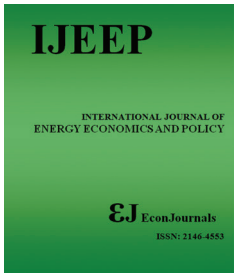

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Causality between Selected Energy Companies' Price Indexes and Barel Oil Prices

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ABSTRACT

Energy production and consumption have an important place in the world. Due to the increase in demand, it reveals the result of the valuation of the companies in this sector. The main purpose of this study is to analyze the relationship between brent oil prices in the world and the index prices of energy companies, which are among the world's most important and top 10 companies. The research covers the period between January 2011 and July 2022. The time series was created by considering the data in the selected time period on a monthly basis. Co-integration analysis was applied to the series and the relationship between the variables was tried to be determined. Short-term relationships were examined by applying the VAR model. At this stage, causality was carried out with Granger causality analysis. As a result of the analysis, it was concluded that brent oil prices, which were formed as a result of events in the world, had an effect on the index prices of two important energy companies, Exxon Mobile and Gazprom. In other words, there is a causal relationship between these variables. This bilateral causality relationship between Brent oil prices and Exxon Mobile is realized unilaterally with the other two energy companies. In short, there is a Granger causality relationship between these variables.

Keywords: Energy Sector, Barel Oil Price, Oil Price, Energy Company
JEL Classifications: Q41, D53, G13

1. INTRODUCTION

Oil is an important input used in all economic activities of any country. People are being pushed to consume more because of globalization, increased international commerce volume, and extensive internet use. They all want to attain absolute growth, whether it's in the food, textile, or other areas. For this expansion to occur, every country needs energy resources (Huseynli and Huseynli, 2022). The world is dominated by the oil industry. The most important source of energy on this planet, the lifeblood of industrialized nations, often the cause of wars, oil has built skyscrapers in the deserts of some countries, even though it has crashed many economies (Bhattacharya and Sachdev, 2021).

From an economic point of view, production, imports, and exports are interrelated and are important points for economic growth. In this sense, energy demand depends on the economic growth rate and standard of living of each country, as well as on the development of the industry (Stoenoiu, 2021). So, energy is the lifeblood of technological and economic development (Huseynli, 2022). When global fuel prices are analysed, it is seen that there is a high level of volatility. From 2008 to 2019, since the financial crises, the price of Brent crude oil showed extreme changes and shocks. The main reasons for these are financial crises, global political instability and supply-demand fluctuations. According to Brown and Yücel (2002), increases in gasoline prices have several detrimental effects on the economy, including a reduction in consumer spending, an increase in production costs, a reduction in the trade surplus, changes in the demand for money and the ensuing monetary policy, and finally, market volatility and an unstable economic environment.

A study by Alkahteeb (2019) examined the effect of oil price on India's economic growth. As a result of the study, it has been revealed that oil price, capital formation and inflation cause economic growth in the long run. Ayo et al. (2021) examined the issues related to production cost, energy recovery levels and economic fortunes of refinery operations in Ghana and proposed a conceptual framework to improve the energy efficiency of Tema Oil Refinery (TOR). From a theoretical point of view, the relationship between energy or especially oil prices and economic indicators is in most cases a non-linear relationship (Lee and Chang, 2007).

There are studies in the literature on the relationship between the energy market and financial markets, in particular oil prices. In this study, the relationship between the world brent oil prices in the period January 2011-July 2022 and the index prices of energy companies, which are among the most important and largest companies in the world, were examined.

2. LITERATURE REVIEW

2.1. Energy Companies and Barel Oil Prices

Commercial products created to create value for their customer or user have a price. Oil is both an important product and an important production cost. For this reason, the increase in oil prices naturally increases the production costs. As oil prices increase, there will be cost inflation and an increase in inflation will reduce economic growth (Gisser and Goodwin, 1986). The increase in oil prices does not only increase production costs, but also affects all prices in the economy.

A study by Cunado and Perez de Gracia (2005) examined the relationship between oil price increases and inflation from 1975 to 2002. As a result of the study, it has been determined that there are negative effects on economic growth and inflation, but mostly in the short term. A study by Tang et al. (2010) analyzed the relationship between variables in China from 1998 to 2008. Korhonen and Ledyaeva (2010) stated that the increase in oil prices will be positive for oil exporting countries at first, but this situation will be observed as economic uncertainty when trade relations are taken into account.

