları dahilinde küresel finansal kriz döneminde uluslararası deniz taşımacılığı maliyetleri dikkate alındığında BIST-Sınai endeksinin DJA'dan ayrıştığı görülmüştür. Böylelikle, uluslararası taşımacılık maliyetlerinin bu nedenle daha küresel sınai endeksler üzerinde etkili olduğu sonucuna varılmıştır.

Anahtar Kelimeler: Küresel Finansal Kriz, Baltık Kuru Yük Endeksi, Borsa İstanbul, Dow Jones Birleşik Ortalama Endeksi, Toda-Yamamoto Nedensellik Testi.

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Abstract

This paper examines on the linkage among stock indexes and transportation costs in global financial crisis. Therefore, we aim to find out whether Dow Jones Composite Average (DJA) and Istanbul Stock Exchange Industrial (BIST-Ind.) have causality relation with Baltic Dry Index (BDI) in 2007-2009 global financial crisis by performing Toda-Yamamoto (1995) causality test with weekly returns of indexes. Tests confirm unidirectional causality from BIST-Ind. to BDI and bidirectional causality between DJA and BDI. Test results show that BIST-Ind. decoupled from DJA in the 2008 global financial crisis when international maritime transportation cost are taken into account. Thus, the impact of international freight rates is influential over more globalized industrial stock markets.

Keywords: *Global Financial Crisis, Baltic Dry Index, Istanbul Stock Exchange, Dow Jones Composite Average, Toda-Yamamoto Causality Test.*

1.Introduction

It is very difficult to find a definition of globalization accepted globally; but it is obvious that international trade consists of largest part of the debates on the matter since it has been one of the major engine for growth and indicator for strength of global economy. Although the globalization term is not new, after the World War II (especially after mid-1980s) it has been accelerated thanks to technological developments, communication revolution, cheap transportation and liberalization of international trade. Multi-dimensional integration of international trade has been expanded its scope by globalization. World trade in goods and services has increased from 301 billion $ at 1969 to 4234 billion $ at 2012 based on the values of 2005 (OECD, 2013).

Maritime transport has vital importance for international trade and spread of globalization. Global seaborne trade has expanded averagely by 3.1% per annum since 1970 and approximately 80% by volume and 70% by value of global trade are carried through sea in 2011 (UNCTAD, 2012:44). According to United Nations Conference on Trade and Development, dry cargo (main bulks and other dry cargoes) loaded volume has been increasing linearly as of 1970 except 2009. Share of dry Cargo loaded was 69% at 2012 among total goods loaded (UNCTAD, 2013:7).

However, financial and economic fluctuations affect the world and international trade frequently. Financial system has been seen as the brain of economy and it coordinates capital for investments (Mishkin, 2005:3). 2007 -2009 global financial crisis has admitted as the most severe financial global crisis after the Great Depression and challenge to global trade (Claessens et. al. 2010:269). The difficulties of advanced economies have led to economic contraction globally. Subprime credit crisis was the first financial crisis of 21th century on a global scale. This global crisis has appeared in United States of America and swept all over the world (Kutlu and Demirci, 2011:122). The crisis has changed dynamics of world economy and as a result of this the volume of international trade decreased dramatically.

In this paper, international maritime transportation cost that is an important expenditure over international trade globally is taken as an indicator for global economic condition. Particularly in the global financial crisis years world trade slowed down and naturally transportation had been affected from this contraction. However, the economy of Turkey was debated in that years regarding the impact of global financial crisis over Turkish economy. When we look to literature there is no such a specific study to find out reaction of Turkish economy to financial crisis. Therefore, we take Turkish industrial index and a global one by using international maritime transportation cost to compare.

2. Measuring Maritime Freight Rates: Baltic Dry Index

BDI was created from Baltic Exchange which was established in 1744 at negotiations between merchants and ships' captains for price of cargo shipping services. In 1985 name of Baltic Exchange was altered to The Baltic Dry Index. BDI is seen a reliable and independent source for cost of shipping and volume of international trade operations (Oomen, 2012:3-4).

BDI is calculated as a weighted average of the Baltic Exchange's indexes for the shipping costs of the four largest dry-vessel classes – Capesize, Panamax, Supramax and Handysize- (Bakshi et. al., 2011:4).

