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The Causal Relationship between Oil Prices and Sector Indices: An Analysis from Turkey

(Research Article)

Petrol Fiyatları ile Sektör Endeksleri Arasındaki Nedensellik İlişkisi: Türkiye Örneği

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ABSTRACT

Since oil is one of the basic inputs in economies, changes in oil prices are important to countries, particularly oil importing countries. In this regard, this paper analyzes the causal relationship between oil prices and sector indices (BIST-Industrial, BIST-Service, BIST-Financial, and BIST-Technology) in the aftermath of the 2008 financial crisis in Turkey. First, the Johansen cointegration test is employed to analyze whether there are long-run relations between oil prices and sector indices over the period from 2008-10-2018:10. Then, the long-run relationships between oil prices and the sector indices was investigated using the Granger causality test based on the Vector Error Correction Model (VECM), and the Standard Granger test is used to analyze the causality between the variables without a long-run relationship. According to the results, there are long-run bidirectional relations between oil prices and the BIST-Industrial, the BIST-Service, and the BIST-Technology sector indices, respectively. -In the short-run period, however, there is a unidirectional relation running from oil prices to the BIST-Technology sector index. There is neither a short-run or long-run relation between oil prices and the BIST-Financial sector index.

1. INTRODUCTION

Oil has always been a key input in economies. However, it is a lot more important to oil importing economies since oil plays a crucial role in helping them achieve and maintain high growth rates. Although there is increasingly more importance attached to renewable energy sources, oil remains the main input in these economies. Thus, changes in oil prices are of great importance. In this regard, oil prices are one of the variables that are closely followed by economic actors. Since there are more fluctuations in oil prices particularly during crises, or fluctuations in oil prices can lead to crises, analyzing the impacts of this variable always draws attention.

Changes in oil prices affect oil importing and oil exporting economies differently. For the oil importing economies[1], rise in oil prices first leads to an increase in input costs. When there is not a substitution for this input, this results in a decrease in profit rates, weaker cash flows, and a reduction in equity prices. It also results in higher inflation. When central banks increase interest rates to decrease inflation, this makes other investment tools (such as bonds) appear more attractive than stocks, thereby contributing to falling stock prices (Basher and Sadorsky, 2006: 225-26; Basher et al, 2012: 229).

The fundamental study in the literature on oil prices belongs to Hamilton (1983). Since then, much research has been devoted to the relation between oil prices and macroeconomic variables, followed by studies analyzing the relation between oil prices and financial markets. Although there are more studies addressing the relation between oil prices and stock markets, it is obvious that there are not many studies focusing on developing countries. Likewise, there are only a few papers studying the relation in Turkey. The literature review shows that studies analyze the relation between oil prices and stock prices mostly by using aggregate data. It is also noticeable that there are only a few studies on sector indices.

This study contributes to the literature in two aspects. First, it analyzes the period following the financial crisis of 2008 and the impacts of the post-crisis period. Second, it enriches the currently limited literature by analyzing the causal relation between oil prices and sector indices. In this regard, this study analyzes the causal relationship between oil prices and sector indices (BIST-Industrial, BIST-Service, BIST-Financial, and BIST-Technology) covering the period from 2008:10 - 2018:10.

The study is organized as follows. Section 2 reviews the literature. Section 3 presents the data and the methodology. Section 4 reports and interprets the empirical results, and last section presents the conclusions.

2. LITERATURE REVIEW

It is obvious that the studies analyzing the relation between oil prices and stock prices in the literature mostly cover developed countries, and they focus on oil prices and real stock returns. For instance, the paper by Sadorsky (1999) examines the period from 1947:01-1996:04 for the US by using the VAR model, concluding that oil prices have a negative impact on real stock returns. In their paper, Park and Ratti (2008) investigate the impact of oil price shocks on real stock returns for the US and 13 European countries over the period of 1986:01-2005:12 using the VAR model. They conclude that oil price shocks have a statistically significant impact on real stock returns for the same month or within a month. The paper by Cunado and Perez de Gracia, (2014) addresses the impacts of oil price shocks on stock returns in 12 European oil importing countries and, finds that changes in oil prices have a negative effect on real stock returns in most of the countries that were analyzed over the period from 1973:02 - 2011:12.

