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The Econometric Analysis of Relationship Between Turkish Economy with Maritime Transport

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Abstract

With the globalization that started in 1980, international trade started to be important. The understanding of the market in international markets has brought with it the need for 'transportation'. The maritime transportation, which enables it to carry large tonnage loads at one time, has created economies of scale, and has become the most preferred transportation system today. Therefore, a parallel relationship is expected between the economy and maritime transport. And 1973 and 1979 world oil crisis that led to structural breaks in Turkey's economy, 1989 Financial Crisis, 1997 in maritime trade in parallel when crises such as the Asian crisis has been observed that examined experienced similar declines.

In this study, we aimed to determine the relationship between Turkey's economy and maritime transport. For this purpose, 2008: Producer Price Index for 1-2016-02 date (PPI) data from the Turkey Statistical Institute (TUIK), Turkey because of the data set for small tonnage of dry cargo vessels Istanbul Freight Index (ISTFIX) provided by. In this research, Vector Auto regressive (VAR) model was used, and Granger causality analysis was performed based on the VAR model. As a result of the econometric analyzes, it was observed that ISTFIX series is the cause of PPI series.

Key words: Time Series Analysis, Var Models, Var Granger, İSTFİX, Maritime Transport

JEL Code: C22, C58, R40

1. Introduction

The concept of "globalization" in its current meaning emerged in the 1960s; however, it only became mainstream in the 1980s. Globalization removed economic borders and introduced overseas trade (Atik, 2007: 4). Together with overseas trade, international transportation activities also gained momentum. As of

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2016, maritime transport accounted for 84% of global transportation activities. The role of maritime transport in international transportation activities raises the question of whether it has a relationship with the economy.

An examination of the relationship between maritime transport and the economy revealed that the global economic crises also affect maritime trade. For example, in 2009, when the effects of the 2008 crisis were felt, it was observed that global maritime trade showed a negative growth of 4% (İMEAK [Istanbul, Marmara, Aegean, Mediterranean, Black Sea Regions] Chamber of Shipping, 2017:5). The world economy entered a recovery period after the 2008 crisis and grew by 4.35% in 2010 according to World Bank data (The World Bank Data, 2019). This improvement in the economy corresponded to a 9.48% growth in the world maritime trade (İMEAK Chamber of Shipping, 2017:3).

This study investigates the relationship between the small-tonnage dry cargo ships' freight rates issued by Istanbul Freight Index (ISTFIX) and the Turkish economy. It aims to observe the reflections of Turkey's maritime transport on the Turkish economy. With the help of this observation, it intends to inform the decision-making processes of the maritime enterprises, shipowners as well as persons and institutions in the maritime-related sectors in the maritime transport industry.

2. Maritime Transport

The first known use of water in transportation activities goes back to 3,000 B.C. when the Egyptians started using the Nile (Bostan and Özbaran, 2009: 11-12). Now the transportation sector has started to develop together with the advancements in technology and the emergence of the concept of globalization.

Maritime transport is more in demand compared to other modes of transportation as it has a bigger transportation volume and lower unit costs due to the economy of scale, which makes it a better cost-saving option (Koçak, 2012:11). As of 2016, 13.55 billion tons of cargo were transported worldwide, and 11.34 million tons, i.e., 0.84%, were transported by sea (IMEAK Chamber of Shipping, 2017: 3). Maritime transport sector moves in parallel with the economic structure of countries (Koçak, 2012: 11). The mortgage crisis that occurred in the United States of America (USA) in 2007 and 2008 and the economic crisis caused by the bankruptcy of Lehman Brothers had a negative impact on the entire world economy. The recession caused by these crises has also impacted maritime transport (Dursun and Erol, 2012: 374).

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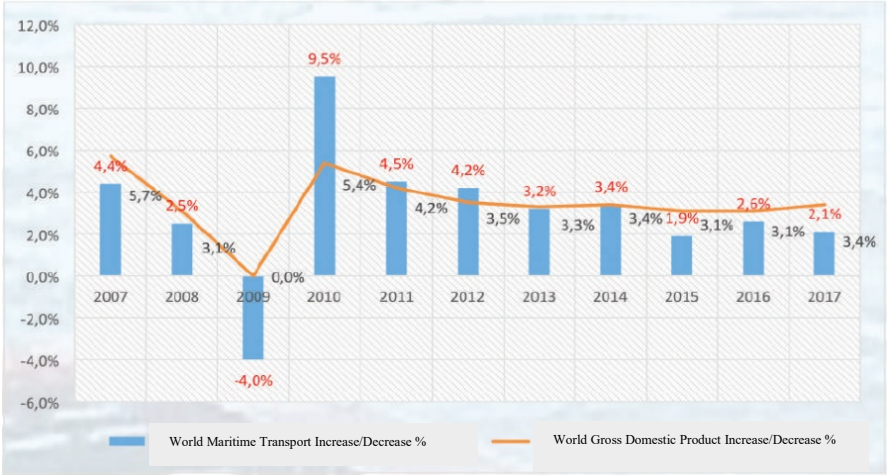
Figure 1. Global maritime trade %



Source: (IMEAK Chamber of Shipping, 2017: 5)

Figure 1 presents the global maritime transport data from January 2007 to February 2017. It is seen that due to the 2008 crisis, the World Gross Domestic Product ratios have decreased, including in 2009. In parallel with the decrease in the World Gross Domestic Product rates, global maritime transport also showed a negative growth of 0.04 in 2009 compared to 2008. Furthermore, it is observed that global maritime transport increased by 0.09 as the World Gross Domestic Product ratios showed an upward trend in 2010.

