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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

THE EFFECT OF OIL PRICES ON ECONOMIC GROWTH, INFLATION AND STOCK MARKET: AN APPLICATION ON TURKEY ECONOMY

PETROL FİYATLARININ EKONOMİK BÜYÜME, ENFLASYON VE HİSSE SENETLERİ ÜZERİNE ETKİSİ: TÜRKİYE EKONOMİSİ ÜZERİNE BİR UYGULAMA

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Abstract

With the developing technology, use of energy and especially consumption of oil are increasing in industrialized countries. Oil use is very important for the growth of economies and development of countries. Changes in oil prices affect country economies deeply. An increase in oil prices, especially for an oil importer country, is considered as a negative indicator of that country's external balance. Thus, Turkey's economy which oil importer is also affected by changes in oil prices. In recent years, sharp increases and decreases in oil prices have attracted the attention of policy makers and macroeconomists and many researches have been made on the macroeconomic impact of oil prices. In this study, it has examined the relationship between economic growth, consumer price index, producer price index, BIST100 index and industrial firms' stocks with oil price using quarterly data for the period 2014Q1-2019Q4 in Turkey. Granger causality analysis was used in the model part of the study. As a result of the study, one-way relation was found from oil prices to economic growth, consumer price index, producer price index and industrial firms' stocks. In addition, a one-way relationship was found from BIST100 index to oil prices.

Keywords: Oil Price, Inflation, Economic Growth

JEL Codes: Q43, E31, F43

Öz

Gelişen teknoloji ile birlikte sanayileşmiş ülkelerde enerji kullanımı ve özellikle de petrol tüketimi giderek artmaktadır. Ekonomilerin büyümesi ve ülkelerin kalkınması adına petrol kullanımı çok önemli bir konumdadır. Petrol fiyatlarındaki değişiklikler ülke ekonomilerini derinden etkilemektedir. Özellikle petrol ithalatçısı bir

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ülke için petrol fiyatlarında meydana gelecek bir artış, o ülkenin dış dengesine ilişkin olumsuz bir gösterge olarak kabul edilmektedir. Dolayısıyla petrol ithalatçısı olan Türkiye ekonomisi de petrol fiyatlarındaki değişimlerden etkilenmektedir. Son yıllarda petrol fiyatlarındaki keskin artışlar ve azalışlar politika yapıcıların ve makro iktisatçıların dikkatini çekmiş ve petrol fiyatlarının makroekonomik etkisi konusunda çok sayıda araştırmaya yapılmıştır. Bu çalışmada Türkiye'den 2014Q1-2019Q4 dönemine ait üçer aylık veriler kullanılarak petrol fiyatları ile ekonomik büyüme, enflasyon ve hisse senetleri arasında ilişki incelenmiştir. Çalışmanın model kısmında Granger nedensellik analizi kullanılmıştır. Çalışmanın sonucunda petrol fiyatlarından ekonomik büyümeye, tüketici fiyat endeksine, üretici fiyat endeksine ve sanayi firmalarının hisse senetlerine doğru tek yönde bir ilişki; BIST100 endeksinden petrol fiyatlarına doğru ise tek yönlü bir ilişki olduğu tespit edilmiştir.

Anahtar Kelimeler: Petrol Fiyatları, Enflasyon, Ekonomik Büyüme

JEL Codes: Q43, E31, F43

Introduction

Energy in the globalizing world appears as an increasingly important concept. An important reason for this is that it is a basic factor in realization of production as well as labor and capital. Depending on the fact that energy is a production factor, it shows how important it is to capture the competitive advantage in international trade and to use it as an economic threat.

Petroleum, one of the primary energy sources, consists of a combination of the Latin word petro (stone) and oleum (oil). Crude oil, one of the greatest riches of the earth, is a liquid substance with organic components extracted from underground through exploration and production.

Petroleum has become a basic input for economic activities since the 19th century, when its use as an energy source began to spread. The distribution of oil is heterogeneous as it is valid for almost every natural resource in the world. While the Middle East, Central Asia and Latin America are the regions with the most oil reserves, the countries with developed industry and the highest oil consumption do not have sufficient reserves. This situation causes oil trade to take place intensely.

Energy – especially oil – is one of the most major raw materials in a modern economy. While petroleum products are generally used in transportation and energy extraction, it is also used in the manufacture of petrochemical products. Therefore, oil price is one of the key prices in the international economy and is widely used as a reference value for other energy sources (Korhonen & Ledyaeva, 2010: 849).

Some economic recessions have been observed in response to the increase in oil prices since the second half of the 19th century. The sudden rise of oil prices and the contraction of oil supply in 1973 caused serious inflation and stagnation in the world.

The fact that the Petroleum Exporting Countries (OPEC) used oil as a threat for political interest in 1973 caused the worldwide energy problem to arise. The 1973 oil crisis led to both a rise of oil price and the emergence of the energy supply security problem. This situation has caused countries to pay more attention to energy security and turn to alternative energy sources. On the other hand, while the increase in oil price provides capital flow to petroleum exporting countries as petroleum

dollar, economic growth slows down with the increase in manufacture in oil importing countries. The slowdown in the economic growth of developed countries, especially with the rising oil price, led to the acceleration of the unemployment rate and the contraction of the world economy along with inflation. Therefore, as seen in the 1973 oil crisis, increases in oil prices have a positive effect on the economies of oil-exporting countries, while it has a negative impact on the economies of oil-importing countries.

Strong increases in the oil price are usually accepted to have major effects on both economic action and macroeconomic politics. For oil-importing countries, fluctuations in oil prices significantly affect the economic policies to be implemented.