Bulk shipping is associated with the business intensity and quotation of raw materials. Oil is not single input for production of the world (iron, ore, wood, coal, phospate rock, bauxite, alumina, copper and so on). Thus, international trade of these materials can be seen an indicator of world economic activity. Economic expansion or downturn in the global business environment instantly affects freight rates. (Alizadeh and Muradoglu, 2011:6). Therefore, BDI is accepted as a leading indicator for international economy (Chang and Lin, 2009:3311). Economic slowdown causes to decrease production and demand for raw materials and BDI has a sensitive structure to changes the demand for raw materials and price of oil.

BDI asks brokers around the world for the cost of cargo at various sizes to carry raw materials across ocean routes (Segupta and Tam, 2009:1). Shipping freight rates provides some advantages for industrial production and future movements of stock market. In process of economic growth and stability, the production capacity is expected to be increase. BDI has been one of the most popular indicators on the shipping and a tool for predicting the volume of worldwide trade and production operations (Lin and Sim, 2012:4).

In the global financial crisis years BDI fluctuations were very high. Index is sensitive to international economic conditions. On 20 May 2008 BDI, reflecting the cost of utilizing dry bulk carriers which are specially designed vessels for transporting primary goods-internationally, reached to all time high. On the other hand, the impact of financial crisis demonstrated unfavorable side concretely. After a few months BDI started to fall its lowest point since 1986 on 5 December 2008 by dropping to 663. Furthermore, other stock markets also dropped all time low (Oomen, 2012:3).

3. Literature Overview

Studies about the BDI generally aim to find out that it is a leading, lagging or coincident indicator for economic variables of the countries. Nonetheless, literature review on BDI topic remained limited. However, studies that are ranged below regarding BDI have been gained momentum especially in recent years.

Chang and Lin (2009) determined causality links among BDI, stock indices of BRIC countries and United States for the period of 2003 - 2008 with daily data. Findings of them revealed no co-integration among BDI and stock markets of US and BRIC countries. On the other hand, study showed that fluctuations of China stock market have Granger causality for BDI.

Thorsen (2010) studied relationships between dry bulk shipping freight rates and business cycles for short and long terms. To measure the freight rates, Thorsen gets data of Baltic Freight Index (BFI) which was predecessor of BDI entire period 1985-2009. Thorsen noted that several business cycle indicators including GDP have cointegration with freight rates. Study of Thorsen revealed the existence of relationship between business cycle and dry bulk shipping freight rates.

Bakshi et. al (2011) focused on the BDI as a predictor of global stock returns and global economy. They used returns of 4 regional stock market indexes from Morgan Stanley Capital International (MSCI) indexes. BDI growth rate are positive and statistically crucial for some markets and commodity returns. Bakshi and others searched out predictive ability of BDI for real and financial sectors. Additionally, other finding of study is that positive relation of BDI with growth rate of industrial production which is a significant indicator for developed and emergihg market economies.

In the same way, Alizadeh and Muradoglu (2011) showed that the shipping freight rates predict stock markets in twenty six out of twenty nine countries throughout the world. Empirical results of this study focus on the explanatory power of freight rate changes on different sectors. That is, shipping freight rates can predict not only market indexes but also stock market prices at various industries.

Study of Gusanu et. al. (2012) based on lead-lag relationship between freight rates and stock returns in dry bulk shipping industry in US, Europe and Asia for the period of January 2007-September 2011. Study found that stock index leads the freight rates which are determined by BDI.

Unpublished study of Oomen (2012) focused on the power of BDI to predict stock market returns for the period of May 1985 - December 2011 with 320 observations. Author also collected data of the Arab Light Crude Oil, Morgan Stanley Capital International (MSCI) regional indices and 10 different industry sectors. One of the basic findings of the thesis is statistically and economically significant predictability of BDI over stock market returns.

Erdogan et. al. (2013) analyzed the co-movement dynamics between stock and maritime markets by using Dow Jones Industrial Average (DJA) and BDI. Therefore, BDI has been chosen for measurement of maritime markets. Data involves November 1999 - January 2012 weekly and monthly closing prices. They used M-GARCH model and divided the study into three periods: modeling the first and second moments and specification of correlation. Study has found mutual feedback between DJA and BDI. In addition to this, according to paper, the relation during the financial uproar becomes stronger.

Lin and Sim (2012) revealed the relation between trade and income development for Least Developed Countries (LDC). They used BDI to detect cost of bulk carriers for the period of 1995 - 2010. BDI helps to make an interpretation on the income of LDCs since the export of LDCs is constructed on primary goods and many of them are transported by sea. Analysis of Lin and Sim shows that decline of BDI has positive impact on the income of LDCs thanks to trade.

Baumaster et. al. (2013) studied on the forecasting of oil prices. BDI is seen as an indicator for business world for future industrial production and one of the predictors of oil price. They found out new evidence about the monthly real price of oil that is predictable at horizons beyond one year.