2.1. Economics of Maritime Transport

In today's global economies, no country can meet the needs and expectations of its population on its own. Every day, tons of products, from coffee to juice, tea, computers, and cars are transported from one country to another by various ships (McConville, 1999: 58). Therefore, maritime transport, which is the most preferred transportation option, creates a certain market, and this market is subject to a free market economy (Erol and Dursun, 2016: 156). The maritime transport market is shaped by supply and demand.

Supply in maritime transport means the number of ships that are ready for trade (Erol, 2013:30). The supply of maritime transport is mainly affected by shipowners, maritime transport carriers, bankers who finance ships, and security legislators. Shipowners influence the decisions on ordering new ships, scrapping old ones, and passive tonnage. Stopford (2009) argued that there are five important factors affecting the supply of maritime transport. These are the merchant fleet, fleet productivity, shipbuilding, scrapping and losses, and freight rates (Stopford, 2009: 150).

Countries need to import mainly because they have to meet the need for goods that cannot be manufactured in the country. Countries have this need because

they lack the raw material for the product to be manufactured, they don't have adequate technology, they have an unfavorable climate, or they don't have the qualified labor to manufacture the products (Çelik, 2008:4). This creates a demand, and this demand is affected by several factors.

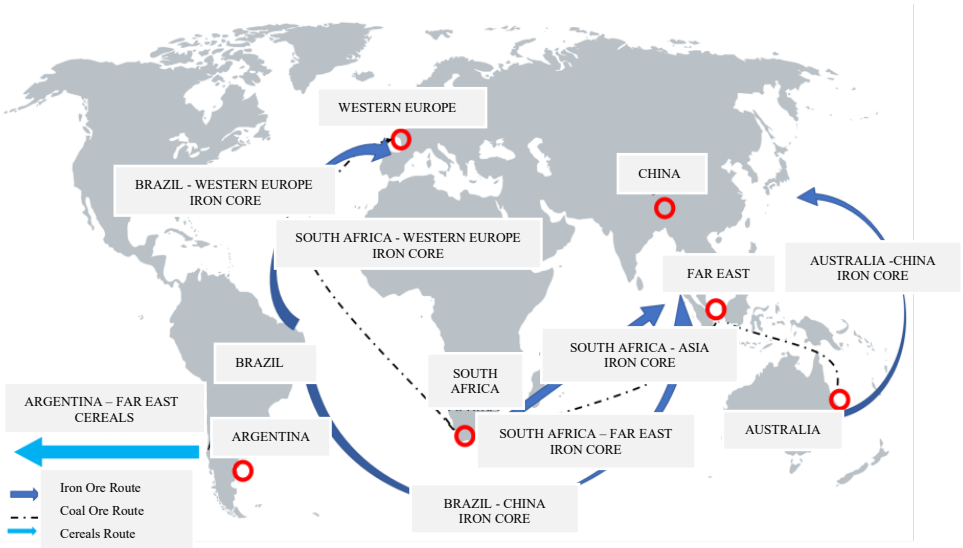
The important factors affecting the demand in maritime transport include the world economy, average haul distance, transport costs, random effects, and global freight trade (Stopford, 2009:136)

2.2. Dry Cargo Maritime Transport and Economy

Maritime transport can be classified in several different ways. One of the most basic one of these classifications is based on the cargo. Accordingly, maritime transport can be divided into general cargo and bulk cargo. Bulk cargoes can be divided into two categories, i.e., liquid bulk and dry bulk. Dry bulks can be further categorized into "five major bulks" and "minor bulk" (Erol, 2013: 18).

When we look into the dry bulk market, we can see that five major bulk cargoes are more common than minor bulk cargoes. Therefore, the five major bulk cargoes can be considered to be the driving force of the dry bulk market. However, since the five major bulk cargoes are used by the entire world economy, they also move in parallel with the world economy (Derindere, 2006:5).

Figure 2. Dry major bulk cargo main route

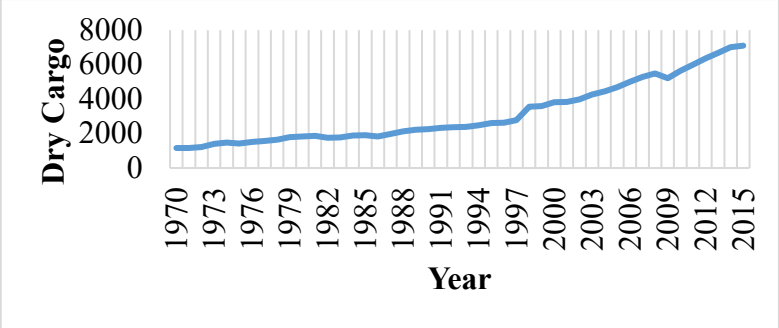


Source: (Köseoğlu, 2010: 15)

Figure 2 presents iron, coal, and grains, which are among the dry major bulks. As of 2016, dry bulk cargo accounts for 52% of the world's freight transport, of which 13%, 10%, and 4% are iron, coal, and grain, respectively (İMEAK

Chamber of Shipping, 2017: 20). This means that major bulk cargo makes up a substantial 32% of that rate.

Figure 3. Dry cargo load amounts in 1970–2014 (Million Tons)



Source: (United Nations Conference on Trade and Development, 2017)

Based on Figure 3, we can say that maritime transport did not show a rapid increase in the first few years. However, as of 1996, the cargo amount increased more compared to other years.