Rising of oil prices influence potential manufacture in the economy. In fact, increases in oil prices are evaluated as an indication of an rise in shortage in the economy, meaning that oil will be less existing in the market. Since oil is a basic input in manufacture, it also causes an impact on decreasing labor productivity in the next period (Jbir & Ghorbel, 2009, 1041). The higher oil prices strongly reduce income and employment, for several reasons. The rise in oil prices increases the all price level above a level that can be supported by the available money stock(Pierce ve Enzler, 1974, 36-38).

Rising oil prices both reduce economic growth and increase inflation. Higher prices for crude are followed, almost likewise, by rises of oil products, such as gasoline and heating oil, used by consumers(Cologni & Manera, 2008, 857).

Located between the oil importing countries and targeting a high economic growth rate Turkey's dependence on foreign energy is realized approximately 74% (TPAO). This high foreign dependency in energy causes the economy of the country to be significantly affected with fluctuations in energy prices. The fluctuation in the barrel price of oil, which has about 31% of the total demand for primary energy type, is to affect the total energy import cost to a large extent.

In this study, It was investigated the interaction between oil prices and producer price index(PPI), consumer price index(CPI), economic growth(GDP), BIST100 index(BIST) and shares of industrial companies located in the BIST(SIC) the help of Granger causality test using quarterly data for the period 2004Q1 – 2019Q4 in Turkey. Since the BIST Industrial Index variable and producer price index have not been used in any study before, it is expected to contribute to the literature.

1. Petroleum Market and Prices

Historical sources show that oil was first searched and used with branches of bamboo tree in China around 400 BC. This strange sticky and black substance found in the following centuries has been used in the field of health in Asia and Europe. The modern petroleum industry began to take shape with the discovery in the mid-19th century in USA, and then the use of petroleum and its derivatives became widespread.

The color of the oil can be dark yellow, green, khaki, brown, dark brown or black. This shows the quality of the oil. Quality is determined by a measuring unit called API. As gravity increases, the

density gets smaller and the quality of the oil increases. The heavy (low gravity) petroleum is dark brown or black, while the light (high gravity) petroleum is light brown, yellow or green. While heavy products such as asphalt are obtained from low gravity oil, light products such as jet fuel, gasoline, gas oil and diesel are obtained from the refining of high gravity oil.

Petroleum has entered human life as a source of energy for the purposes of warming and enlightenment. With the technological developments and especially the use of internal combustion engines, the vital and economic role of oil has increased. Increasing the need for oil also increased the oil exploration efforts; new reserves were found over time. More than half of the world's oil reserves are in the Middle East. Because the Middle East resources are very close to the surface and almost all of the reserves are defined.

The unbalanced distribution of oil reserves and the steady increase in oil demand in the course of economic growth have increased the strategic importance of oil. Thus, the oil market has developed very rapidly with the industrialization process since the 19th century. After World War I, giant oil companies were established in the world. The most important of these are BP, Shell, Mobil, Exxon, Gulf, Texaco and Chevron, known as Seven Sisters. The Organization of the Petroleum Exporting Countries(OPEC), which is the most important producer organization of the world, was established in 1960 in Baghdad with the participation of Iraq, Iran, Venezuela, Saudi Arabia and Kuwait (OPEC, 2018). OPEC has 71,8% of world oil reserves as of 2018 and realizes 41,4% of world production (BP, 2019).

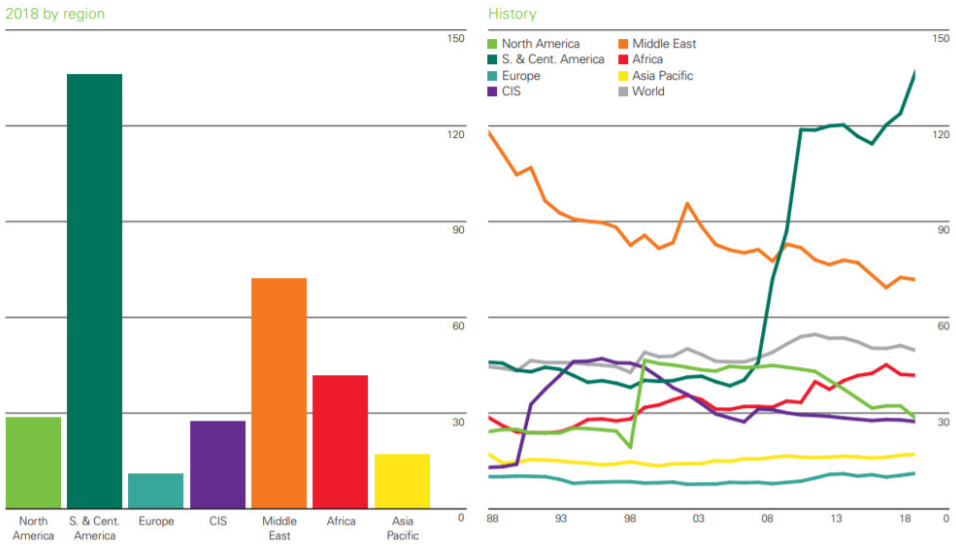
The proven total reserve amount of oil, which is used as the most energy source in the world, is 1.729 billion barrels as of 2018. Approximately 48,3% of this oil reserve amount belongs to Middle Eastern countries. The Middle East countries are followed by South and Central America countries with a rate of 18,8% and North America with a rate of 13,7%, respectively. In terms of countries, it is seen that the countries with the highest oil reserves are Venezuela with 17,5% and Saudi Arabia with 17,2% (BP, 2019).

Figure 1 : Distribution of proved reserves in 1998, 2008 and 2018(%)

Source: BP Statistical Review of World Energy, 2019

At the end of 2018, oil reserves increased by 2 billion barrels compared to 2017 and reached 1,730 billion barrels. The worldwide R / P ratio shows that oil reserves accounted for 50 years of current manufacture in 2018. Regionally, Europe has the lowest (11 years), while Central and South America have the highest R / P ratio (136 years). OPEC countries have 71,8% of worldwide oil reserves. Venezuela is the country with the most oil reserves worldwide. Venezuela has about 17.5% of the world's oil reserves. Venezuela is followed by Saudi Arabia with 17.2%, Canada with 9.7%, Iran with 9% and Iraq with %8.5, respectively.