Although the relation between oil prices and stock returns has been investigated mostly in oil importing countries, it is important to review the analyses on oil exporting countries. The paper by -Arouri and Rault, (2010) analyzes the relation between oil prices and the stock markets in the countries of the GCC (Gulf Corporation Council) (Bahrain, Kuwait, Oman,

[1] It is not as easy to analyze the relation between oil prices and stock market for oil exporting countries as it is for oil importing countries. While rising oil prices is expected to negatively affect the stock market in oil importing economies, the relation is not very clear for oil exporting countries since oil shocks impact national income, productive activities, and corporate earnings (Arouri et al, 2013: 3).

Qatar, the United Arab Emirates, and Saudi Arabia). They find that there is a bidirectional causal relation between oil prices and the stock market in Saudi Arabia and that in other countries there is unidirectional Granger causality from oil prices to stock prices. The paper by Arouri et al. (2013) examines the relation between oil prices and the stock market in the countries of the GCC over the period between June 7, 2005 and December 31, 2009 by using weekly data. Their paper indicates that the impact of changes in oil prices on the stock market is asymmetric and that negative oil shocks affect stock returns more, while the causality is from oil prices to the stock market in most cases. No long-run relation is found between oil prices and the stock market in any of the GCC countries that are analyzed.

Although the number of studies on the relation between oil prices and sector indices has increased, we cannot argue that there is rich literature on the subject for developing countries. The paper by Arouri, (2011) investigates the short-run relation between oil prices and various sector indices in Europe. In his paper covering the period of 1998-2010, weekly data are used and 12 sector indices (automobile-parts, financials, food-beverages, oil-gas, health care, industrials, basic materials, personal-household goods, consumer services, technology, telecommunications, and utilities) are analyzed via the DJ Stoxx 600 index. The sectors that were analyzed in his paper, long-run relations are found only between oil prices and the automobile-parts, food-beverages and oil-gas sector indices, respectively, but the findings regarding those long-run relations are not highlighted since the purpose of that paper was to investigate short-run relations. His paper finds that the increases in oil prices negatively affect six sector indices (financials, food-beverages, health care, personal-household goods, technology, and telecommunications), and positively affect three sector indices (oil-gas, basic materials, and consumer services) and that there is no relation between oil prices and two sector indices (industrials and utilities). Additionally, when analyzing the causality between oil prices and sector indices, his study finds bidirectional causal relations between oil prices and the DJ Stoxx 600 index, automobile-parts, food-beverages, oil-gas, basic materials, personal-household goods, consumer services, and utilities indices, respectively. It also concludes that there is unidirectional Granger causality from oil prices to the financials, health care, industrials, technology, and telecommunications sectors, respectively. The paper by Lee et al. (2012) analyzes the relation between oil prices and the composite stock index and various sector indices for the period from 1991:01-2009:05 for G-7 countries. They find that there is no Granger causality from changes in oil prices to the composite stock index for any of G-7 countries. The findings of the sector indices are as follows: for 6 sector indices out of 11 (discretionary consumer spending, energy, health care, industrials, materials, and telecommunications), there is no causality from oil prices to sector indices, while for the remaining indices (consumer staples, financial, information technology, utility, and transportation), changes in oil prices Granger-cause sector stock prices for at least one country. The analysis carried out by Cong et al. (2008) for China covering the period from 1996:01-2007:12 indicates that oil shocks do not have a statistically significant impact on many stock returns except for their impacts on manufacturing and some oil companies' stock returns. The paper by Li et al. (2012) addresses the causal relationship between oil prices and the stock market for China for the period from 2001:07 – 2010:12 with respect to sectors. They use panel-data analysis and 13 sector indices (agriculture, mining, manufacturing, utilities, construction, transportation, IT, wholesale & retail, financials, real estate, social services, media, and conglomerates) for four sub-periods (2001:07 – 2005:10; 2005:12 – 2007:06; 2007:08 – 2008:11 and; 2009:01 – 2010:12). Their findings show that there is bidirectional causality between oil prices and sector indices for the 2007:08–2008:11 and 2009:01–2010:12 sub-periods in the long-run, and that there is long-run causality from sector indices to oil prices for the period from 2005:12 – 2007:06. The paper by Dagher and El Hariri, (2013) analyzes the causal link between oil prices and various stock indices in Lebanon, and finds that there is causality from oil prices to all indices that are included while there is no causality from the indices to oil prices.