As a result of the study by Cong and Shen (2013), it was determined that a 1% increase in the energy price index could decrease the stock market index by 0.54% and the increase in industry value added by 0.037%. As a result of their study, Managi and Okimoto (2013) found that after 2007 there was a positive link between crude oil prices and new energy stocks. In another study by Cunado et al. (2015), oil prices were investigated in Japan, Korea, India and Indonesia for the period 1997-2014. As a result of the study, surprisingly, it was revealed that the increases in oil prices did not significantly affect the economies of these countries.

As a result of the study by Horng and Tsai (2016), it was found that the volatility of the Thai and Malaysian stock markets took the effect of the positive and negative values of the volatility of the global energy index and the global material index. As a result of his study, Dutta (2017) found that the new energy stock market is highly sensitive to the impact of the crude oil price volatility index. Reboredo and Ugolini (2018) found in their study that crude oil plays an important role in the dynamic shifts of new energy stocks for the United States.

In a study conducted by Afşar et al. (2019), the effect of oil price fluctuations on the current account balance for BRIC countries and Turkey was investigated. Nasreen et al. (2020) analyzed the dynamic linkage of crude oil prices and new energy stocks. According to the study by Zhou and Geng (2021), crude oil demand shock and supply shock have little impact on any new energy market volatility, but the impact of crude oil risk shocks on China and US new energy market volatility is 2%, respectively. 44 and 3.14%.

2.2. Studies related to Price Indices of Energy Companies and Barrel Petrol Prices

In a study by Kaneko and Lee (1995), the relationship between many variables such as inflation rate, production amount, oil prices, money supply and stock returns in the USA and Japan was analyzed. In a study by Basher and Sadorsky (2006), the relationship between the stock returns of 21 developing countries and oil prices between December 1992 and October 2005 was analyzed using the international multi-factor model. As a result of the study by Boyer and Filion (2007), it was found that the Canadian energy stock is positively related to the Canadian stock market return, crude oil and natural gas prices, which supports the market theory.

Cong et al. (2008) analyzed the relationship between the Chinese stock market and oil prices between January 1996 and December 2007. As a result of the study by Ravichandran and Alkhathlan (2010), it has been determined that oil price change has an impact on GCC stock market returns in the long run. In a study by Kapusuzoğlu (2011) the relationship between BIST100, 50 and 30 indices and brent oil prices between January 2000 and January 2010 was analyzed using Johansen and Juselius cointegration and Granger causality tests. As a result of the study by Negi et al. (2011), it has been proven that there is a long-term relationship between oil prices and stock market prices for both countries.

In a study conducted by Ünlü and Topçu (2012), the effect of oil prices on Borsa Istanbul between January 1990-February 2001 and March 2001-December 2011 was examined using cointegration and causality analysis. In a study by Aydogan and Berk (2012), the relationship between the BIST100 index and crude oil prices and global financial liquidity conditions was examined by dividing the years between January 1992 and November 2011 into three sub-periods. In a study by Güler and Temel Nalın (2013), oil prices and weekly closing prices of BIST100, BIST Industrial and BIST Chemical, Petroleum and Plastic indices were analyzed by Granger causality method between February 1997 and November 2012. In a study conducted by Özmerdivanli (2014), daily data for the period 2003:01-2014:02 for oil prices and BIST 100 index variables were used to investigate the relationship between oil prices and stock prices. Cointegration and Granger causality tests were used in the study.

According to Maghyereh et al. (2019) examined the link between oil prices and new energy stocks and found that there is a significant return and risk transfer relationship from crude oil to new energy stock markets. Pham (2019) found that the link between crude oil prices and different categories of new energy stocks is heterogeneous. In a study by Demirkale and Ebghaeı (2020), the mutual sensitivities and interaction degrees of oil prices and BIST100, BIST Industry, BIST Chemical, Petrol and Plastic, Dollar/TL, interest rate variables were analyzed. According to the results of a study by Attarzadeh and Balcilar (2022), it was determined that oil and clean energy markets have bidirectional volatility spillovers.