Figure 2: Reserves-to-production (R/P) ratios



Source: BP Statistical Review of World Energy, 2019

Production amount of oil in the world was 4.4 billion tons in 2018. When oil production shares are analyzed, it is seen that OECD member countries produce approximately 1.2 billion tons and non-OECD countries produce approximately 3.2 billion tons. However, it is seen that OPEC countries produce approximately 1.8 billion tons, while countries other than OPEC countries produce approximately 2.6 billion tons. When analyzed by country, it is seen that the country producing the most is USA with 670 million tons of production. The USA is followed by Saudi Arabia with 578 million tons and Russia with 563 million tons, respectively. Venezuela, which has the highest proven oil reserves in the world, has a production amount of 77 million tons in 2018 (BP, 2019).

It is used for many purposes such as heating, transportation and industrial by refining the petroleum and making it more useful. For different purposes, oil was consumed around 4.6 billion tons worldwide in 2018. OECD countries used 2.2 billion tons of consumption, while non-OECD countries used 2.4 billion tons. When we look at the oil consumption amounts regionally, the region with the highest oil consumption is the Asia Pacific region. The total consumption value of the Asia Pacific region is approximately 1.7 billion tons in 2018. The reason for the high oil consumption in

this region is that they use a lot of oil due to the developed industries of China, Japan, India and South Korea. Asia Pacific region is followed by North America with 1.1 billion tons of consumption and Euro-Eurasia regions with 742 million tons of consumption. According to the 2018 data on the countries' oil consumption shares, the country with the highest consumption was the USA with 919.7 million tons. The USA is followed by China with 641.2 million tons and India with 239.1 million tons, respectively. Turkey has made the oil consumption in 2018 to 48.6 million tons (BP, 2019).

On the other hand, when oil prices are analyzed over the years, it is seen that oil prices rose to the highest level with 110.8 USD in 2012. In the following years, it is observed that it has decreased due to crises between countries. Today, oil prices are also used as a tool used by countries to harm each other economically. The excessive decline in oil prices puts countries such as Saudi Arabia, Russia and Iran in a difficult situation, which are of great importance for the economies of oil exports.

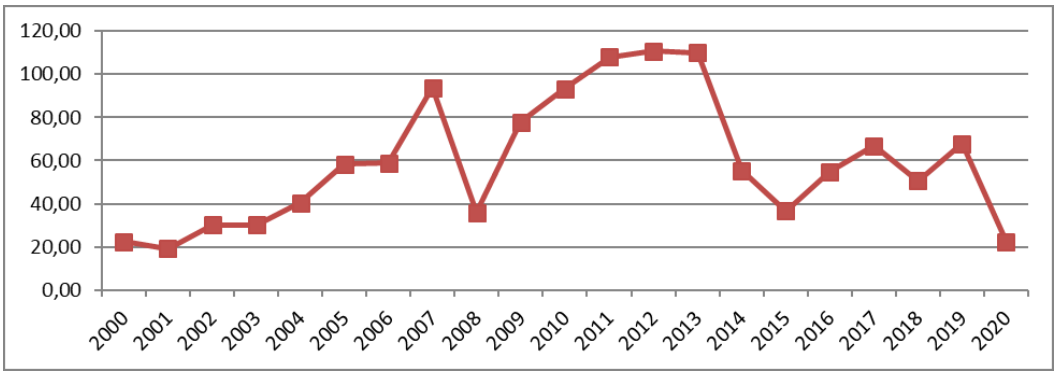
Global oil markets have seen major ups and downs in recent years. In the first half of 2018, the positive outlook in global growth data supported oil prices with the decision of OPEC and Russia to cut back the supply. In addition, the US administration's announcement that it would withdraw its country unilaterally from the nuclear agreement called the Joint Comprehensive Plan of Action(JCPOA) in May, strengthened this trend. However, this trend is provided to reduce the intake of 8 countries including Turkey which bought 85 percent of oil exported from Iran six months ended with the exemption. In addition to this exemption, exacerbation of concerns about global economic growth and trade wars accelerated the decline in oil prices. According to the BP 2019 report, oil prices, which were 50.57 USD in 2018, fell below 25 USD in March 2020. Undoubtedly, Coronovirus, which started in Wuhan city of China at the end of 2019 and spread all over the world, had an effect.

Table 1: Brent Oil Prices (US dollars per barrel)

Brent Oil Price ($/bbl)	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
	22,58	19,35	30,12	30,30	40,38	58,34	58,96
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
	93,68	35,82	77,91	93,23	108,09	110,80	109,95
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020 March**
	55,27	36,61	54,96	66,73	50,57	67,77	22,39

Source: TCMB, EVDS

Figure 3: Brent Oil Prices's Figure



Source: TCMB, EVDS

2. Oil Prices and Developments in Turkey

Turkey does not have the rich in oil reserves, although as being rich in terms of energy source and geographically close to the oil reserves.However, in terms of Turkey's geographical structure it is costly in oil exploration. MTA(General Directorate of Mineral Research and Exploration) and TPAO (Turkish Petroleum Corporation) which established in 1954 started to oil exploration in Turkey. In addition, domestic and foreign investors are given the right to seek oil with the production privileges given by the state.

Turkey, along with industrialization, especially after World War II has been affected by economic developments. Hydraulic and thermal power plants were established as prepared in the 1947 Development Plan, and efforts were made to increase coal, lignite and oil production. Then it was formed public institutions such as Directorate of State Hydraulic Works, Turkey Petroleum Corporation, Prime Minister's Atomic Energy Commission, Turkey Coal Enterprises, Cukurova Electricity Anonim Company, Kepez and Antalya Air Power Plants. In addition, in 1957, the oil law was changed to give foreign investors the right to refine.