The papers analyzing the short-run and long-run relations between oil prices and stock prices in Turkey mostly focus on the relation between the National-100 index (formerly BIST-100 index) and oil prices. For instance, the paper by İşcan, (2010) analyzes the relation between oil prices and stock prices over the period from December 3, 2001, to December 31, 2009, by using daily data. The results of his paper indicate that there is not a long-run relation between the National-100 Index, which represents stocks, and oil prices, and that there is no causality between these two variables. The analysis carried out by Ünlü and Topçu, (2012) examines the relation between oil prices and stock prices over two separate periods (1990:01–2001:02 and 2001:03–2011:12). They also use the National-100 index to represent stock prices. Their results indicate that there is no long-run relation or causality between the variables over the period from 1990:01-2001:02, while there is a long-run relation over the period from 2001:03- 2011:12. Also finding unidirectional causality from oil prices to stock prices, they emphasize that oil prices have a positive impact on stock prices over the period from 2001:03-2011:12, which is different from the findings in the literature on oil importing countries. Unlike the two studies that were reviewed above, the research by Kapusuzoglu, (2011) includes the National-50 index and the National-30 index into his analysis, and investigates the short-run and long-run relations between oil prices and the National-100, National-50, and National-30 indices by using daily data over the period from 2000-2010. His paper finds a long-run relation between oil prices and the three indices that were covered. According to Granger-causality results, there is a unidirectional causal relation from the indices to oil prices. Abdioğlu and Değirmenci, (2014) analyze the relation between oil prices and sector indices in terms of four main sectors (industry, services, financials, and technology) and their sub-sectors by using daily data over the period from 2005-2013. Their analysis finds a long-run relation between oil prices and the aggregate industrial sector, the chemical and textile sub-sectors, and the communication sector, which is a subsector of services. It also indicates that there is short-run causality from the aggregate industrial sector, services, financial, communication, insurance and holding, chemistry, basic metals, metal products, and stone-soil sub-sectors to oil prices. Similar to the research done by Kapusuzoglu, (2011), their study finds causality from most of the indices that were analyzed to oil prices and emphasizes that there is no causal relation between the technology sector and oil prices and that there is bidirectional causality for the trade subsector. Güler and Temel Nalın, (2013) investigated a causal relationship between oil prices and the Istanbul Stock Exchange (ISE) 100, the ISE Industrial and the ISE chemistry, petroleum, and plastic indices over the period from 1997 – 2012 by using weekly data. They find that there is a long-run relation between the indices that were included in their analysis and oil prices, while there is no causality between the variables in the short-run. The paper by Kılıç et al. (2014) focuses on the relation between oil prices and only the industrial price index over 1994:01– 2013:11 and finds a long-run relation between these two variables. Şahin, (2015) investigates the causality between oil prices and the BIST 100, BIST Manufacturing, and BIST Technology indices by using daily data over the period from 02.01.2001–30.10.2013, and finds unidirectional causality running from oil prices to the BIST 100 and BIST Manufacturing indices and bidirectional causality between oil prices and the BIST Technology index in the long-run. Büberkökü, (2017) analyzes the causality between oil prices and the BIST 100, BIST Financial, BIST Industrial and BIST Services indices over the period between January