3. RESEARCH METHODOLOGY

3.1. Data Set

A set of data is required to perform the analysis. The data required for the time series includes a period of approximately 12 years on a monthly basis. By carrying out the study, it was tried to measure whether there is a causal relationship between brent oil prices and the index price values of the three selected companies that have the most important share in this sector. In the study, the Granger method was preferred to measure causality. Before proceeding to the Granger analysis, tests such as the ADF test and the VAR model were performed.

3.2. Analysis Method

In this research, the causality between brent oil prices and the index price values of three selected pollutants, which are among the top 10 energy companies, has been examined. It has been tried to measure how the price increases in oil prices, which cover the most important part of production and consumption, affect the values of companies in this sector. The variables used in the study were analyzed monthly between 01: 2011-06:2022. The information required for the analysis was taken from investing.com.

Vector Auto Regression (VAR) analysis, which is one of the time series analysis methods, was preferred in the study. In this analysis, cointegration analysis, causality analysis and variance decomposition techniques were also applied. VAR analysis is a model used in time series that are stationary at the same level. In this study, the VAR model was preferred because the time series were first-order stationary. After the necessary tests were carried out, Granger analysis was started.

Dual Granger causality will show the presence and direction of causality, if any, between the variables. However, it will give us neither the length of time required for the causal effect to occur nor the true qualitative nature of the relationships. According to Granger (1988), "X is Y's Granger causality if Y's prediction is more useful when using X's historical data than when X's historical data is not used". After this identification is verified, it is formatted as X→Y.

Granger (1969) developed this approach for causality testing based on two main econometric links. If Xt helps predict Yt, a variable Xt is said to be a Granger-causal variable for another time series variable Yt. The Granger causality test is one of the best-known criteria for assessing predictive causality between the elements that make up a system. The Granger test is based on the idea that knowing the past dynamics of the causative element should help predict the future dynamics of the causative agent, because by definition the latter is partially defined or delimited by the former (Zanin, 2021).

4. ANALYSIS AND RESULTS

Before applying Granger and other types of analysis, the price movements of the oil prices of the companies examined as an example over the 11-year period are included in the Tables 1-3 with the table names suitable for them. As can be seen from the tables, prices do not show stability and they are in a dynamic movement according to years (Figures 1-4).

Before establishing Granger analysis and VAR model, it is necessary to test the stationarity of the data. According to the unit-root test results, it was observed that the given time series are not stationary. If there is no stationarity between the data, the analysis may cause the spurious regression result to be estimated. This result may show that there are relationships between the variables that do not exist in reality.