Oil consumption is closely related to the economies of countries. The level of industrialization of countries is closely related to how much oil they use, rather than how much oil reserves or how many populations they have. For this reason, oil consumption is higher in industrialized countries. Industrialized countries consume the most energy in the world. Because in these countries, there is a great need for energy for the continuation of economic growth and high living standards of people. Developing countries group located in Turkey, the energy needs for economic development and growth in each period. Turkey's highest share in energy consumption is oil with data rates 48,6'lık% according to the 2018 BP(BP, 2019). Between the years 2013-2018 in the following Table 2 provides information on oil in Turkey.

Table 2: Some Indicators of Petroleum in Turkey (million tonnes)

	2013	2014	2015	2016	2017	2018	2019
Consumption	36.5	37.2	44.0	47.4	49.2	48.6	-
Export	8.3	9.2	10.8	9.6	10.1	8.8	14.2
Imports	32.0	32.5	39.6	40.1	42.6	38.7	44.7
Production	21.5	20.1	27.8	28.7	28.9	25.0	34.7
Price($)	108.62	109.35	71.88	43,80	49.40	65.50	68.24

Source: BP, EPDK, TCMB

Turkey is quite a difference between consumption and production of oil. The main reasons for this is rising of the population, rising energy demand and insufficient to Turkey's oil reserves. While the imported crude oil was 32 million tons in 2013, it increased by 6.7 million in 2018 and reached 38.7 million tons. On the other hand, while 8.3 million tons of oil had exported in 2013, 8.8 million tons of oil was exported in 2018. Turkey imports more oil from Russia, Iran and Iraq in 2018, while more oil exported to Egypt, Spain and Malta (Table 2).

Turkey has a share of approximately 1% of the world consumption of oil according to the data in the BP 2019 report. Turkey's oil consumption decrease of 1,2% compared to 2017 and realized as 48.6 million tons (BP, 2019).

Global oil markets have seen major ups and downs in recent years. With the decisions taken regarding the supply of oil by OPEC and Russia, the sanctions of the USA to Iran and the start of trade wars, the prices of oil prices have constantly fluctuated. Turkey is also influenced by international price volatility of the oil market. The depreciation of the Turkish lira against the US Dollar also multiplied this effect during the year. The crude oil price in international markets, which was sold at an average of $ 108.6 a barrel in 2013, declined in the following years and decreased to $ 65.5 in 2018.

Turkey as a high dependence on foreign in terms of sources of primary energy realize a large amount of the foreign trade deficit and current account deficit for. Therefore, while the developments in global energy prices reflect directly on the country's energy bill and foreign financing needs, they put additional pressure on Turkish financial assets. Although there has been a sharp decline in oil prices in recent years, there has been no decrease in consumers, but an increase has been observed. As a result, it can be said that the increase in the exchange rate has been effective especially since the last quarter of 2013. This situation can be explained as follows. While it was 1 USD = 2.03 Turkish Lira in the last quarter of 2013, it was 1 USD = 5.79 in the last quarter of 2019. In other words, the US dollar appreciated by 185% against the Turkish lira compared to 2013. On the other hand, oil prices decreased by 37% compared to 2013. To summarize, despite the 37% decrease in oil prices, the 185% increase in the exchange rate did not decrease the oil consumption costs for consumers (TCMB, EVDS).

According to Turkey's foreign trade data, Turkey's the most oil imports have been made in Russia share of with 25% in 2018 Turkey has imported 9.7 million tons of oil from Russia. Russia is followed by Iran with 18% and 7.1 million tons, and Iraq with 17% and 6.6 million tons, respectively. On the other hand, when the export data is analyzed, it is seen that the highest export in 2018 was Egypt with a rate of 10%. Turkey, Egypt in 2018 was approximately 941 thousand tons of oil exports. Turkey, followed by Egypt has the largest amount of exports 874 thousand tons and 508 thousand tons of Malta and Spain, respectively. After Egypt, the highest export was made to Spain with 874 thousand tons and Malta with 508 thousand tons respectively (Table 3).

Table 3: Petroleum Import and Export Quantities by Country in 2018 (Tonnes)

Imports			Export		
	Total	**Share (%)**		**Total**	**Share (%)**
Russia	9.758.156	25,21	**Various countries***	2.339.465	26,36
Iranian	7.109.530	18,37	**Egypt**	941.328	10,61
Iraq	6.613.428	17,08	**Spain**	874.594	9,85
India	4.305.242	11,12	**Malta**	508.132	5,73
Saudi Arabia	1.934.475	5,00	**USA**	380.792	4,29
Greece	1.914.539	4,95	**Russia**	291.263	3,28
Kuwait	1.436.721	3,71	**Gibraltar**	250.206	2,82
Kazakhistan	1.214.449	3,14	**K.K.T.C**	241.463	2,72
Israel	898.834	2,32	**Italy**	236.763	2,67
Italy	742.640	1,92	**Netherlands**	231.102	2,60
Others	2.783.440	7,18	**Others**	2.579.908	29,07
Total	**38.711.454**	**100**	**Total**	**8.875.016**	**100**

*It refers to the fact that the country of export is more than one.
Source: EPDK, Petroleum Market Sector Report, 2018

3. Literature Review

The fact that the relationship between oil prices and macroeconomic variables began to take a popular place in the literature begins with the study put forward by Hamilton in 1983. Hamilton stated that there was an rise in oil prices in general before the economic recessions in the USA after the second world war, but it did not mean that only oil prices caused this stagnation. However, Hamilton revealed that the correlation between oil prices and economic recession was statistically significant

but unimportant for the period 1948-1972. It has provided evidence to support the idea that oil prices were a contributing factor in at least some of the stagnation in the USA before 1972 (Hamilton, 1983, 228).

