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Relationship between Oil Prices and Russia Exchange Indices: Analysis of Frequency Causality

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ABSTRACT

One of the important research topics is the potential impact of changes in oil supply and demand on current and future price movements or financial market instruments. Especially in developing countries such as Russia, which is an oil and natural gas exporter, sanctions on oil exports affect the country on a macroscale and businesses on a microscale. In this context, the aim of the aforementioned study is to examine the causality relationship between Brent oil price, which is an important input for the chemistry and transportation sectors, and the Moscow Stock Exchange MOEX Chemicals, MOEX Transport, and MOEX Financials indices using Breitung and Candelon frequency causality analysis. For this purpose, monthly data for the period January 2015-December 2022 were analysed first with traditional Granger causality analysis, Toda and Yamamoto causality analysis, and finally with Breitung and Candelon frequency causality analysis. Traditional Granger causality analysis (Toda and Yamamoto causality analysis) revealed a bidirectional causality relationship between Brent Petrol and the MOEX Chemistry and MOEX Finance Indices. However, there is no causality between Brent Petroleum and MOEX Transport. As a result of the Breitung and Candelon frequency causality analysis, causality has been determined from oil prices to stock prices in the chemical sectors, both in the short term, in the medium term, and in the long term. Only short-term causality has been found between Brent oil prices and stock prices in the financial and transportation sectors.

Keywords: Oil Prices, Russia Exchange Indices, Frequency Causality, Stock Market
JEL Classifications: B26, C58, G14, G15, O16

1. INTRODUCTION

Energy is the most basic requirement of any economy's modern economic cycle, because it is a vital input in key economic sectors and also critical in ensuring national security and the stability of economic policies (Ma et al., 2021). Oil is estimated to be the most common energy source, accounting for about 1/3 of total energy consumption. Oil is not only the most widely used energy material but also a unique natural resource that confers political and economic power to countries with rich oil reserves (Bashir et al., 2020). According to the International Agency for Energy, as a result of developing economies' economic policies, demand for fossil fuels will rise by 30% by 2040, with daily oil consumption reaching 103.5 million barrels. As a result, crude oil has become the most traded commodity, but it has a huge impact on emerging and industrial economies, as sudden changes in oil prices affect not only economic policies but also the stock markets. Shocks have a significant impact on financial markets (Bashir, 2021). In recent years, crude oil prices have fluctuated significantly, which affects the operational costs of companies and thus their sales. As a matter of fact, the price of Brent crude oil, which is one of the criteria of the global crude oil pricing system, has been showing instability since the twenty-first century. From 2000 to 2008, crude oil prices rose from $73 to $132.3 at most and fell sharply to $39.95 after the mortgage credit crisis. When the world economy came out of the crisis, crude oil prices rose above $100 in 2011. However, it fell to its lowest point in history in 2016, with 26.68. Brent oil fell sharply during the COVID period, falling as low as $ 19.33. The dollar, which rose to the level of 127 dollars in 2022, is currently (January, 2023) at around 87 dollars. As a result, this change in oil prices affects asset prices and increases volatility, which directly affects financial markets. Today, more and more individuals and institutions see crude oil as a financial tool for the protection and increase of values that increase the volatility in the oil price and thus increase the volatility of the country's economy, especially in the stock market (Shahzad et al., 2021). In this context, investigating the relationship between stock markets, oil prices, and spillover effects is important as it allows investors to hedge their portfolio risks from sudden market changes. Less research has been done on the relationship between financial markets and oil price changes. (Arouri et al., 2011; Hamao, 1988; Jones and Kaul, 1996; Papapetrou, 2001; Park, 2007; Sadorsky, 1999; Scholtens and Wang, 2008). When these studies are examined, they basically differ in terms of methodology, data period, and stock market. A common approach in the asset pricing literature is to use a standardised market model enriched with the oil price and some other factors to measure the impact of oil price or volatility shocks on stock markets. It is tested by Chen and Millero (1986) whether shocks in macroeconomic variables are risks valued by the stock market. They concluded that the difference between long- and short-term interest rates, expected and unexpected inflation, industrial production, and the difference between high- and low-grade bonds explain the variation in stock prices. However, they determined that oil prices did not have a significant effect on the stock market. Huang et al. (1996) examined the efficiency of oil futures and stock markets, that is, the extent to which price changes or returns in one market lead to returns in another. As a result, they concluded that there is almost no correlation between the returns on oil futures and the returns of various stock indices. On the other hand, Ciner (2011) provides evidence that oil shocks affect stock index returns, and this link strengthened in the 1990s. Sadorsky (1999) examined the dynamic interaction between the oil price and other economic variables, including stock returns, with US data. He found that oil price changes and oil price volatility have a significantly negative effect on real stock returns. Bastianin et al. (2016) found that oil price changes not only affect costs but also have indirect effects on business cycles and stock market volatility.