1999 and September 2014, and finds that when regime shifts are not taken into consideration, there is a bidirectional relation between oil prices and the BIST 100 and BIST Industrial indices and a unidirectional relation between the BIST Financial and BIST Services. According to his findings, unidirectional relations exist from the BIST Financial index to oil prices and from oil prices to the BIST Service index. According to the findings of the causality test considering the regime shift, there are unidirectional relations from oil prices to the BIST Services and BIST Industrial indices and from the BIST Financial index to oil prices during the first term of the regime. His paper also emphasizes that there is a unidirectional relation from the BIST Financial index to oil prices during the second term of the regime.

Unlike the studies that were mentioned above, Ekşi et al. (2012) examine the relation between oil prices and seven industrial sub-sector indices (food and beverages; textiles and leather; wood, paper & printing; chemical, petroleum, and plastics; basic metals; and nonmetal mineral products) over the period from 1997:01-2009:12. Their research has not found any short-run or long-run relations between oil prices and the indices except for two industrial indices (chemical, petroleum, and plastics and basic metals) that they included in their study. They argue that the long-run causality running from oil prices to chemical, petroleum, and plastic and basic metals results from the fact that these sectors use oil as a direct input. Similar to the article by Ekşi et al. (2012), the paper by Eyüboğlu and Eyüboğlu, (2016) addresses industrial sub-sector indices (stone-soil; basic metals; chemical, petroleum and plastics; metal products and machinery; food and beverages; textiles and leather; and wood, paper & printing). However, their article is different in that it also includes the industrial index and analyzes the long-run relations between the relevant indices and natural gas prices along with oil prices over the period from 2005:10–2015:09. Although they find a long-run relation between the indices and natural gas prices and oil prices, respectively, they indicate an absence of any causality between natural gas prices and the indices discussed. Their findings also reveal that there is unidirectional causality from oil prices to the industrial; stone-soil; basic metals; chemical, petroleum and plastics; and wood paper & printing indices only in the short-run, and no relation is found between oil prices and other indices.

3. DATA SET AND METHODOLOGY

3.1. Data Set

This paper investigates the causal relationship between oil prices and sector indices (BIST-Industrial, BIST-Service, BIST-Financial, and BIST-Technology) over the period from 2008:10-2018:10. The underlying reason for starting the period in October 2008 is that the financial crisis became global following the collapse of Lehman Brothers at that time.

The variables that are used in this paper, their abbreviations, and their sources are shown in Table-1[2]. All the variables in this paper are in real terms and natural logarithm forms. To represent the world oil prices, West Texas Intermediate (WTI) is employed[3]. Just as Li et al. (2012: 1953) do in their paper, the real world oil prices have been calculated; divided by the

[2] The variables for which seasonality is mentioned were seasonally adjusted by using the Census X12 method.

[3] There are three types of data that are commonly used in the literature to represent world crude oil prices: West Texas Intermediate (WTI), U.K Brent and Dubai. In this study, West Texas Intermediate (WTI) has been used to represent world crude oil prices.

US Producer Price Index, and every sector index has been turned into real terms; divided by Turkey's Consumer Price Index.

Table 1. The Variables used in the Analysis and Their Sources

Variable	*Definition*	*Source*
oil	Crude Oil Prices: West Texas Intermediate (WTI)	FRED (Federal Reserve Bank St. Louis Economic Research)
industrial	BIST Industrial	Central Bank of the Republic of Turkey
service	BIST Service	Central Bank of the Republic of Turkey
finance	BIST Financial	Central Bank of the Republic of Turkey
technology	BIST Technology	Central Bank of the Republic of Turkey

3.2. Methodology

In the literature, a causal relationship between variables is commonly analyzed using the Granger causality test. As stated by Granger, (1969), Granger causality between two stationary time series such as X_t and Y_t can be predicted using the VAR model.