Keane and Prasad investigated the relationship between oil price shocks and employment, real wages using OLS estimation method. As a result of the study, they found the effect of oil price rises on total employment negative in the short term, while they found insignificant in the long term (Keane & Prasad, 1991).

Mork et al. analyzed the relationship between oil prices and GDP by using data from the USA, Canada, Japan, Germany, France, England and Norway countries for the period 1948-1988. As a result of the study, the relationship between oil prices and GDP was found to be significant and negative in most countries (Mork et al., 1994).

Uri examined the effects of oil prices on agricultural employment by using Granger causality method, using data from the USA for the period 1947-1995. As a result of the study, There was found a negative relationship between oil prices and agricultural employment(Uri, 1996).

Papapetrou investigated the dynamic relationship between oil prices and interest rate, employment, stock prices, economic activities using the data from 1989-1999 period with the help of a multivariate vector-autoregression (VAR) model. As a result of the study, it was revealed that oil price changes played an important role in affecting economic activity and employment, and a positive change in oil prices decrease stock returns (Papapetrou, 2001, 531).

Leblanc and Chinn investigated the relationship between oil prices and inflation using augmented Phillips curve, using quarterly data from the USA, Britain, Germany, France and Japan for the period 1980-2001. They found that oil price rises had a moderate effect on inflation in the USA, Japan and Europe, a 10% rise in oil prices led to approximately 0.1-0.8 points direct inflationary rises in the USA and the European Union (Leblanc & Chinn, 2004, 2).

Jimenez-Rodriguez and Sanchez examined the effects of oil price shocks on the real economic activities of the main industrialized countries by establishing both linear and nonlinear models using multivariate VAR analysis method. They were found a negative relationship between oil prices and GDP in all importing countries but Japan(Jimenez-Rodriguez & Sanchez, 2005, 201).

Olomola and Adejumo investigated the relationship between oil prices and GDP, inflation, real exchange rate, money supply with the help of the VAR model method and using quarterly data from the Nigerian economy for the period 1970-2003. As a result of the study, they revealed that oil prices don't affect GDP and inflation, but affect the real exchange rate (Olomola and Adejumo, 2006, 28).

Celik and Cetin examined the relationship between oil price and GDP, interest rates, consumer price index(CPI), current account balance, stock market index with the help of VAR model, using quarterly data from Turkish economy for the period 1997–2006. As a result of the study, they found the positive effect of oil price rises on CPI, current account deficit and stock market index. They also found the negative effect of oil price rises on GDP and interest rate.

Narayan et al. investigated the relationship between oil prices and exchange rates using generalized autoregressive conditional heteroskedasticity (GARCH) and exponential GARCH (EGARCH) models, using daily data from the Fiji Islands for the period 2000-2006. They revealed that the rise in oil prices caused national currencies to appreciate (Narayan et. Al. 2008, 2686).

Farzenegan and Markwardt examined the dynamic relationship between oil price shocks and important macroeconomic variables with the help of VAR model in Iran. They revealed that positive and negative shocks in oil prices significantly increased inflation. They also found a strong and positive relationship between positive changes in oil prices and industrial production growth (Farzenegan & Markwardt, 2009, 134).

Du et al examined the relationship between oil price and macroeconomy with the help of multivariate vector autoregression (VAR) method using monthly data from 1995-2008 in China. As a result of the study, they found that oil price significantly affected economic growth and inflation, and the effect was not linear. They also found that China's economic activity did not affect oil price (Du et al. 2010, 4142).

Ono analyzed the relationship between oil prices and exchanges with the help of VAR model and monthly data from 1991-2009 from BRIC countries. As a result of the study, it has been revealed that there is a positive relationship between oil prices and stock returns in China, India and Russia (Ono, 2011, 29).

Ghosh examined the relationship between oil prices and exchange rates with the help of GARCH and EGARCH models, using daily data from India for the period of July 2007 to November 2008. It was concluded that the increase in oil price caused the Indian currency to depreciate against the US dollar (Ghosh, 2011).

Ghalayini investigated whether there is an interaction between oil prices and economic growth with the help of Granger causality analysis using quarterly using data from 2000 – 2010 in G-7, OPEC, Russia, China and India countries. As a result of the study, there was no causal relationship between oil prices and economic growth except G-7 countries, whereas G-7 countries revealed that there is a one-way relationship from oil prices to GDP (Ghalayini, 2011, 127).

Jayaraman and Lau analyzed the relationship between oil prices and economic growth with the help of fully modified OLS (FMOLS) analysis and Granger causality analysis for the period of 1982-2007 from Fiji, Samoa, Solomon Islands, Tonga and Vanuatu. As a result of the study, they revealed that there is no causality between the variables in the long term, but there is a causality from oil prices to economic growth in the short term (Jayaraman & Lau, 2011, 152).

Altintas examined the relationship between oil prices and exports, real exchange rate with help of ARDL method and causality test using quarterly data for the period 1987-2010 from Turkey. It has been revealed that there is a bidirectional causality relationship between oil prices and exports. There also was found a positive relationship between oil prices and exports (Altıntaş, 2013, 1).

Sek et. al. analyzed the effects of changes in oil prices on inflation using the annual data from 1980-2010 period from the countries with high and low oil dependence, using the autoregressive distributed lag ARDL model. As a result of the study, they concluded that the change in oil prices in the countries with low oil dependence had a direct effect on inflation, but in countries with high oil dependence, the change in oil prices had an indirect effect on inflation (Sek et al. 2015, 630).

Nusair investigated the relationship between oil price shocks and GDP with the help of nonlinear cointegration autoregressive distributed lag (NARDL) method in the Gulf Cooperation Council (GCC) countries. As a result of the study, a positive relationship was found between oil prices and GDP (Nusair, 2016).