It is known that the dry bulk cargo market grew by 0.14 between the period of 2000–2003. In the same period, it is seen that the economy of China, which is one of the most important countries affecting the dry bulk cargo market, has grown (Derindere, 2006: 7).

The global growth figures affect maritime transport. The effects of the 2008 global economic crisis can also be seen in the maritime trade data. The Baltic Dry Index (BDI) can be examined to analyze this effect (Koçak, 2012:16). The BDI shows the dry cargo transportation cost (freight) index (Turkish Shipbuilders' Association, 2014:2). The BDI data shows that there was a significant decrease in 2008, and it continued until 2012. Its peak value was 11.933 before the 2008 crisis, however, it decreased to 776 by the end of 2012 (Turkish Shipbuilders' Association, 2012:5). Freight showed an upward trend by 2013, and it increased up to 2277 by the end of the year. The increase in 2013 stopped, and the value went down to 1110 by the first month of 2014, and it continued to decrease throughout the year until it reached 755. By February 2015, it decreased to 542, which was the lowest value since 2001. This decrease was caused by the fact that China, one of the biggest importers of coal, which has the biggest share among the five major dry bulks, changed its energy policy and focused on other resources other than coal. Another reason was that Indonesia has significantly reduced its bauxite and nickel exports (IMEAK, 2017:13).

2.3. Maritime Transport in Turkey

Turkey is very well positioned for maritime transport due to its geographical location. It is surrounded by seas on three sides and has a coastline of 8333 km. (Presidency of Republic of Turkey, State Supervisory Council, 2008: 26). Although the geographical location of the country is suitable for maritime transport, it could not show much progress in the private sector until the 1950s (Akdoğan, 1999: 17). On the other hand, many countries, especially Greece, have risen to the top of the list in global maritime transport due to various incentives. Turkey started taking action after 1999 and created the "Turkish International Registry." Ships and yachts that are listed in this registry were exempted from income tax. They were also exempt from corporate tax (Çelikkaya, 2012: 73-78).

As of January 01, 2016, the data on national and foreign-flagged ships over 1,000 Gross Tons (GRT)3 show that Greece, Japan, and China are among the top three in the global maritime transport national and foreign-flagged vessels list, while Turkey ranks 14th (IMEAK Chamber of Shipping, 2017:12). The data on Turkish-owned national and foreign-flagged vessels over 1,000 show that the total average age of Turkish-owned ships is 18.1 as of 2015. 8,272 DWT (deadweight tons)4 of these vessels are Turkish-flagged, and 20,879 DWT are foreign-flagged. The total was 8,715 DWT in 2003, which grew by 234% by 2015 and reached 29,151 DWT. Turkish maritime industry was not affected by the 2008 global crisis and even achieved 12.22% growth in that period (Republic of Turkey Ministry of Transport, Maritime Affairs and Communications, General Directorate of Maritime Trade, 2015: 10).

3. Literature Review

When we look at the studies on maritime transportation in the world and Turkey, we can see that there are not many studies on the maritime transportation market.

Erol and Dursun (2016) investigated the market structure of non-regular liner maritime transport. They stated that free market conditions apply to non-regular liner maritime transport, and the freight prices are determined by the law of supply and demand. They investigated the world economy, maritime freight trade, average distance, external factors, and transportation activities as the factors affecting the demand of non-regular liner market. The factors that affect the supply, on the other hand, are identified as the world merchant fleet, fleet productivity, shipbuilding market, scrap market and freight price (Erol and Dursun, 2016: 153-170).

[3] Gross Tonnage (GRT) is a measure of volume and is determined by dividing by 100 the contents, in cubic feet, of the vessel's enclosed spaces. (Nas, 2010:1)

[4] Deadweight Tonnage (DWT): It is the weight, in tons, of the vessel when the ship is immersed to its maximum summer load line (Nas, 2010:1).

Saraç, Zeren, and Başar (2015) conducted a study to investigate whether the Baltic Dry Index (BDI) and the US Supplemental Nutrition Assistance Program (SNAP) expenditures have an effect on global gold prices. This study used the gold price data set from the USA Federal Reserve Bank of St. Louis for the period of 1988–2012 together with the SNAP and BDI data sets from the same periods. Further, they used the ARDL bounds testing, while treating the global gold prices as dependent observations and the BDI and SNAP expenditure data as independent observations. The results of the analysis showed that the global gold prices are significant in the long term for fixed-term and SNAP expenditures, while nonsignificant for BDI data. The authors concluded that the SNAP expenditures and BDI data are significant in the short term. They used the Toda–Yamamoto Granger causality test to determine the direction of the causality relationship. The results of the test also revealed a one-sided causality relationship from SNAP expenditures to global gold prices. Furthermore, it showed a one-sided causality relationship from global gold prices to BDI and a two-way relationship between SNAP expenditures and BDI data (Saraç et al., 2015:12-20).

Köseoğlu and Mercangöz (2012) investigated the impact of the 2008 global financial crisis on maritime transport in Turkey. They used the ISTFIX data as an indicator of Turkey's maritime transport and BDI data as international data. Furthermore, they used the Zivot and Andrews test in the study, which revealed that there was a structural change in the series in 2008, and based on this, they argued that there is a parallel relationship between maritime transport and the global economy (Köseoğlu and Mercangöz, 2012: 25-38).