$$X_t=\sum_{j=1}^{m} a_j X_{t-j}+\sum_{j=1}^{m} b_j Y_{t-j}+\varepsilon_t \quad (1)$$

$$Y_t=\sum_{j=1}^{m} c_j X_{t-j}+\sum_{j=1}^{m} d_j Y_{t-j}+\eta_t \quad (2)$$

where ε_t *and;* η_t - are uncorrelated, white-noise error terms. The error terms have the following features: $E[\varepsilon_t \varepsilon_s] = 0 = E[\eta_t \eta_s]$, s≠t, and for every t and; s $E[\varepsilon_t \varepsilon_s] = 0$. m → represents the lag length.

The equality above shows us that Y_t is the cause of X_t when b_j is nonzero. Similarly, X_t is the cause of Y_t when c_j is nonzero. If both of these events occur, it means there is a correlation between X_t and Y_t (Granger, 1969: 431). If the series are stationary, a standard Granger causality analysis is conducted. When the series are nonstationary or have the same order of integration; but there is no cointegration, the VAR model is predicted by taking the differences between the variables and Granger causality analysis is conducted (Belloumi, 2009: 2749; Masih and Masih, 1996:174).

However, according to Engle and Granger, (1987), if variables are cointegrated, a VAR model that is composed of the first differences of series is misspecified. In other words, when the variables are cointegrated, the standard Granger causality test is not valid. The presence of cointegration between variables reveals that there may be at least one Granger causality, but it does not give an idea about its direction. In this case, the causality should be analyzed using the Vector Error Correction Model (VECM) (Masih and Masih, 1996: 169). The Vector Error Correction Model (VECM) between two variables can be shown as follows:

$$\Delta X_t=\sum_{j=1}^{m-1} a_j \Delta X_{t-j}+\sum_{j=1}^{m-1} b_j \Delta Y_{t-j}+\lambda ECT_{t-1}+\varepsilon_t \quad (3)$$

$$\Delta Y_t=\sum_{j=1}^{m-1} c_j \Delta X_{t-j}+\sum_{j=1}^{m-1} d_j \Delta Y_{t-j}+\Phi ECT_{t-1}+\eta_t \quad (4)$$

The meaning of each symbol is as follows:

X_t → oil price;

Y_t → every sector index;

Δ → difference processor;

ε_t, η_t → uncorrelated white-noise error terms and;

ECT_{t-1} error correction term.

VECM analysis specifies the direction of the relation between variables and differentiates short-run and long-run Granger causality. While short-run causality is tested using an F-test, the significance of the lagged error correction term according to the t-test indicates long-run causality (Masih and Masih, 1996: 171, 1997: 424; Odhiambo, 2008: 708, 2009: 637).

4. EMPIRICAL FINDINGS

The stationarity of the variables that are used in this analysis is tested using the Augmented Dickey-Fuller (ADF, Dickey and Fuller, 1981) unit root test and Phillips Peron (PP, Phillips and Perron, 1988) unit root test, which are commonly preferred tests in the literature. Table-2 and Table 3 show the results of the unit root tests.

Table 2. ADF Unit Root Test Results

Variables	**ADF (Test Statistic)**				
		Level	**Critical Value**	**1.Difference**	**Critical Value**
oil	Intercept	-1.48	-3.48	-9.21 ***	-3.48
	Trend and intercept	-1.61	-4.03	-9.17 ***	-4.03
industrial	Intercept	-2.91	-3.48	-8.78 ***	-3.48
	Trend and intercept	-2.11	-4.03	-9.08 ***	-4.03
service	Intercept	-3.27	-3.48	-10.19 ***	-3.48
	Trend and intercept	-2.67	-4.03	-10.48 ***	-4.03
finance	Intercept	-1.87	-3.48	-9.41***	-3.48
	Trend and intercept	-2.19	-4.03	-9.87***	-4.03
technology	Intercept	-2.42	-3.48	-9.38***	-3.48
	Trend and intercept	-2.08	-4.03	-9.58***	-4.03

Notes: *** indicates significance at the 1% level. The optimum lag lengths are set according to the Schwarz Information Criteria (SC) for the ADF.