Alper et al. examined the effect of changes in oil prices on the profitability of companies operating in Borsa İstanbul (BIST) industrial sector. they revealed that oil price changes have a significant and negative effect on firm profitability.

Choi et al. analyzed the relationship between oil prices and inflation using Weighted Least Squares (WLS) method using the data from 1970-2015 in seventy-two developed and developed countries. They found that the 10 percent increase in oil prices increased the effect of domestic inflation by about 0.4 points and this effect ended two years later (Choi et al. 2017, 1).

Bala and Chin investigated the asymmetrical effects of oil price changes on inflation with the help of autoregressive dispersed lag (ARDL) dynamic panel method in Algeria, Angola, Libya and Nigeria. They concluded that positive and negative changes in oil prices had a positive effect on inflation (Bala & Chin, 2018, 1).

Bayraktutan and Solmaz analyzed the effect of oil prices on inflation with the help of panel data analysis method, using annual panel data from 1993 to 2017 in the twenty countries that imported the most. They revealed that oil prices had a stimulating effect on inflation (Bayraktutan and Solmaz, 2019, 279).

Table 4 : Findings of the Studies in the Literature

Name of The Study	Variables	Method	Result
The Employment and Wage Effects of Oil Price Shocks: A Sectoral Analysis - KEANE & PRASAD(1991)	Oil Price, Employment Rate, Real Wage	OLS Estimation Method	While there was found the impact of oil price increases on total employment negative in the short term, there found it insignificant in the long term.
Macroeconomic Responses to Oil Price Increases and Decreases in Seven OECD Countries - MORK et. al. (1994)	Oil Price, GDP	Correlation Analysis	There was found a negative relationship between oil prices and GDP.
Changing Crude Oil Price Effects on US Agricultural Employment - URI (1996)	Oil Prices, Agricultural Employment	Granger Causality Method	There was found a negative relationship between oil prices and agricultural employment.
Oil Price Shocks, Stock Market, Economic Activity and Employment in Greece - PAPAPETROU (2001).	Oil Price, Stock Returns	Multivariate Vector-Autoregression (VAR)	There was found a negative relationship between oil prices and stock returns.
Do High Oil Prices Presage Inflation? The Evidence from G-5 Countries - LEBLANC & CHINN (2004)	Oil Price, Inflation	Augmented Phillips Curve	There was found a positive relationship between oil prices and inflation.

Oil Price Shocks and Real GDP Growth: Empirical Evidence for Some OECD Countries - JIMENEZ-RODRIGUEZ & SÁNCHEZ(2005)	Oil Price, GDP	Multivariate Vector Autoregression (VAR) Method	There was found a negative relationship between oil prices and GDP
Oil Price Shock and Macroeconomic Activities in Nigeria - OLOMOLA & ADEJUMO(2006)	Oil Price GDP, Inflation, Real Exchange Rate	Multivariate Vector Autoregression (VAR) Method	The oil prices don't affect GDP and inflation, but affect the real exchange rate.
Macroeconomic Impacts of Oil Prices: An Empirical Application for Turkish Economy - CELİK & CETİN (2007)	Oil Price, GDP, Interest Rates, Consumer Price Index, Current Account Balance, Stock Market Index	Multivariate Vector Autoregression (VAR) Method	There was found a positive relationship between oil prices and consumer price index, current account deficit and stock market index and a negative relationship between oil prices and GDP, interest rate.
Understanding the Oil Price-Exchange Rate Nexus for the Fiji Islands - NARAYAN et. al.(2008)	Oil Price, Exchange Rate	GARCH – EGARCH Models	There was found a negative relationship between oil prices and exchange rate
The Effects of Oil Price Shocks on the Iranian Economy - FARZANEGAN & MARKWARDT (2009)	Oil Price, Inflation, Industrial Production Growth	Multivariate Vector Autoregression (VAR) Method	They revealed that positive and negative shocks in oil prices significantly increased inflation. There also was found positive relationship between positive changes in oil prices and industrial production growth

The Relationship Between Oil Price Shocks and China's Macro-Economy: An Empirical Analysis - DU et. al. (2010)	Oil Price, Inflation, GDP Growth	Multivariate Vector Autoregression (VAR) Method	They found that oil price significantly affected China's economic growth.
Oil Price Shocks and Stock Markets in BRIC - ONO (2011)	Oil Price, Real Stock Returns	Multivariate Vector Autoregression (VAR) Method	There was found a positive relationship between oil prices and real stock returns.
Examining Crude Oil Price–Exchange Rate Nexus for India during the Period of Extreme Oil Price Volatility - GHOSH (2011)	Oil Price, Exchange Rates	Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and Exponential GARCH (EGARCH)	There was found a positive relationship between oil prices and exchange rates.
The Interaction between Oil Price and Economic Growth - GHALAYINI (2011)	Oil Price, Economic Growth	Granger Causality Analysis	There was found a one-way relationship from oil prices to GDP in G-7 countries.
Oil Price and Economic Growth in Small Pacific Island Countries - JAYARAMAN & LAU (2011)	Oil Price, Economic Growth	Fully Modified OLS (FMOLS) Analysis - Granger Causality Analysis	There was found causality from oil prices to economic growth in the short term.
The Relationship Between Oil Prices, Export and Real Exchange Rate in Turkey: Bounds Testing Approach and Analysis of Dynamic Causality - ALTINTAS (2013)	Export, GDP, Oil Price, Real Exchange Rate	ARDL Method	There was found a bidirectional causality relationship between oil prices and exports.