In this context, this study researches the relationship between Brent oil prices and Moscow Stock Exchange MOEX Chemicals, MOEX Transport, and MOEX Financials indices for the period January 2015-December 2022, and the contribution of the study to the literature is as follows: The fact that the econometric methods used are up-to-date, the results are compared using three methods, and there is a limited number of studies in this field in the Russian Federation.

2. LITERATURE REVIEW

In the literature, there are many international studies examining the relationship between stock market value and oil prices both on a sectoral basis and on a national index basis. Since the methods and periods used to reveal the relationship between the variables in the studies differed, a clear and common decision could not be reached. It is possible to summarise some of the literature sources selected from the studies published on this subject as follows:

Unlike their study, Hamao (1988) did not find oil prices to be the most important international factor affecting Japanese stock market returns. However, in their study, they found that oil prices have less impact on Japanese stock market returns than trading volume.

El-Sharif et al. (2005) examined the relationship between oil prices and the stock returns of oil and gas companies traded in the UK capital market for the period from January 01, 1989 to June 30, 2001. According to the findings they obtained in their studies, they found a direct correlation between the stock returns of these companies and their oil prices. In other words, they found that the positive change in oil prices positively affected the stock returns of this sector.

Cong et al. (2008) analysed the relationship between oil price shocks and the Chinese stock market using the multivariate VAR method with monthly data for the period 1996:1-2007:12. According to the findings they obtained from the study, they determined that international oil price shocks were not very effective on the Chinese stock market indices, but both the world oil price shock and the Chinese oil price shock were more effective on the production index than the interest rates.

According to Filis et al. (2011), oil prices have a negative effect on the stock markets of both oil-importing and oil-exporting countries.

Şener et al. (2013) examined the relationship between oil prices and the closing prices of Borsa Istanbul using daily data for the period 2002-2012, with the help of Granger and Yoon (2002) and Hatemi-J and Irandoust (2012) hidden cointegration tests. In the light of the findings obtained as a result of the analyses in the study, it has been shown that the increase or decrease in oil prices will be effective in the formation of stock prices. Abdioğlu and Değirmenci (2014) examined the long- and short-term relationship between the stock prices of the sub-sectors of Borsa Istanbul and the oil price on a sub-sector basis with the daily parent Granger causality test for the 2005-2013 period. According to the findings obtained from the study, they determined a one-way causal relationship from sub-sector stock prices to oil prices.

Güler and Nalın (2013) tried to determine the relationship between oil prices and the ISE 100, ISE Industrial, and ISE Chemical, Petroleum, and Plastic indices with weekly data for the period February 03, 1997-November 30, 2012 using Granger cointegration analysis and the Granger causality test. According to the findings obtained from the study, it was determined that the series of these variables were in a long-term relationship, but there was no causal relationship between them in the short term.

Özmerdivanlı (2014) examined the relationship between oil prices and investment instruments traded in financial markets (BIST100 index closing prices) by using daily data for the period 2003:01-2014:02 and using Granger cointegration and Granger causality tests. In the study, according to the findings obtained from the Granger cointegration analysis, oil prices and the closing prices of the BIST 100 index are in an equilibrium relationship in the long run, while according to the Granger causality test findings, there is a one-way causal relationship from the closing prices of the BIST 100 index to the oil prices.

According to Yıldırım et al. (2014), they examined the relationship between international crude oil and natural gas prices and the stock prices of industrial sector companies using monthly data for the period 1991:01-2013:11 with the help of Johansen cointegration and the Granger causality test. In the study, according to the findings obtained from the Johansen cointegration analysis, they found that there is a long-term relationship between the international crude oil and natural gas price indices and the Borsa Istanbul industrial index. According to the Granger causality test findings, they found a one-way causality relationship from the oil price index to the industrial index, and a one-way causality relationship from the industrial index to the natural gas price index.