Table 3. PP Unit Root Test Results

Variables	PP (Test Statistics)				
		Level	**Critical Value**	**1.Difference**	**Critical Value**
oil	Intercept	-1.48	-3.48	-9.18***	-3.48
	Trend and intercept	-1.61	-4.03	-9.13***	-4.03
industrial	Intercept	-2.91	-3.48	-8.76***	-3.48
	Trend and intercept	-2.11	-4.03	-9.04***	-4.03
service	Intercept	-3.34	-3.48	-10.29***	-3.48
	Trend and intercept	-2.77	-4.03	-10.49***	-4.03
finance	Intercept	-2.12	-3.48	-9.45***	-3.48
	Trend and intercept	-2.25	-4.03	-9.84***	-4.03
technology	Intercept	-2.31	-3.48	-9.50***	-3.48
	Trend and intercept	-2.31	-4.03	-9.63***	-4.03

Notes: *** indicates significance at the 1% level. In the PP test, the "Barlett Kernel" method and the "Newey West Bandwidth" method are used.

When the unit root test results are analyzed, it is seen that all the variables are I (1) based on both the ADF unit root test and PP test and that the series become stationary when their first differences are taken.

Before moving to the analysis of the causality between variables, it is necessary to analyze whether there is cointegration between the unit root series or not since the analysis of the causality between variables varies, as presented in the methodology in detail, depending on the existence or absence of cointegration. Therefore, whether there is a long-run relation between oil prices and each sector index is first investigated using the Johansen cointegration test[4], which is a commonly preferred test in the literature (Johansen, 1988; Johansen and Juselius, 1990). The results of the trace and maximum eigenvalue tests analyzing the relation between oil prices and each sector index[5] are shown in the table below.

[4] Since the purpose of this paper is to analyze the causality between oil prices and sector indices, there is no theoretical background considering the Johansen cointegration test that is presented; and only the empirical results are presented.

[5] Four different VAR models were predicted while investigating the cointegration between oil prices and each sector index (oil prices – BIST-Industrial index; oil prices – BIST-Services index; oil prices – BIST-Finance index and; oil prices – BIST-Technology index). While determining the lag length in the VAR models, information criteria (LR, FPE, AIC, SC and HQ) were applied. For every model the lag length without autocorrelation and heteroskedasticity was taken into consideration. Accordingly, in the VAR model analyzing the long-run relation between oil prices and the BIST-Industrial index, the lag number was determined to be 3; in the VAR model analyzing the oil prices and the BIST-Service index,

Table 4. The Results of Johansen Cointegration Test between Oil Prices and Sector Indices

	Rank (r)	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
Oil-Industrial	**None (r=0)**	23.248** [0.018]	20.261	20.714*** [0.008]	15.892
	At most 1 (r≤1)	2.534 [0.670]	9.164	2.534 [0.670]	9.164
Oil-Service	**None (r=0)**	18.258** [0.018]	15.494	14.579** [0.044]	14.264
	At most 1 (r≤1)	3.679 [0.055]	3.841	3.679 [0.055]	3.841
Oil-Finance	**None (r=0)**	11.860 [0.163]	15.494	9.510 [0.246]	14.264
	At most 1 (r≤1)	2.350 [0.125]	3.841	2.350 [0.125]	3.841
Oil-Technology	**None (r=0)**	26.148*** [0.006]	20.261	24.547*** [0.001]	15.892
	At most 1 (r≤1)	1.600 [0.855]	9.164	1.600 [0.855]	9.164

Notes: The values in the square brackets are the probability values.