A Comparative Study on the Effects of Oil Price Changes on Inflation - SEK et. al.(2015)	Oil Price, Inflation	Autoregressive Distributed Lag ARDL Model	There was found a direct effect between oil prices and inflation in the countries with low oil dependence. There also was found found a indirect effect between oil prices and inflation in the countries with high oil dependence.
The Effects of Oil Price Shocks on the Economies of the Gulf Co-Operation Council Countries: Nonlinear Analysis - NUSAIR (2016)	Oil Price, GDP	Nonlinear Cointegrating Autoregressive Distributed Lag (NARDL) Model	There was found a positive relationship between oil prices and GDP.
The Effect of Oil Prices on Firm's Profitability: An Application on Borsa Istanbul - ALPER et. al. (2016)	Oil Price, ROE	System GMM method	There was found a negative relationship between oil prices and firm profitability.
Oil Prices and Inflation Dynamics: Evidence from Advanced and Developing Economies - CHOI et. al. (2017)	Oil Price, Inflation	Weighted Least Squares (WLS)	There was found a positive relationship between oil prices and inflation.
Asymmetric Impacts of Oil Price on Inflation: An Empirical Study of African OPEC Member Countries - BALA & CHİN (2018)	Oil Price, Inflation	Autoregressive Distributed Lag (ARDL)	There was found that positive and negative changes in oil prices had a positive effect on inflation.
Oil Price and Inflation Relation: Panel Data Analysis For Selected Petroleum Importer Countries - BAYRAKTUTAN & SOLMAZ (2019)	Oil Price, Inflation	Panel Data Analysis Method	There was found a relationship between oil prices and inflation.

4. Data and Methodology

4.1. Data Description

In this study, It was investigated the interaction between oil prices and GDP, consumer price index, producer price index, BIST100 index, BIST industrial index the help of Granger causality test using quarterly data for the period 2004Q1 – 2019Q4 in Turkey. The data were obtained from the TCMB electronic data distribution system (EVDS). Among the variables used in the study, the **economic growth** variable is included in the model inspired from Hamilton (1983, 2003), Mork et al. (1994), Jimenez-Rodriguez and Sanchez (2005), Du et al. (2010), Ghalayini (2011), Jayaraman and Lau (2011)from studies; **consumer price index** variable, Chinn & Leblanc (2004), Olomola & Adejumo (2006), Farzenegan & Markwardt (2009), Du et al. (2010), Sek et al. (2015), Choi et al. (2017) and Bala & Chin (2018) from studies; and **BIST100 index** variable was included in the model, inspired by Papapetrou (2001) and Ono (2011) 's work. Another variables used in the study is the **BIST industrial index** variable and **producer price index**. Since the BIST industrial index and producer price index variables have not been used in any study before, it is expected to contribute to the literature. The variables in the model are shown in Table 5 below.

Table 5: Variables in Model

Symbols	Variables	Explanation
OP	Oil Price	Brent petrol spot FOB price
GDP	GDP	Quarterly GDP values
CPI	Consumer Price Index	A measure of the average change over time in the prices paid by consumers
PPI	Producer Price Index	A price index that measures the average changes in prices received by producers for their output
SIC	BIST Industrial Index	Stocks of industrial companies in BIST
BIST	BIST100 Index	BIST100 closing prices

In the analysis part of the study, causality between oil prices and each of the other variables was examined. Diversity causality tests are used to test the causality relationship between the two variables. Granger causality test, Sims test, Geweke-Meese-Dent test, Pierce-Haugh test and Geweke tests are usually used causality tests. In the study, Granger causality test was used. The Granger causality test is preferred over other causality tests because of its simple and easy application and some implications in the test result.

4.2. Granger Causality Tests

Granger causality test was used in the analysis part of the study. This test was preferred because there is a relationship between the two variables and it is one of the most effective tests that test the direction of the relationship (Granger, 1969).

The hypotheses of the test and the equations used in the calculation are as follows (Granger, 1969).

H_0: It is not Granger reason.

H_1: It is Granger reason.

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

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

In the equations above, ***a, b, c, d*** show the coefficient of lags, ***m*** the length of lag, and ***Ɛt*** and ***ηt*** are error terms.

The Granger causality test tests whether the lagged values of the independent variables before the error terms in equations 1 and 2 are equal to zero. According to the hypothesis established bilaterally, it is determined whether causality is unilateral or mutual. In the first equation, if *b values are different from* zero at a certain level of significance, it is expressed as "Y_t causes X_t", in other words, "Y_t is Granger cause of X_t". This means that there is a one-way relationship from Y_t to X_t.

On the other hand, if c values differ from zero at a certain level of significance, it is expressed as "X_t causes Y_t", in other words, "X_t is Granger cause of Y_t". This means that there is a one-way relationship from X_t to Y_t.

When these two conditions are valid, if both the b and c coefficients are different from zero, both Yt the Granger cause of Xt and Xt are expressed as the Granger cause of Yt . Here, mutual, in other words, bidirectional causality is mentioned. If the conditions are not valid and the coefficients b and c are not different from zero, it means that the two variables are not the cause of each other, in other words, Yt and Xt are independent series (Granger, 1969).

4.3. Results

The data set must be stable to perform the Granger causality test. The Extended Dickey-Fuller (ADF) unit root test was used to test the stability of these variables before moving on to the econometric analysis part of the study. Before performing the unit root test, it was examined whether there were fragility in the series due to the crises experienced in the period covered by the study (Figure 4).

Figure 4 : Fragility of The Series

When the graphics of the series in the model in Figure 4 are analyzed, it is seen that there are vulnerabilities in the graphics of the series in the period in 2004Q1-2019Q4. For this reason, it is more appropriate to examine the unit root test with a break here. Break unit root test results are shown in Table 5 below.

Table 6: ADF Test Statistic Results

Variable	Trend Specification	ADF Test statistic	t-Statistic			Prob.
			1%	5%	10%	
OP	Trend and Intercept	-5.61	-5.34	-4.85	-4.60	<0.01
logGDP	Trend and Intercept	-6.51	-5.34	-4.85	-4.60	<0.01
CPI	Intercept	-6.97	-4.94	-4.44	-4.19	<0.01
PPI	Intercept	-7.09	-4.94	-4.44	-4.19	<0.01

SIC	Trend and Intercept	-5.18	-5.06	-4.52	-4.26	<0.01
BIST	Trend and Intercept	-5.66	-5.34	-4.85	-4.60	<0.01

When Table 6 is examined, it is seen that the variables in the model are stationary, in other words, there is no unit root. Therefore, it has been observed that there is no obstacle to apply the Granger Causality analysis to test the existence of the relationship between variables.