Papailias and Thomakos (2013) reported statistics which inform about the coincidence and probable synchronization of annual change of BDI and annual change in some commodities. According to result of the study copper, cotton and tin have highest coincidence with BDI.

This paper aims to find out link between returns of Baltic Dry Index (BDI) with Istanbul Stock Exchange (BIST), Istanbul Stock Exchange Industrial (BIST-Ind.) and Dow Jones Composite Index (DJA) during 2007-2009 Global Financial Crisis which affected the global economy deeply. The relation between DJA and BDI will be helpful to compare BIST and BIST-Ind. with global markets during crisis years.

4. Data and Methodology

The data covers the period of September 2007 – December 2009 when the global financial crisis hit the world intensively. Data of BIST-Ind. includes 119 common observations while BDI and DJA consist of 112 common observations based on weekly returns at the specified dates.

The reason why DJA chosen is it has 65 components which are from Dow Jones Industrial, Dow Jones Transportation Average and the Dow Jones Utility Average. Companies of DJA are various which range from electricity to restaurants.

Additionally, BIST-Ind. covers 162 companies which operate various sectors such as textile, cement, mining and food.

Weekly BDI data series are obtained from Data CNBC and official web site of BIST provides necessary data series for BIST-Ind.. DJA data is provided by yahoo finance. All prices are adjusted for dividends and splits.

Firstly, natural logarithms of the series are tested to detect stationary levels of data. After that relationships between BDI-DJA and BDI-BIST Ind. will be revealed by using Toda and Yamamoto test of Granger causality.

4.1. Unit Root Test

For time series studies, stationary is significant to estimate accurate forecasting. Application of least squares regressions on non-stationary variables can clear away spurious regression misleading estimation of relationship between variables (Mahadeva and Robinson, 2004:3). Absence of the unit root which means data is stationary induces the fluctuations around a constant long-run mean and finite variance. Meanwhile, non-stationary series do not reject the random walk hypothesis and shocks from past that have impact on current values (Granger and Swanson, 1997:39).

If the data is non-stationary at level, the data will include a unit root at its differences. Generally, macroeconomic series are not stationary at their levels. Augmented Dickey Fuller (ADF) is accepted a valid test to detect the stationary of the series (Glynn et. al. 2007:66). ADF test eliminates the autocorrelation at error term by using lagged values of time series and it differs from Dickey-Fuller (DF) unit root test (Yılmaz, 2005:69). Appropriate lag criteria of the series is detected by Schwarz Info Criteria (SIC).

The formula of constant and trend of DF is:

$$\Delta Y_{t=} \beta_0 + \beta_1 t + \alpha Y_{t-i} + \varepsilon_t \qquad (1)$$

If error term ε_t contains autocorrelation the formula changes into:

$$\Delta Y_{t=} \beta_0 + \beta_1 t + \alpha Y_{t-i} + \delta_i \sum_{i=1}^{k} \Delta Y_{t-i} + \varepsilon_t \qquad (2)$$

The equation aiming to show the whether $\alpha = 0$. If Ho: $\alpha=0$ is rejected, alternative hypothesis will be accepted H_1: $\alpha<0$ that means time series of Y is accepted stationary at level (Dickey and Fuller, 1981). Test results of the variables are below:

Table 1: ADF Unit Root Test

Intercept Critical Values	Intercept and Trend Critical Values

1%*	5%*		1%*	5%*
-3,49	-2,88		-4,04	-3,45
Variables	**Intercept**	**Probability**	**Intercept and Trend**	**Probability**
LNBDI	-1.808	0.3747	-1.983	0.6041
LNDJCI	-1.334	0.6115	-1.091	0.9252
LNBIST-Ind.	-0.777	0.8216	-0.225	0.9918
ΔLNBDI	-4.243	0.0009	-4.246	0.0053
ΔLNDJCI	-10.283	0.0000	-10.313	0.0000
ΔLNBIST-Ind.	-5.967	0.0000	-11.000	0.0000

*MacKinnon (1996) one-sided p-values.