Figure 1: 10-year change in exxon mobil stock prices

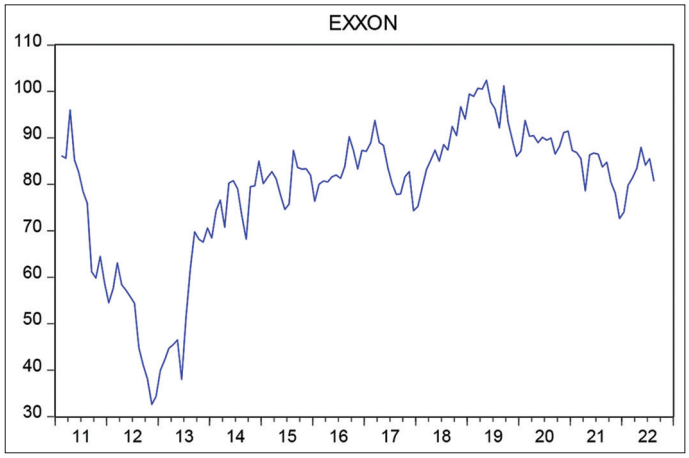

Figure 2: 10-year change in gazprom stock prices

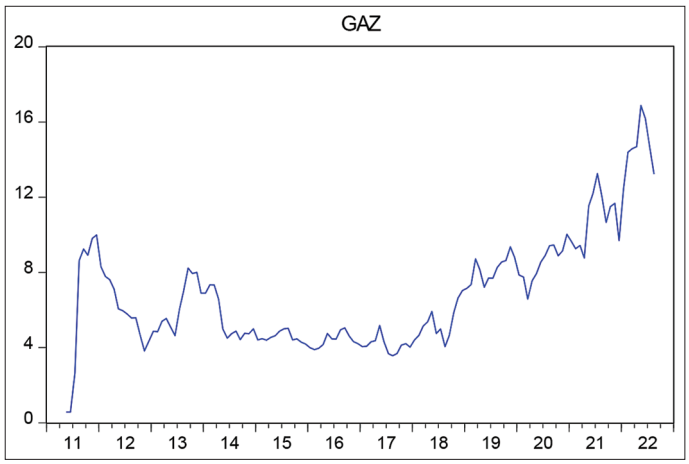

Table 1: Level values of series

	Exxon mobil price index		Gazprom price index		Korea electric terminal price index		Brent oil prices	
	t-statistics	Possibility	t-statistics	Possibility	t-statistics	Possibility	t-statistics	Possibility
ADF testing statistics	−2.613997	0.2749	−2.208774	0.4805	−1.588381	0.7928	−3.027919	0.1285
Test critical values								
1%	−4.025924		−4.027463		−4.025924		−4.026429	
5%	−3.442712		−3.443450		−3.442712		−3.442955	
10%	−3.146022		−3.146455		−3.146022		−3.146165	

Table 2: Level values of first order series

	Exxon mobil price index		Gazprom price index		Korea Electric Terminal price index		Brent oil prices	
	t-statistics	Possibility	t-statistics	Possibility	t-statistics	Possibility	t-statistics	Possibility
ADF testing statistics	−12.18684	0.0000	−9.276502	0.0000	−10.78293	0.0000	−9.581375	0.0000
Test critical values								
1%	−4.026429		−4.027959		−4.026429		−4.026429	
5%	−3.442955		−3.443704		−3.442955		−3.442955	
10%	−3.146165		−3.146604		−3.146165		−3.146165	

Table 3: Appropriate Delay Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−2512.293	NA	7.63e+11	38.71220	38.80043	38.74805
1	−1874.128	1227.241*	53173425*	29.14043*	29.58158*	29.31968*
2	−1861.369	23.75145	55933035	29.19029	29.98437	29.51295
3	−1850.928	18.79310	61036962	29.27582	30.42283	29.74189
4	−1836.048	25.86854	62305564	29.29304	30.79299	29.90252
5	−1827.269	14.72186	70002891	29.40414	31.25700	30.15702
6	−1818.213	14.62859	78519569	29.51097	31.71676	30.40726

*Indicates the appropriate lag length for the relevant test.

Table 4: Granger causality test

Hypotheses	F-value	Probability value (p)	Decision at 5% significance level
The price index changes of Gazprom company are the reason for the changes in the price index values of Exxon Mobile company	6.740435	0.0344	Acceptable
The price index changes of Korea Electric are the reason for the changes in the price index values of Exxon Mobile.	7.533690	0.0231	Acceptable
The change in Brent oil prices is the reason for the change in the price index values of Exxon Mobile.	17.57256	0.0002	Acceptable
The price index changes of Exxon Mobile are the reason for the changes in the price index values of Gazprom.	5.046585	0.0802	Rejected
Changes in the price index of the Korea Electric company are the reason for the changes in the price index values of the Gazprom company	3.059780	0.2166	Rejected
The change in Brent oil prices is the reason for the change in the price index values of Gazprom company	10.43995	0.0054	Acceptable
The price index changes of Exxon Mobile are the reason for the changes in the price index values of Korea Electric.	2.226787	0.3284	Rejected
The price index changes of Gazprom company are the reason for the changes in the price index values of Korea Electric company	0.846336	0.6550	Rejected
The change in Brent oil prices is the reason for the change in the price index values of Korea Electric company.	3.115042	0.2107	Rejected
The price index changes of Exxon Mobile are the reason for the change in Brent oil price values.	7.120328	0.0284	Acceptable
Changes in Gazprom's price index are the reason for the change in Brent oil price values.	4.431483	0.1091	Rejected
The price index changes of Korea Electric are the reason for the change in Brent oil price values.	7.856874	0.0197	Acceptable

As a result of the stationarity test performed in the analysis, all four variables; Brent oil prices, index price of Exxon Mobil, index price of Gazprom and index prices of Korea Electric company are not stationary in terms of level. The fact that the t statistics values are lower than the test critical values and the probability values are greater than 0.05 show that there is no stationarity situation