Korkmaz (2012) conducted a study to analyze the relationship between Turkey’s maritime transport and economy. The study analyzed the variables of the total number of ships arriving at and departing from the Turkish ports, the industrial production index, and the total trade volume. The data for the years 2004 through 2010 were obtained from the Undersecretariat for Maritime Trade and the Central Bank of the Republic of Turkey, Electronic Data Delivery System. Vector Autoregression (VAR) analysis was performed to analyze how the industrial production index and total trade would react to any shock that may occur in the number of ships arriving at and departing from the Turkish ports. According to the results of the VAR analysis, when there was an unusual increase in the number of ships arriving at and departing from the Turkish ports, the industrial production index and total trade variables responded to the change and resulted in a positive and statistically significant response (Korkmaz, 2012:97-109).

Derindere (2006) conducted a study to investigate the factors affecting tanker freights. The author used the data from 1982 through 2004. The Multiple Regression analysis method was used in the study. The dependent variables in the analysis were Ultra Large Crude Carrier and Very Large Crude Carrier tanker freight rate index. The independent variables were world oil supply and demand, world tanker fleet, world lay-up tonnage, world tanker maritime transport trade, productivity, crude oil barrel price, world crude oil production, and world crude oil exports. Among the independent variables, crude oil prices were found to be the

variable with the highest effect on tanker freight rates. It has been determined that as predicted, there is an inverse economic relationship between the tanker fleet and the freight rate. An inverse relationship was identified with productivity, which was another independent variable, while a direct relationship was identified with crude oil production volume. The author also stated that several other related variables, such as political events, economic crises, and finding new energy sources, should be examined (Derindere, 2006).

Bakshi, Panayotov, and Skoulakis (2011) conducted a study to investigate the relationship between global securities, commodity index and BDI using a quarterly data set. The study suggested that portfolio strategies can be determined by using the Sharpe ratio and BDI growth rate as economic signals that are used to predict stock returns. BDI growth rate reports and commodity index reports can give stock likelihood ratios in a system of predictive regressions. In conclusion, the role of the BDI growth rate prediction in facilitating the identification of global economic activity is BDI's revelation of the link between the real and financial sectors (Bakshi et al., 2011).

4. Data and Econometric Analysis

The aim of this study is to analyze the relationship between Turkish maritime transport and the Turkish economy and to determine how they affect each other. For this purpose, ISTFIX has been chosen as Turkey's maritime transportation data, and PPI has been chosen as the basic indicator of the Turkish Economy. In the study, the relationship between ISTFIX and PPI was investigated by causality analysis.

4.1. Examination of the Data Set

The data between January 2008 to February 2016 were examined in this study that investigated the relationship between ISTFIX and PPI. The ISTFIX data set was prepared for small-tonnage dry cargo ships and was obtained from the ISTFIX website, and the PPI data set was obtained from the Turkish Statistical Institute website. First, the graph method and unit root tests (Augmented Dickey Fuller (ADF) and Phillips-Perron (PP)) were used to examine the stationarity of the data sets, which consisted of 98 observations. Based on the findings of these tests, causality and cointegration tests were conducted to investigate short and long-term relationships. The VAR approach was used to examine the dynamics of the ISTFIX and PPI series.

4.1.1. Preparation of ISTFIX Data Set

ISTFIX is an independent research company founded in 2008. It processes and reports independent data from shipowners, brokers, and ship operators in the region. They are specialized in dry/general cargo markets between 2.000–10.000

DWT, focusing on the Mediterranean and the Black Sea basins (Çakır, Small Tonnage Ship Markets, 2012: 32).

The data set in the study is the indexed values for dry cargo ships. The study used weekly values, which were converted into monthly data using the geometric mean method.

Figure 4. The Time Path Graph of the ISTFIX Data Set

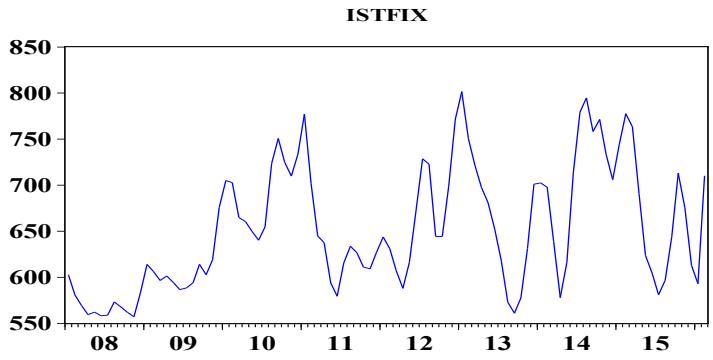
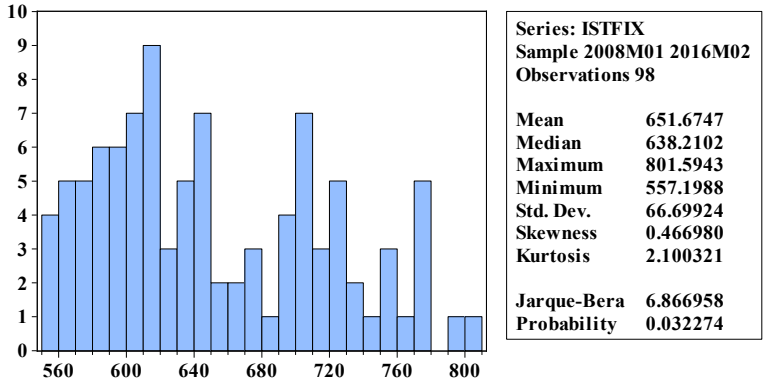


Figure 4 shows the time path graph created from the monthly data of the ISTFIX series for the years 2008–2016. The value of 557.2, which is the month 11 data of the year 2008, is the lowest value. The highest value of the series is 801,6 at Month 1 of the year 2013. When the graph is examined, the first impression is that the series fluctuates in certain periods, and these fluctuations indicate that there may be seasonal effects. In addition, it is seen that the series does not have a certain mean and a fixed variance.