In the Granger causality test, the optimal lag length for each variable is determined using information criteria such as Akaike, Schwarz and Hannan-Quinn. In this study, the appropriate delay length in the Granger causality analysis was determined using the Schwarz information criterion. Here, according to Schwarz Hannan-Quinn criteria, which gives the minimum delay value according to the stinginess principle, the delay length was chosen as 1 (Gujarati, 2003).

Table 7: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: SIC OIL CPI LOGGDP PPI BIST						
Exogenous variables: C						
Sample: 2004Q1 2019Q4						
Included observations: 61						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-1888.917	NA	3.87e+19	62.12843	62.33606	62.20980
1	-1620.338	475.5181	1.90e+16	54.50287	55.95626*	55.07247*
2	-1576.445	69.07753	1.51e+16	54.24408	56.94323	55.30191
3	-1526.521	68.74689*	1.05e+16*	53.78758*	57.73249	55.33363
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Granger causality test results of 1 delay length determined according to Schwarz and Hannan-Quinn information criteria are shown in the Table 8 below.

Table 8: Granger Causality Test Results

Causality Direction	Test Statistics	Prob.	Conclusion
OP à SIC	3.788	0.0516*	H_0 rejected.
SIC à OP	1.331	0.2486	H_0 not rejected.

OP à CPI CPI à OP	5.696 0.045	0.0170 0.8310	H_0 rejected. H_0 not rejected.
OP à log(GDP) Log(GDP) à OP	3.711 1.121	0.0540* 0.2897	H_0 rejected. H_0 not rejected.
OP à PPI PPI à OP	4.450 0.033	0.0349 0.8540	H_0 rejected. H_0 not rejected.
OP à BIST100 BIST100 à OP	0.429 3.129	0.5124 0.0769*	H_0 not rejected. H_0 rejected.

*H_0 is rejected at 10% significance level.
The number of observations is 61.
H_0: It is not Granger reason. H_1: It is Granger reason

When Table 8 is analyzed, one-way causality relationship between oil prices and both consumer and producer price index has been determined. In other words, it has been determined that there is a one-way relationship from oil prices to consumer price index and producer price index. This result was similar to the results of the studies of Celik ve Cetin(2007), Leblanc & Chinn(2004), Farzenegan & Markwardt(2009), Du et al. (2010), Sek et. al.(2015), Choi et al.(2017), Bala & Chin(2018) and Bayraktutan & Solmaz(2019).

A causal relationship has been determined between oil prices and economic growth. It is seen that oil prices are the Granger causes of economic growth at the level of 10% significance, but economic growth is not Granger caused by oil prices. Therefore, one-way relation has been found from oil prices to economic growth. This result was similar to the results of the studies of Celik & Cetin(2007), Öksüzler & İpek(2011), Mork et al.(1994), Jimenez-Rodriguez & Sanchez(2005), Du et al.(2010), Ghalayini(2011), Jayaraman & Lau(2011)and Nusair(2016).

Causality has been determined between oil prices and BIST100 index. It is seen that oil prices are the Granger causes of the BIST100 index at the level of 10% significance, but the BIST100 index is not Granger caused of oil prices. Therefore, one-way relation has been found from BIST100 index to oil prices. This result was similar to the results of the studies of Celik & Cetin(2007), Papapetrou(2001), Ono(2011) and Syzdykova(2018).

Finally, it has been observed that there is a causality relationship between oil prices and stocks of industrial companies operating in Borsa Istanbul at the level of 10% significance. It has been determined that the oil prices are the reason for Granger of the stocks of the industrial companies operating in Borsa Istanbul but not the opposite. In other words, a one-way relation has been found from oil prices to the stocks of industrial companies.

5. Summary and Conclusions

Energy consumption is of great importance in the economic growth and development processes of the countries. The development and growth of the global market day by day makes energy a more

important input position in terms of the production input required for increasing the market shares of the countries. Oil, which has an important place in energy resources, has an important effect on the growth rates and economic stability of countries. The concept of oil is increasing its importance not only in terms of countries but also in terms of human needs. This situation has been valid since the existence of humankind.

Due to the limited production of oil, which has a significant share in primary energy sources, changes in oil prices have important effects on economic growth. Changes in oil prices affect countries differently. While the increase in oil prices will increase economic growth in oil exporting countries; In oil importing countries, it causes increase in production costs, increase in general level of prices, increase in unemployment and economic weakening.

Turkey due to a booming economy and growing energy needs, is one of the countries that used to be concentrated in oil and oil derivatives. The increase and decrease of oil price is many effects on macroeconomic variables in Turkey due to the high dependence on foreign energy. In this context, It was tested causal relationship between oil prices and economic growth, consumer price index, producer price index, BIST100 index and stock index of the located industrial companies in the BIST using quarterly data for the period of 2004Q1-2019Q4.

As a result of the study, a one-way relation has been determined from oil prices to economic growth, consumer price index, producer price index and stocks of industrial companies in Borsa İstanbul. On the other hand, a one-way relationship has been determined from the BIST100 index towards oil prices.

Finally, energy and especially oil, together with the growing importance for the national economy, developing country group located in Turkey, to reduce dependence on foreign energy and to work on national resources is an intense orientation. Oil exploration studies in the Eastern Mediterranean in recent years are the clearest example of this. Along with petroleum exploration works, investments in renewable energy sources and investments in domestic technology open the way and many energy investments are made.

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