Kendirli and Çankaya (2016) investigated the relationship between crude oil prices and the BIST 100 and BIST Transportation Index (XULAS). They looked at the crude oil barrel price from January 01, 2000 to April 30, 2015, as well as the daily closing data of the BIST 100 and XULAS variables. The causal relationship between them was examined using According to the findings, a one-way causality relationship was found from BIST 100 to other variables, while a one-way causality relationship was found from XULAS to crude oil barrel prices.

Zortuk and Bayrak (2016) examined the relationship between crude oil price shocks and stock market prices in G-7 countries using monthly data for the period 2002:04-2014:08 using an autoregressive distributed lag cointegration test. According to the findings of their study, they found that oil prices and stock prices were cointegrated and that the adjustment process for long-term equilibrium was asymmetrical.

Eyüboğlu and Eyüboğlu (2016) used the Johansen cointegration test with monthly data for the period 2005:10-2015:09 in order to investigate whether there is a long-term relationship between oil and natural gas prices and Borsa Istanbul industrial sector indices. According to the findings obtained from the study, they found that there is a long-term equilibrium relationship between natural gas and oil prices and industrial sector indices. According to the Granger causality test results, they found a one-way causal relationship from oil prices to the relevant index.

Kang et al. (2017) found that oil price shocks on the stock returns of oil and gas companies have a negative effect on stock returns.

Yun and Yoon (2019) investigated the effect of crude oil prices on the stock prices of the airline industries by taking four airlines (Korean, Asiana, Air China, and China Eastern Airlines) as examples. The study concluded that the volatility spillover effect is more severe than the yield spillover effect. In addition, the study concluded that the impact of the oil price shock was more significant for small airlines than for large airlines.

Kelikume and Muritala (2019) applied a dynamic panel analysis technique using quarterly data from 2010:1 to 2018:4 in their study examining the effect of oil prices on African stock markets. According to the analysis's findings, oil prices have a negative impact on stock markets in Africa.

Anyalechi et al. (2019) analysed the response of stock returns on the Nigerian Stock Exchange for the period 1994-2016 to fluctuations in oil prices. According to the cointegration test results, changes in oil prices cause a positive but insignificant effect on stock returns in both the long and short run. In addition, the result of the Bounds Test showed that there was no long-term relationship between oil prices and stock market returns in the analysed period.

Golder et al. (2020) used the Johansen Cointegration Test, the Vector Error Correction Model, and the Granger Causality Test in their study investigating the effects of foreign exchange reserves, exchange rates, and crude oil prices on the stock index of the Dhaka Stock Exchange. According to the analysis findings, no causal link was found between Dhaka Stock Exchange indices and crude oil prices, and it was determined that all macroeconomic factors selected according to the Impact-Response function had a long-term permanent effect on the Dhaka Stock Exchange index.

Nguyen et al. (2020) used daily data from August 01, 2000, to October 25, 2019 in their study investigating the effect of oil prices and exchange rates on two Vietnamese stock market indices, the VN index and the HXN, and found that oil prices had a significant positive effect on two Vietnamese stock market indices. In terms of stock index volatility, it has been determined that both VN index and HNX index volatility are negatively affected by oil returns.

Ajala et al. (2021), in their study investigating the effects of oil prices on stock prices and exchange rates in Nigeria, used the NARDL model and revealed that changes in oil prices affect exchange rates and stock prices asymmetrically.

Alamgir and Amin (2021), in their study, examined the relationship between the stock market indices of 4 South Asian countries and oil prices for the period 1997-2018 with the NARDL model, and according to the analysis findings, there is a positive relationship between the oil price and the stock market index. In addition, the reaction of the stock market index to positive and negative oil price shocks has an asymmetrical nature. In the study, it was determined that the Efficient Market Hypothesis is not valid for South Asian countries.

Asaad (2021), in his study, analysed the relationship between oil price, gold price, exchange rate, and Iraqi Stock Exchange stock prices. In his study, which used the ARDL cointegration test and Granger causality test, it was determined that there was no cointegration between the variables in the pre-Covid-19 period, and the effects of oil price, gold price, and exchange rate on Iraqi Stock Exchange stocks were insignificant according to the results of the short-term model.

Das (2021) discovered that shocks in developed markets had a spillover effect in the Indian market in his study in which he investigated the relationship between stock returns, exchange rates, and crude oil prices in the Indian Stock Exchange between 1999 and 2021 using wavelet analysis technique.