Figure 5. Histogram of the ISTFIX Series



When the histogram of the series is examined, it is seen that the skewness of the ISTFIX series is close to zero (0.47), and its kurtosis is close to three (2.10).

The Jarque–Bera test shows whether the time series is normally distributed. The hypotheses are expressed as follows:

H_0: The series is normally distributed

H_1: The series is not normally distributed

The probability value of the ISTFIX series is 0.03. Since the probability is 0.03>α=0.01, the null hypothesis cannot be rejected and the series is normally distributed at a significance level of 0.01.

Seasonality should be investigated as it could have an impact on the cargo transported in small-tonnage dry cargo ships. First, dummies were used in order to examine the presence of seasonal effects.

Table 1. ADF and PP Unit Root Test Results at ISTFIX Series Level

	ADF		**PP**	
Significance Level	**With Intercept and Trend** $t_{\hat{\delta}}=-3.2462$	**With Intercept and Without Trend** $t_{\hat{\delta}}=-2.7347$	**With Intercept and Trend** $t_{\hat{\delta}}=-3.2377$	**With Intercept and Without Trend** $t_{\hat{\delta}}=-2.7588$
1%	-4.0575	-3.5006	-4.0554	-3.4991
5%	-3.4578	-2.8922	-3.4568	-2.8915
10%	-3.1548	-2.5831	-3.1542	-2.5828
Statistical	$t_{\hat{\delta}} > \tau_\tau$	$t_{\hat{\delta}} > \tau_\tau$	Zα	Zα
Decision	H_0 cannot be rejected	H_0 cannot be rejected	H_0 cannot be rejected	H_0 cannot be rejected

The results of the unit root analysis performed at the observation level using the time path graph of the ISTFIX series are summarized in Table 1. The hypotheses used in the ADF and PP unit root tests are as follows:

H_0: Has a unit root

H_1: There is no unit root

According to the ADF and PP unit root tests, the ISTFIX series cannot reject the null hypothesis at the significance level of 5%. In other words, the ISTFIX series is not stationary at the significance level of 5%.

Since the ISXFIX time series data covers the period of 2008 through 2016, the effects of the 2008 Economic Crisis should be investigated as economic crises can cause structural breaks. When the world maritime trade is analyzed, it can be seen that a recovery period has started after the 2008 Economic Crisis. Therefore, the additive structural break model was used. When the time path graph of the

ISTFIX series is examined, it is observed that there is a change in the level of the series and this change started after November 2008. The appropriate model pattern for structural break testing is 3.1, which is also known as Model A. The model that reflects the appropriate alternative hypothesis for this model is estimated as equation (3.1).

$$\text{İSTFİX}_t = \mu + \beta t + \gamma_2 \text{DVU}_t + \hat{Y}_t^A \qquad (3.1)$$

The results obtained from the estimation of equation (3.1) are summarized in equation (3.2).

$$\text{ISTFIX}_t = 565.14 + 0.65(t) + 62.16\text{DVU}_t + \hat{Y}_t^A \qquad (3.2)$$

The series of residues is obtained from equation (3.2). ADF unit root test with no trend and no constant at level was applied to the series of residues.

Table 2. Results of the Structural Break Analysis in the ISTFIX Series

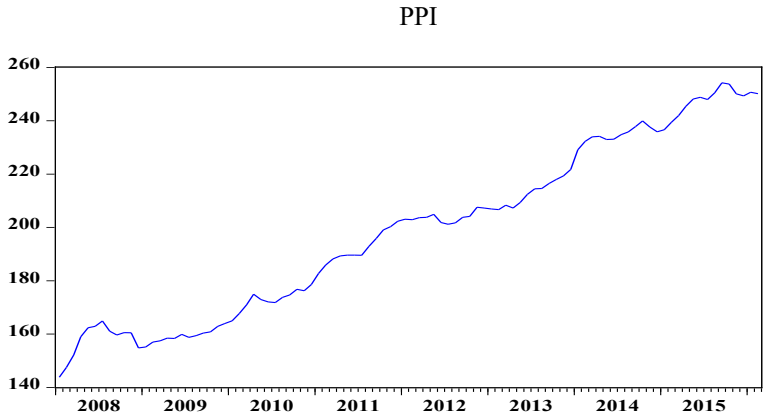
		t-Statistics	**Probability**
ADF Test Statistic		-4.146535	0.0001
Critical Test Values	1% level	-2.592129	
	5% level	-1.944619	
	10% level	-1.614288	

Table 2 summarizes the results of the ADF unit root test applied to the series of residues obtained from the equation (3.2). The relative break reflection value (λ) was found to be 0.11. For the relative break value of 0.1, the critical table values for the 1%, 5%, and 10% significance levels are −4.30, −3.68 and −3.40, respectively. Based on the calculated $t_{\hat{\delta}}$ value of −4.14, the null hypothesis is rejected for the significance level of 5%. It was concluded that the structural break is significant. If a series contains a structural break, unit root tests deviate and tend not to reject the null hypothesis. In other words, the ISTFIX series does not have a unit root, which means it is stationary.