According to the trace and maximum eigenvalue test results, there is cointegration between oil prices and the BIST-Industrial sector index, the BIST-Service sector index, and the BIST-Technology sector index, there is no cointegration between oil prices and the BIST-Finance sector index. After this stage, the analysis continues with causality analysis based on the VECM for the variables having cointegration and with the Granger causality test based on the VAR analysis for the variables lacking cointegration by taking the first differences of the variables.

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the lag number was determined to be 3; in the VAR model analyzing the long-run relation between oil prices and the BIST-Finance index, the lag number was determined to be 7 and; in the VAR model analyzing the long-run relation between oil prices and the BIST-Technology index, the lag number was determined to be 3. In every one of these four VAR models, since all inverse roots are in circles, the condition for stability is met.

Table 5. Oil-Industrial Granger Causality Analysis based on Oil-Industrial VECM

Dependent Variable	Short-run Causality		Long-run Causality
	Explanatory Variable		Error Correction Coefficient ECT (-1)
	Δoil	**Δindustrial**	
Δoil	-	4.221 [0.121]	-0.021*** (-2.618)
Δindustrial	2.223 [0.329]	-	-0.025*** (-4.146)

*** and ** show causality at the 1 and 5 percent significance levels respectively. The values in square brackets show the probabilities while the ones in parenthesis show the t-statistics. For the t-statistic, the critical values are 2.57 (%1) and 1.96 (%5).

Table 6 . Oil-Service Granger Causality Analysis based on VECM

Dependent Variable	Short-run Causality		Long-run Causality
	Explanatory Variable		Error Correction Coefficient ECT (-1)
	Δoil	**Δservice**	
Δoil	-	2.499 [0.286]	0.001** (2.262)
Δservice	1.176 [0.555]	-	0.001*** (3.361)

*** and ** show causality at the 1 and 5 percent significance levels respectively. The values in square brackets show the probabilities while the ones in parenthesis show the t-statistic. For the t-statistics, the critical values are 2.57 (%1) and 1.96 (%5).

Table 7. Oil-Technology Granger Causality Analysis based on VECM

Dependent Variable	**Short-run Causality**		**Long-run Causality**
	Explanatory Variable		Error Correction Coefficient ECT (-1)
	Δoil	**Δtechnology**	
Δoil	-	2.152 [0.340]	-0.051*** (-3.038)
Δtechnology	9.611*** [0.008]	-	-0.075*** (-3.963)

*** and ** show causality at the 1 and 5 percent significance levels respectively. The values in square brackets show the probabilities while the ones in parenthesis show the t-statistic. For the t-statistics, the critical values are 2.57 (%1) and 1.96 (%5).

When the results of the Granger causality based on the VECM are analyzed, it is seen that there is a long-run bidirectional relation between oil prices and the BIST-Industrial sector index, but there is no causal relation between them in the short-run period. Similarly, although there is a long-run bidirectional relation between oil prices and the BIST-Service sector index, there is no causality between the variables in the short-run period. Different from other indices, there is a unidirectional relation running from oil prices to the BIST-Technology index in the short-run period, whereas there is bidirectional relation between them in the long-run period. The BIST-Technology sector index is not frequently included in analyses particularly in Turkey when compared to other indices. Nevertheless, the analysis done by Şahin, (2015) shows a bidirectional causal relation between oil prices and the BIST Technology index.

Causal relationships running from oil prices to sector indices (industrial, service and technology) are expected to be found in the long-run period since some subitems of these sector indices such as chemical, petroleum, and plastics for the industrial sector and transportation for the service sector are directly dependent on oil prices. Similarly, the study by Eksi et al. (2012) also finds a causal relation running from oil prices to chemical, petroleum and plastics and basic metals in the long-run, and they claim that this results from the fact that these sectors use oil as a direct input. The findings of the analysis by Büberkökü (2017) also show that there is a bidirectional relation between oil prices and the BIST industrial index. Furthermore, the paper by Güler – Temel Nalın, (2013) also shows a long-run relation between oil prices and industrial index but an absence of causality between them in the short-run period. Kılıç et al. (2014) also find that there exists a long-run relation between oil prices and the industrial index.