On the other hand, Endri et al. (2021), in their study aiming to determine the economic variables that affect the stock returns of the mining sector companies traded in the Indonesian Stock Exchange, determined that oil prices have a positive and significant effect on the stock returns.

According to Fasanya et al. (2021), ARDL and NARDL models were used in their study in which they analysed the relationship between oil prices and stock returns in the Gulf Cooperation Council countries, using the weekly data set between 1992 and 2016. They discovered that the risks are highly dependent on the oil price specification.

Jawadi and Sellami (2021), in their study examining the impact of the change in oil prices on the stock market, exchange rate, and real estate market in the USA in the last 10 years, found that oil prices had significant effects on the US stock market and the US dollar rate during the COVID-19 period, but had no significant effect on the US real estate market. In the study, it was also determined that the stock market gave a positive and significant reaction to an oil price shock, which can be explained by the effect of high oil financialization in the last decade.

In his study, Nwosa (2021) examined the impact of the COVID-19 pandemic on the oil price, exchange rate, and stock market performance in Nigeria from December 01, 2019, to May 31, 2020. In the study, it was determined that COVID-19 had negative effects on oil price, exchange rate, and stock market performance, and it was concluded that these negative effects were more effective than those of the 2009 and 2016 global recessions. He also determined that oil prices have a high effect on the exchange rate and stock market performance.

Shi and Kong (2021), in their study examining the impact of international crude oil prices on energy stock prices in China during the COVID-19 epidemic, found that COVID-19 significantly strengthened the correlation between the variables and the volatility between oil price returns and energy stock returns has been found to have a spreading effect.

Hashmi et al. (2022) determined that the effect of Brent crude oil prices on the Chinese stock market is generally positive.

Ahmed and Mohammad (2022), in their study, compared and analysed the relationship between daily returns on the Pakistan Stock Exchange and oil prices for the period before and after COVID-19. In the study, VAR analysis and the Granger Causality Test were applied, and according to the analysis findings, oil shocks are inversely proportional to daily firm stock returns, and the adverse effect increases even more during the epidemic period. In addition, it has been determined that stock prices have no effect on oil prices.

Katsampoxakis et al. (2022) applied the VAR model and the Granger Causality Test in their study, in which they examined the interrelationships between crude oil prices and stock returns in oil-importing and oil-exporting European countries during the COVID-19 period. According to the findings of the analysis, there is no interdependence between crude oil and stock prices in the stable periods before the COVID-19 epidemic and after the announcement of the vaccines, while the causality from stock markets to oil prices increases during periods of high volatility, and these developments show that both countries are equally affected by these developments was found to be affected.

According to Atif et al. (2022), they analysed stock returns and oil price changes for oil exporting and importing countries with the help of Granger causality, action-response, and variance decomposition tests. The results of the causality test showed that after the decline in oil prices due to the COVID-19 pandemic, the interdependence between oil and stock price changes increased, and the causality from oil to stocks accelerated, especially during the rapid outbreak of the COVID-19 pandemic. In addition, it has been determined that the changes in oil prices have a greater effect on oil-exporting countries.

Tien (2022), in his research examining the asymmetrical relations between global oil prices and selected Vietnamese macroeconomic indicators, determined that there is a strong relationship between the macroeconomic factors examined and the changes in oil prices. In addition, according to the analysis findings, it has been determined that oil prices have a positive effect on the exchange rate, inflation, GDP, and stock market prices.

According to Karaoğlan et al. (2022), they examined the causality relationship between the oil price and the stock price of the Borsa Istanbul Industry Index for the January 1991-May 2020 period with the frequency causality analysis of Breitung and Candelon (2006). According to Breitung and Candelon's frequency causality analysis findings, they concluded that there is causality from oil prices to stock prices in both the short- and medium-term and long-term, and from stock prices to oil prices, there is only causality in the short-term.

In the study of Kaya and Güneş (2022), the short-term causality relationship between Brent oil prices and the BIST-100, BIST Chemical, BIST Industrial, and BISTUization indices was analysed by the Granger causality test. According to the findings obtained from the DCCGARCH model, while no correlation was found between Brent oil and other variables, it was concluded that there was a positive correlation between the BIST-100, BIST-Chemistry, BIST-Sinai, and BIST Transportation indices.