4.1.2. Preparation of PPI data set

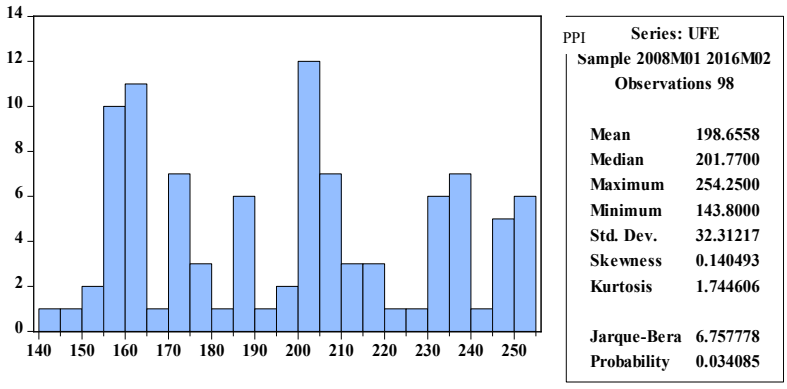
The inflation data is calculated based on two different indices. One is Consumer Price Index and the other is the Producer Price Index (Eğilmez, 2012:1). The PPI data set was obtained from the Turkish Statistical Institute database. The data set belongs to the period 2008Q1–2016Q2 and is monthly.

Figure 6. Time Path Graph of PPI Series



The time path graph of the PPI series is shown in Figure 6. The lowest value is 143.8, which belongs to the first month of 2008. The highest value of the series is 254.3, which belongs to the ninth month of 2015. When the time path graph of the series is examined, it is observed that it has an increasing trend. Whether the trend observed in the PPI series graph is significant or not should be investigated and decided by statistical methods. However, it can be said that the series is not stationary in mean and variance.

Figure 7. Histogram of the PPI Series



When the histogram of the PPI series is examined, it is observed that its skew is close to zero (0.14) and its kurtosis is close to two (1.75).

The Jarque–Bera test shows whether the time series is normally distributed. The hypotheses are expressed as follows:

H_0: The series is normally distributed.
H_1: The series is not normally distributed.

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The probability value of the PPI series is 0.03. Since the probability is 0.03>0.01=α, the null hypothesis cannot be rejected and the series is normally distributed at a significance level of 0.01.

Seasonality should be investigated as seasonal effects can be observed in the producer price index data set. First, seasonal dummies were used to investigate the presence of seasonal effects.

Table 3. Seasonality Analysis of the PPI Index:

Variable	Coefficient	Standard Error	t-Statistics	Probability
C	142.9685	1.933837	73.92995	0.0000
@TREND	1.125749	0.018486	60.89895	0.0000
D2	0.700917	2.430056	0.288437	0.7737
D3	2.076052	2.505863	0.828478	0.4097
D4	2.924053	2.505386	1.167107	0.2464
D5	2.577054	2.505045	1.028746	0.3065
D6	1.690055	2.504840	0.674716	0.5017
D7	0.936806	2.504772	0.374008	0.7093
D8	0.579806	2.504840	0.231474	0.8175
D9	1.104057	2.505045	0.440733	0.6605
D10	1.245808	2.505386	0.497252	0.6203
D11	0.316309	2.505863	0.126227	0.8999
D12	-0.904441	2.506477	-0.360841	0.7191

In Table 3, seasonal dummies were used to investigate whether there is a deterministic trend in the PPI series. Based on the model shown in the table, it was concluded that the trend and constant were significant at the significance level of 5%, and the dummy variables were statistically insignificant. Therefore, there are no seasonal effects in the PPI series.

After reaching the conclusion that seasonal effects are not observed in the PPI series, the stationarity of the series will be analyzed. Unit root tests should be performed even though the time path graph in Figure 6 shows that the series is not stationary and has an upward trend.

Table 4: ADF and PP Unit Root Test Results at PPI Series Level

	ADF		**PP**	
Significance Level	**With Intercept and Trend** $t_{\hat{\delta}}$= −3.0902	**With Intercept and Without Trend** $t_{\hat{\delta}}$= −0.2026	**With Intercept and Trend** $t_{\hat{\delta}}$=−2.5436	**With Intercept and Without Trend** $t_{\hat{\delta}}$= −0.6109
1%	-4.0565	-0.3501	-4.0554	-3.4991
5%	-3.4573	-2.8922	-3.4568	-2.8915
10%	-3.1545	-2.5831	-3.1542	-2.5828
Statistical Decision	$t_{\hat{\delta}} > \tau_{\tau}$	$t_{\hat{\delta}} > \tau_{\tau}$	Zα	Zα
	H_0 cannot be rejected	H_0 cannot be rejected	H_0 cannot be rejected	H_0 cannot be rejected

ADF and PP unit root test results at the level of the PPI series are summarized in the table. The hypotheses used in the ADF and PP unit root tests are as follows:

H_0: Has a unit root
H_1: Has not unit root

According to the ADF and PP unit root tests, the PPI series cannot reject the null hypothesis at the significance level of 5%. In other words, the PPI series is not stationary at the 5% significance level.