Although causality from sector indices to oil prices seems surprising especially for Turkey, the main reason may be that these sectors use oil as a fundamental input. Similar findings are also seen in the analyses by Kapusuzoglu, (2011) and Abdioğlu and Değirmenci, (2014). Kapusuzoglu, (2011) employs the National-100, National-50, and National-30 indices and finds a unidirectional relation from these indices to oil prices. Abdioğlu and Değirmenci, (2014) focus on sector indices and their sub-sectors, and find that there is a short-run causal relation from stock prices to oil prices for these sub-sectors: the aggregate industrial sector, the service sector, the finance sector, communication, insurance and holding, chemical, basic metals, and stone-soil. Apart from the analyses for Turkey, the study carried out by Li et al. (2012) for China suggests that the existence of a unidirectional causal relation from sector indices to oil prices results from the data frequency and the period of the data.

Table 8. Oil-Finance Standard Granger Causality Analysis

Dependent Variable	**Explanatory Variable**	
	oil	**finance**
oil	-	1.871 [0.392]
finance	3.643 [0.161]	-

No causal relationship has been found in the short-run period between oil prices and the BIST-Finance sector index that lacks cointegration. The reason for this finding may be that oil prices are not a fundamental input in the BIST-Finance sector index.

5. CONCLUSION

This paper analyzed the causality between oil prices and the BIST-Industrial, BIST-Service, BIST-Financial, and BIST-Technology sector indices. The financial crisis of 2008 is the starting point of the period that is covered. The reason why sector indices have been preferred instead of the BIST-100 index is that there are only a small number of studies on the relation between oil prices and sector indices in developing countries such as Turkey. This paper first analyzes whether there are long-run relations between oil prices and sector indices using the Johansen cointegration test. If a long-run relation exists, then the causality between the variables is analyzed using the Granger causality test based on Vector Error Correction Model. Conversely; if there is no long-run relation between them, then the causal relation between the variables is analyzed using the Standard Granger test. In this regard, the findings show that there are bidirectional relations between oil prices and the BIST-Industrial sector index, the BIST-Service sector index, and the BIST-Technology sector index, respectively, in the long-run period. Additionally, there is a unidirectional causal relation from oil prices to the BIST-Technology index in the short-run period. However, there is no causal relation between oil prices and the other sector indices that are analyzed in the short-run period.

The findings can be compared to the findings of previous studies for Turkey. To start, the study by Büberkökü (2017) finds long-run relations between oil prices and the sector indices and a bidirectional relation between oil prices and the BIST industrial index similar to this study. However in contrast to the findings of this paper, his paper shows unidirectional relations running from oil prices to the service sector index and from the financial sector index to oil prices. The results of the paper by Abdioğlu and Değirmenci, (2014) show causality from the aggregate industrial sector, service sector and financial sector indies to oil prices in the short run but an absence of any causality from the technology index to oil prices. Güler and Temel Nalın, (2013) also conclude that there is a long-run relation between oil prices and the industrial index -while there is no causality between them in the short-run. Similarly, the paper by Kılıç et al. (2014) also finds a long-run relation between oil prices and the industrial index. Similar to the findings of this paper, the analysis carried out by Şahin,

(2015) shows a bidirectional causal relation between oil prices and the BIST Technology index. He also analyzes the relations between oil prices and the BIST 100 and BIST Manufacturing indices and finds unidirectional relations from oil prices to these indices.

When the findings of the previous analyses on Turkey are taken into consideration, it seems that it is not easy to achieve a common result. While one reason may be the differences in terms of the periods that are covered, another one may be that in every study the indices that are analyzed are different and that there are not many studies dealing with this relation. How the changes in oil prices affect the stock market is of great importance for investors, in particular. Therefore, it can be argued that carrying out more studies on sector indices may help investors make their future decisions.

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