The article by Suleymanli et al. (2022) offers some insightful new information about the link between shifting gasoline prices and the demand for fuel in Turkey. According to their results, shifts in the value of one currency compared to another as well as changes in the price of petrol have a considerable influence on overall fuel use. In addition, the research reveals a favourable correlation between expenditures related to automobile sales and rental charges and the prices of gasoline.

According to the findings of Humbatova et al. (2020), there are positive correlations between the Gross Domestic Product, the Consumption of Electric Energy, and the Growth of the GDP in Various Sectors of the Economy in Azerbaijan. These results lead to a better understanding of the interplay between economic development and energy consumption in the nation as a whole as a whole. The authors make the suggestion that it is important to save electric energy as a piece of advice, most likely in account of the positive link that exists between the use of electric energy and the expansion of GDP.

Ahmadov and Memmedova (2016) conducted research on the significance of commitments and found that maintaining a high level of commitment is essential.

In her research, Sarkhanov (2022) demonstrates the significant impact that changes in oil prices have on the Azerbaijani economy. She places particular emphasis on the correlation that exists between shifts in oil prices and fundamental economic metrics such as GDP and oil output.

3. DATASET AND METHODOLOGY

In this study, the causal relationship between oil prices (BOIL) and the Moscow Stock Exchange MOEX Chemicals, MOEX Transport, and MOEX Financials return indices was tested with frequency causality analysis. The oil price data used in the study and the Moscow Stock Exchange MOEX Chemicals, MOEX Transport, and MOEX Financials indices return were taken from the Investing.com database (https://tr.investing.com/), and the analysis period is monthly data between January 2015 and December 2022.

The ADF unit root test was used for the stationarity analysis in the study, and Granger causality and Toda and Yamamoto causality tests were used to show that the causality test used in the study is a stronger test. Frequency effect causality analysis explains the causal relationships between short, medium, and long-term variables. In this regard, it has departed from traditional causality analysis. In this study, a methodology based on the work of Breitung and Candelon (2001 and 2006) is used. In frequency causality analysis, between 0.01 and 0.005 indicates short-term causality, between 1.00 and 1.50 indicates medium-term causality, and 2.00-2500 indicates long-term causality (Bayat et al., 2015. p. 22).

3.1. Stability Tests

One of the most important characteristics of time series data is stationarity. With a non-stationary series, it is feasible to draw a "false regression" from the study. The link between these variables does not, however, always result in spurious regression when there are non-stationary data. The results of the regression analysis will reveal the long-run equilibrium relationships between the variables if they are cointegrated in their level form.

Several techniques can be used to determine whether the variables satisfy the stationarity criteria. Unit root testing is one method for evaluating the stationarity of variables. It is demonstrably not stationary if a unit root exists. The Extended Dickey Fuller Unit Root Test, which can be downloaded from the Dickey and Fuller Test (1979), was employed in this investigation. The conventional Dickey and Fuller (1981) test can be used to run the following three equations:

$$\Delta_{yt} = \beta_1 * y_t{-}1 + \varepsilon_t$$

$$\Delta_{yt} = \beta_0 + \beta_1 * y_t{-}1 + \varepsilon_t$$

$$\Delta_{yt} = \beta_0 + \beta_1 * y_t{-}1 + \beta_2 * Trend + \varepsilon_t$$

Her üç testte de hipotez aşağıdaki gibidir:
H_0: $\beta_1 = 0$ The variable has a unit root, the variable is not static.
H_1: $\beta_1 < 0$ The variable has no unit root, the variable is static.

3.2. Granger Causality Test

The reliance of one variable on other variables is the subject of study in regression analysis. This does not necessarily imply that there is a causal relationship between these variables, though. In other words, the presence of a relationship between the variables does not show causality or the direction of the effect (Gujarati, 2013.p. 652).