Since the PPI time series data covers the period of 2008 through 2016, the effects of the 2008 Economic Crisis should be investigated because economic crises can cause structural breaks. When the PPI series is analyzed, it can be seen that a recovery period started after the 2008 economic crisis. Therefore, the additive structural break model was used. It has been observed that there is a change in the slope of the series and that this change has started after November 2008. The appropriate model pattern for the structural break testing is equation 3.3, which is known as Model B. The model that reflects the appropriate alternative hypothesis for this model is estimated as equation (3.3).

$$PPIt = \mu + \beta t + \gamma_3 DVT_t^* + \hat{Y}_t^B \quad (3.3)$$

The results obtained from the estimation of equation (3.3) are summarized in equation (3.4).

$$PPIt = 155{,}45 - 0{,}26(t) + 1{,}42(DVT_t^*) + \hat{Y}_t^B \quad (3.4)$$

The series of residues is obtained from equation (3.4). ADF unit root test with no trend and no constant at the level was applied to the series of residues.

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Table 5. Results of the Structural Break Analysis in the Series

		t-Statistics	Probability
ADF test statistic		-4.033223	0.0001
Critical Test Values	1% level	-2.589273	
	5% level	-1.944211	
	10% level	-1.614532	

Table 5 summarizes the results of the ADF unit root test applied to the series of residues obtained from equation (3.4). The relative break reflection value (λ) was found to be 0.11. For the relative break value of 0.1, the critical table values for the 1%, 5%, and 10% significance levels are −4.27, −3.65 and −3.36, respectively. Based on the calculated $t_{\tilde{s}}$ value of −4.14, the null hypothesis is rejected for the significance level of 5%. In other words, the ISTFIX series does not have a unit root, which means it is stationary.

4.2. VAR Analysis

One of the widely used models in economic and financial time series modeling is VAR. VAR model is used in estimations in order to analyze the relationship between variables. (Yavuz,2015: 329-346).

The appropriate lag length for the ISTFIX and PPI time series is determined as three and the estimation results of the VAR model are summarized in Table 6.

Table 6. VAR Model Estimation Results for the ISTFIX and PPI Time Series

ISTFIX(-1)	1.448471 (0.10354) [13.9898]	-0.003004 (0.00677) [-0.44352]
ISTFIX(-2)	-1.060246 (0.15546) [-6.82018]	0.008685 (0.01017) [0.85416]
ISTFIX(-3)	0.394588 (0.10392) [3.79716]	-0.008155 (0.00680) [-1.19986]
PPI(-1)	-0.500862 (1.61406) [-0.31031]	1.296649 (0.10557) [12.2822]
PPI(-2)	-3.229910 (2.57014) [-1.25670]	-0.425813 (0.16811) [-2.53300]

PPI(-3)	2.926335 (1.63612) [1.78858]	0.003174 (0.10701) [0.02966]
C	249.4508 (119.394) [2.08931]	19.96615 (7.80924) [2.55673]
@TREND	1.137051 (0.81360) [1.39756]	0.146474 (0.05322) [2.75248]

Note: () represents standard errors and [ ] represents t-statistics.

“

Autocorrelation:

Table 7. VAR Breusch–Godfrey (LM) Test Results

Lag	LRE* stat	Probability
1	6.578564	0.1599
2	3.185173	0.5273
3	1.894406	0.7552
4	6.724073	0.1512
5	5.042646	0.2829
6	3.844390	0.4275
7	1.695876	0.7915
8	3.929708	0.4156
9	6.022527	0.1975
10	6.508326	0.1643
11	0.783761	0.9406
12	3.833819	0.4290

Table 7 shows that all of the LM probability values are greater than 0.05. The null hypothesis cannot be rejected for the significance level of 5% and it is concluded that there is no autocorrelation. The lag value was determined as 12.

The White test was used to examine the heteroscedasticity. According to the White test result, the null hypothesis cannot be rejected at the significance level of 5%. In other words, there is no problem of heteroscedasticity.

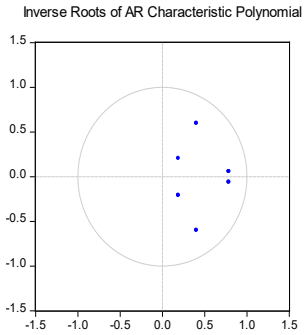
Jarque–Bera Normality Test was applied for the assumption of normality. The test result was calculated as 0.15. The hypotheses are expressed as follows:

H_0: The series is normally distributed
H_1: The series is not normally distributed

The null hypothesis cannot be rejected for the significance level of 5%. Therefore, the distribution is normal.

Table 8. VAR Model Roots:

Root	Module
0.783638 - 0.059595i	0.785901
0.783638 + 0.059595i	0.785901
0.400842 - 0.598749i	0.720538
0.400842 + 0.598749i	0.720538
0.188080 - 0.207260i	0.279876
0.188080 + 0.207260i	0.279876



The roots of the VAR model are in the unit circle. In other words, inverse characteristic equation roots are greater than one.

4.2.1. Variance Decomposition

In VAR models, variance decomposition determines what percentage of the change in one of the variables is explained by itself and the other variable.