Figure 3: 10-year change in Korea electric stock prices

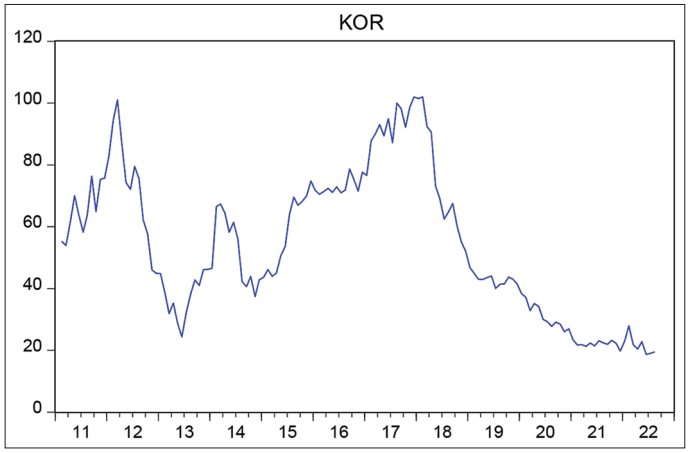

Figure 4: 10-year change in Brent oil prices

as it can be understood from the Table 1. This is true for all four variables, and in this case, the H1 hypothesis is accepted.

As stated before, the ADF test was applied to ensure the stationarity, which is one of the important conditions for the analysis, and it was concluded that the data were stationary in the first order. Information about the first-order stationarity result is given in Table 2. The fact that the probability values are less than 0.05 also indicates the validity of the H1 hypothesis.

After the time series were made stationary at the same level, the VAR model was established and the appropriate lag numbers of the series were determined with the help of Akaike (AIC), LL, LR, FBE, SC and HQ information criteria. The appropriate lag numbers in Table 3 indicate that these time series have the appropriate lag number in the first length.

After the stationarity test of the data, the establishment of the VAR model and the determination of the appropriate lag numbers, the transition to the Granger model was made. Granger results between Brent oil prices, Exxon Mobil price index, Gazprom price index and Korea Electric price index are shown in Table 4.

According to the results of the Granger analysis, a causal relationship was found between the variables, either bilaterally or unilaterally. Table 4 shows that there is a bidirectional causality between Brent oil prices and Exxon Mobile values. A unilateral causality relationship was obtained between the other remaining variables. As a final result, we know that there is a causal relationship between bremt oil prices and Exxon Mobile and Gazprom company. In other words, there is Granger causality between these variables. These indicators obtained as a result of econometric analysis show that there is a relationship between these variables.

5. DISCUSSION AND CONCLUSION

Energy production and consumption has an important place in the world. Due to the increase in demand, it reveals the result of the valuation of the companies in this sector. The main purpose of this study is to analyze the relationship between brent oil prices in the world and the index prices of energy companies, which are among the most important and largest companies in the world. The research covers the period between January 2011 and July 2022. The time series was created by considering the data in the selected time period on a monthly basis. Co-integration analysis was applied to the series and the relationship between the variables was tried to be determined. Short-term relationships were examined by applying the VAR model. At this stage, dual causality was carried out with Granger causality analysis. As a result of the analysis, it was concluded that brent oil prices, which were formed as a result of events in the world, had an effect on the index prices of two important energy companies, Exxon Mobile and Gazprom. In other words, there is a causal relationship between these variables. This bilateral causality relationship between Brent oil prices and Exxon Mobile is realized unilaterally with the other two energy companies. In short, there is a Granger causality relationship between these variables.

The results obtained from the study are similar to the results of the study conducted by Basher and Sadorsky (2006). In other words, according to the study by Basher and Sadorsky, it has been revealed that the increase in oil prices affects stock returns positively when they use daily and monthly data, and the decrease in oil prices affects stock returns positively when they perform the analysis with weekly and monthly data. Another study, Cong et al. (2008) also show the same results in their studies. As a result of the study, it was revealed that oil price shocks do not have an effect on stock returns. Likewise, as a result of the study conducted by Ünlü and Topçu (2012), it was found that there was a cointegration relationship between the BIST100 index and crude oil prices in the March 2001-December 2011 period, and there was a unidirectional causality relationship from the crude oil variable to the BIST100 index. According to the results of the study conducted by Güler and Temel Nalın (2013), it has been determined that there is no causality relationship between oil prices and indices.

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