ADF test results bring out that data are stationary at their first differences I(1). Also, all probabilities of the data are less than 1% according to MacKinnon one-sided p-values for both included intercept and intercept and trend. In essence, the analysis of the variables is seen as a problematic issue due to data period that covers crisis years. Therefore, standard unit root tests possibly lead to misleading results due to number of datasets structural breaks. Rapid fluctuations of the series for a short period change the stationary levels of the variables. Thus, the study employs the Kapetanios (2005) m-breaks unit root test which allows at most five unknown structural breaks of the series endogenously. Kapetanios (2005) unit root test was developed from Zivot and Andrews (1992) and Lumsdaine and Papell (1997) unit root tests. The following model (1) is the main result of Kapetanios (2005) m-breaks unit root test:

$$y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \sum_{i=1}^{k} \gamma \Delta y_{t-i} + \sum_{i=1}^{m} \phi_i DU_{i,t} + \sum_{i=1}^{m} \psi_i DT_{i,t} + \varepsilon_t \qquad (3)$$

The dummy variables DUi,t = 1 (t > T b,i) and DTi,t = 1 (t > T þ,i) (t-T b,i) indicate structural break in the mean and trend. Also, Tb,i denotes the time of ith structural break and or 0 according to if argument of the function is true, indicator function takes 1 however otherwise it takes 0. The null hypothesis is H0 = p = 1, μ1 = φ1 = φ2 = ... = φsmax = ψ1 = ψ2 = ... = ψsmax = 0. The minimum t-statistic for all ρ up to m breaks minimize sum of squared residuals in the (1) equation estimation up to i structural breaks (Kapetanios, 2005:124-7). Kapetanios m-break unit root test results are given at table 2:

Table 2. Kapetanios Unit Root Test Results

Level	BDI	BIST-Ind.	DJA

t- stat	4.239	5.392*	5.392*
Break Dates	-	12.09.2008	03.10.2008
	1st Differences of Variables		
t- stat	7.502**	-	-
Break Dates	31.10.2008	-	-

** and * are statistically significant at 1% and 5%.

Datasets of BIST-Ind. and DJA are stationary at levels. However, BDI is stationary at its first differences. Also, all variables have one break date that generally occurs in the global financial crisis of 2008. The break dates coincide with the peak points of the global financial crisis. Helleiner (2011) states that three developments in September 2008 led to totally collapse of market confidence. The first one is the rescue of mortgage lenders Fannie Mae and Freddie Mac by USA government. Next is the bankruptcy of Lehman Brothers investment bank by the middle of the month. After a short period, the world's largest insurance company, American International Group (AIG) was rescued by USA government as Fannie Mae and Freddie Mac (Helleiner, 2011:69). In addition to this September 2008 is the transition point from Phase I to Phase II in the timeline of global financial crisis (Filardo et. al., 2010:22).

4.2. Toda Yamamoto Granger Causality

Causality can be explained by various tests that need to test unit root and cointegration for applicable (Afzal et. al. 2012:32). Toda and Yamamoto (TY) (1995) prepared a new model to estimate Granger causality test with augmented Vector Autoregressive (VAR). TY model contains the prediction of augmented VAR model by adding maximal order of integration (d_{max}) to optimal lag length (k) in the VAR system (Ghazali et. al., 2008:84). Asymptotic distribution of Wald-statistic is guaranteed by augmented VAR (Zapata and Rambaldi, 1997:285). Therefore, TY is used in this paper to test for causality between BDI and other indexes. TY ignores possible non-stationary and cointegration between series for causality. Adding one extra lag to each equation and Wald test results to find whether jointly zero of coefficients of the lagged other variables (Mavrotas and Kelly, 2001:102). Wald test estimates a VAR ($k+d_{max}$) for linear restrictions on the parameters of VAR(k) model and this test has an asymptotic χ^2 distribution which has k degrees of freedom (Sinha and Sinha, 2007:5, Ghazali et. al., 2008:84). The causal relationship between BDI and other indexes would be as below:

$$Y = \alpha + \sum_{i=1}^{k+d} \beta_i Y_{t-i} + \sum_{j=1}^{h+d} \delta_j X_{t-j} + \varepsilon_t \qquad (4)$$

Where t is time period, k and h are optimal lag length, d is the maximal order of integration and ε is error term of the series. Optimal lag lengths of series are detected by Information Criteria. However, autoregressive model stability and no autocorrelation are required by VAR model to find optimal lag length[1]. VAR Order [(k+d) and (h+d)] of all listed at Table 3:

Table 3:Optimal Lag Lengths and VAR Order of Series

Series	Optimal Lag Length	d_{max}	VAR Order
BDI & BIST-Ind.	AIC: 3 SC: 2 HQ: 2	1	3
BDI & DJA	AIC: 3 SC: 2 HQ: 3	1	4

*AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information Criterion

Toda-Yamamoto Granger causality test results are indicated at Table 4. Non-stationary variables causal relationship is provided in the levels of all variables.