Table 9. ISTFIX and PPI Series Variance Decomposition Results

ISTFIX Variance Decomposition:			
Period	**S.E.**	**ISTFIX**	**PPI**
1	27.97212	100.0000	0.000000
2	49.26108	99.96542	0.034585
3	57.91759	97.86019	2.139806
4	60.71984	92.20181	7.798190
5	62.35690	87.42674	12.57326
6	62.97804	85.71320	14.28680
7	63.24923	85.54041	14.45959
8	63.68726	85.71757	14.28243
9	64.02556	85.84526	14.15474
10	64.16159	85.83068	14.16932

PPI Variance Decomposition:			
Period	**S.E.**	**ISTFIX**	**PPI**
1	1.829582	0.056287	99.94371
2	2.998635	0.239863	99.76014
3	3.778827	0.163545	99.83646
4	4.273041	0.137044	99.86296
5	4.560490	0.127365	99.87264
6	4.722418	0.322267	99.67773
7	4.822979	0.823937	99.17606
8	4.891927	1.379886	98.62011
9	4.939364	1.772251	98.22775
10	4.970739	2.004780	97.99522

The first part of Table 9 examines what percentage of changes in the ISTFIX series are caused by itself and what percentage is caused by the PPI. The second part shows the period-based explanation power of the changes in the PPI series on the ISTFIX and PPI series.

The ISTFIX series can explain itself by 100% in the first period. This percentage gradually decreases through the following periods and the explanation power of the PPI series gradually increases. By the tenth period, 86% of the shock in ISTFIX is explained by itself and 14% is explained by PPI.

In the first period, one-unit shock in the PPI can be explained by itself by 99.95% and by ISTFIX by 0.05%. This percentage gradually decreases over the following periods and the explanatory power of the ISTFIX series gradually increases to the point that and a shock in the PPI in the tenth period is explained by itself by 98% and 2% by the PPI.

4.3. VAR Granger Causality

VAR Granger causality test investigates the relationship between the variables and the direction of the relationship if any.

Table 10. VAR Granger Causality Result

Dependent Variable: ISTFIX			
Excluded	Chi-sq	df	Probability
PPI	7.595743	3	0.0551
All	7.595743	3	0.0551
Dependent Variable: PPI			
Excluded	Chi-sq	df	Probability
ISTFIX	1.538234	3	0.6735
All	1.538234	3	0.6735

The Granger causality results in Table 10 show that the PPI series is the cause of the ISTFIX series. The results showed a unidirectional relationship.

5. CONCLUSION

This study investigated whether there is a relationship between maritime transport and the Turkish economy, and the direction of the relationship if any. It aimed to investigate the reflections of Turkey's economic course on Turkish maritime transport using VAR model.

Dry bulk cargo, which has the highest share among other cargoes in maritime trade was chosen as the study data set. In addition, non-regular liner transportation was chosen as it responds to demand more quickly and can express changes in the economy more clearly. The data set for Turkish small-tonnage dry cargo ships was provided by the ISTFIX between January 2005 and February 2016. The ISTFIX series was examined and in consideration of the time period of the data set, the effects of the 2008 economic crisis was investigated using the Perron (1989) equation (3.1). The break time is determined to be November 2008 in the analysis which examined the additive and level deviation. According to the Perron (1989) test result, it was concluded that there was a structural break. In other words, it was found to be stationary at the ISTFIX series level.

The other data set used in the study is PPI. PPI data, which is one of the basic indicators of the Turkish economy, was obtained from the website of the Turkish Statistical Institute for the dates January 2008 –February 2016. While analyzing the data set time period, it was considered that the 2008 economic crisis may have had an impact on this period. Therefore, Perron (1989) structural break test was used with equation (3.2) for the PPI data set and the break time was determined as 2008:11. The test results showed that there was a structural break in the PPI series in the 2008 November period. Therefore, it was concluded that the PPI series is stationary at its level.

Based on the result that the ISTFIX and PPI series are stationary in level, the VAR model was used since the analysis is not based on a specific economic theory. While creating the VAR model, the appropriate lag length was determined as three. The VAR model, for which the appropriate lag length was determined, was examined using certain diagnostic tests and it was concluded that there were no autocorrelation or heteroscedasticity issues. However, it was observed that the series was normally distributed. Finally, it was observed that the roots of the VAR model characteristic equations are within the unit circle. Based on these diagnostic tests, it was concluded that the parameters of the model were effective and consistent.

According to the diagnostic tests performed on the VAR equation that was created for the study, it was decided to continue the analysis with the VAR model. An impulse-response analysis was performed for the VAR model. This analysis showed that a one-unit shock in ISTFIX would first have a negative effect on the

PPI series and this effect would show a negative to positive trend after the fifth period. A one-unit shock that may occur in the PPI, on the other hand, showed a fluctuating course for a certain period of time, and the impact turned negative as of the fifth period.

When the explanatory power of the series was investigated in the study on ISTFIX and PPI, it was seen that 86% of ISTFIX was explained by itself and 14% by PPI as of the tenth period. When the explanation percentages for the PPI as of the tenth period were examined, it was concluded that PPI is explained by itself by 98% and by ISTFIX by 2%. Based on these results, it was concluded that PPI has an impact on ISTFIX.

The direction of the interaction was analyzed with the VAR Granger Causality test in the study. According to the analysis results, the ISTFIX series is the Granger cause of the PPI series. In other words, it was concluded that the ISTFIX series is the cause of the PPI series.

Both the effects of BDI on the developments in the world economy and the effects of the fluctuations in the Turkish economy on the ISTFIX series demonstrate the effect of the economy on maritime transport. Due to Turkey's geopolitical position, maritime trade is of great importance. Therefore, the economy should be analyzed correctly with respect to Turkey’s growing maritime trade. However, in order to increase the supply of the maritime transport market, there should be more fleets and their productivity should be improved. It could be possible to increase the share of maritime transport through tax reductions in line with the relevant legislation, laws that facilitate maritime transport, and infrastructure improvements within Turkey.

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