Table 4:Toda-Yamamoto Granger Causality Test Results

Null Hypothesis	Chi-Sqr	Prob.	Causality
1. BDI does not Granger cause BIST-Ind	3.695	0.2962	Unidirectional Causality BIST-Ind. → BDI
2. BIST-Ind does not Granger cause BDI	7.088	0.0691	
3. BDI does not Granger cause DJA	8.985	0.0295	Bidirectional Causality DJA ↔ BDI
4. DJA does not Granger cause BDI	10.173	0.0171	

** and * are statistically significant at 5% and 10%.

Results show that there is a bilateral Granger causality between DJA and BDI. Meanwhile, unilateral causality from BIST and BIST-Ind. to BDI is another outcome of the test.

5. Conclusion

International trade felt the financial crisis pressure globally. Stocks, international trade volume and growth rate of countries were under the negative impact of this financial crisis. This paper examines on the linkage among stock indexes and transportation costs in global financial crisis period. Study covers 2007:09 – 2009:12 weekly closing prices of BDI, BIST-Ind. and DJA. We found out that bilateral Granger causality between DJA and BDI signifies a strong interaction linkage. It brings out

[1] Related tables are given in the Appendix 1 and Appendix 2.

the integration of indexes of the advanced economies. Besides, fluctuations of international maritime freight rates are indicator regarding global economic condition because maritime freight is one of the most important aspects for international trade.

On the other part, the unilateral Granger causality from BIST-Ind. to BDI can denote the existence of interaction however it is lower than DJA and BDI. It depends to small scale of Bist-Ind. and Turkey all around the world. Therefore, global financial crisis impact remained low than other giant economies. In addition to this, strong public finance of Turkey support to resist economic crisis in that years. Nonetheless, it does not mean that Turkey did not affect from global financial crisis. Stagnation in advanced economies decreased the international trade capacity of Turkey.

To sum up, BIST-Ind. decouple from DJA in terms of Granger causality relation with BDI. That is, it is possible to mention that Turkey has experienced relatively less negative effects of the 2007 global financial crisis in terms of BIST-Ind. stock values than DJA and BDI.

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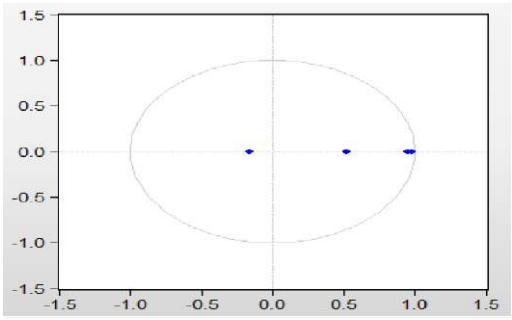
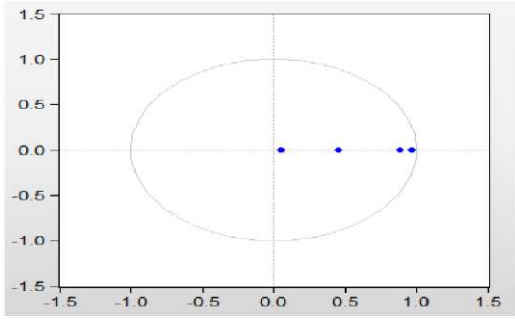
Appendix 1: Summary of LM Test Statistics Tarih:

Series	Lags	LM-Stat	Probability	
BDI&Bist-Ind.	1	10.4667	0.0333	Autocorrelation
	2	**7.74085**	**0.1015**	**No autocorrelation**
	3	1.15854	0.8849	No autocorrelation
	4	3.3348	0.5034	No autocorrelation
	5	3.53134	0.4731	No autocorrelation
	6	2.73074	0.6038	No autocorrelation
	7	4.01861	0.4035	No autocorrelation
	8	2.01615	0.7328	No autocorrelation
BDI&DJA	1	15.12	0.0045	Autocorrelation
	2	7.0595	0.1328	No autocorrelation
	3	**5.97129**	**0.2013**	**No autocorrelation**
	4	4.46766	0.3464	No autocorrelation
	5	3.93975	0.4142	No autocorrelation
	6	1.87563	0.7586	No autocorrelation
	7	1.68788	0.7929	No autocorrelation
	8	1.14326	0.8873	No autocorrelation

Appendix 2: Autoregressive Model Stability*



BDI & Bist - Ind



BDI & DJA

*Note: Graphs obtained from AR roots graph (inverse roots of AR characteristic polynominal). Stability is valid if every point is in the circle.