The following regression systems must be estimated for the Granger causality test (1969):

$$Yt = \alpha_0 + \sum_{i=1}^{m} \beta i Yt\text{-}1 + \sum_{i=1}^{m} \alpha i Xt\text{-}^{1} + \varepsilon t$$

$$Xt = \alpha_0 + \sum_{i=1}^{m} \gamma i Yt\text{-}1 + \sum_{i=1}^{m} \delta i Xt\text{-}^{1} + \varepsilon t$$

3.3. Toda and Yamamoto Test

The Granger Causality Test uses these models to show not only the importance of the relationship between variables, but also the direction of this relationship. The Toda and Yamamoto causality test, which is regarded as an extension of the Granger causality test created by Toda and Yamamoto (1995), is one of the techniques used to determine the causation link between time series. When the traditional Granger causality test cannot be employed, the Toda and Yamamoto causality test can be used effectively. This is especially true when analysing variables that do not have stationarity at level values in terms of causal links. Information about the variables used in the analysis is given in Table 1.

4. EMPIRICAL ANALYSIS AND RESULTS

The Granger Causality Test uses these models to show not only the importance of the relationship between variables, but also the direction of this relationship. The Toda and Yamamoto causality test, which is regarded as an extension of the Granger causality test created by Toda and Yamamoto (1995), is one of the techniques used to determine the causation link between time series. When the traditional Granger causality test cannot be employed, the Toda and Yamamoto causality test can be used effectively. This is especially true when analysing variables that do not have stationarity at level

values in terms of causal links.

4.1. ADF Unit Root Test Results

Table 2 presents the Augmented Dickey-Fuller unit root test for stationarity. The results revealed that BRENTOIL, MOEXCH, and MOEXTN all have a unit root at level; however, after the first difference, the series becomes stationary at the second difference. As a result, BRENTOIL, MOEXCH, and MOEXTN were integrated from the start. MOEXFN was integrated in order zero, which explains why it is stationary at its original series (I[0]).

4.2. Unit Circle Position of the Inverse Roots of the AR Characteristic Polynomial

The graph in Figure 1 depicts the stability of the vector autoregressive model since the roots are within the unit circle. According to Lütkepohl (1991), if all roots have a modulus less than one and lie within the unit circle, the result is stable and good for prediction.

4.3. LM-Autocorrelation Test

Table 3 presents the LM autocorrelation. This test intends to show if there is an autocorrelation in the model. The test was set at lag 12. The results showed that there was no autocorrelation problem in the analysis; hence, the results were free of autocorrelation problems.

4.4. Granger Causality Analysis

Table 4 shows the Granger causality test set at lag seven. The result shows that BRENTOIL and MOEXCH have predictive inherent power among themselves. This demonstrates that BRENTOIL cause MOEXCH, and MOEXCH cause BRENTOIL at a 10% significant level (P = 0.088 and −0.0387). Hence, at a 10% significant level, BRENTOIL and MOEXCH have a bi-causality effect. Furthermore, BRENTOIL and MOEXFN also have a bi-causality effect (P = 0.036 and 0.056, respectively), with the direction of causality running from BRENTOIL to MOEXFN and vice versa. BRENTOIL and MOEXTN, on the other hand, do not cause each other (P = 0.132 and −0.828, respectively). This demonstrates that BRENTOIL does not cause MOEXTN and vice versa.

4.5. Toda and Yamamoto (1995) Causality Analysis Results

Figure 1: Unit Circle Position of the Inverse Roots of the AR Characteristic Polynomial

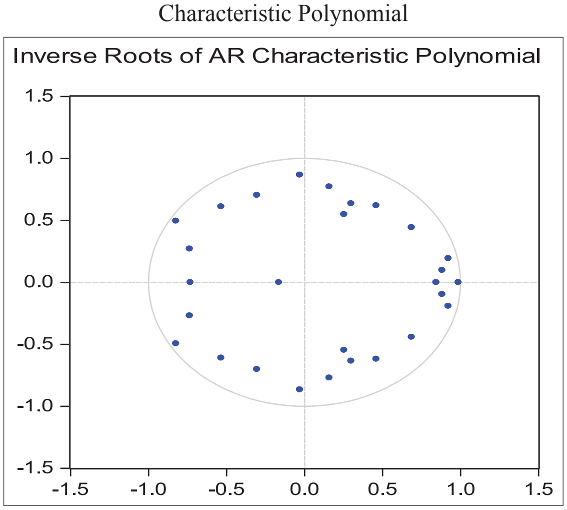


Table 5 shows the Toda Yamamoto causality test, which displays the short-run causes and effects of BRENTOIL on MOEXCH, MOEXFN, and MOEXTN. The result showed that BRENTOIL and MOEXCH have a causal effect among themselves at a 5% and 10% significant level, respectively (P = 0.027 and −0.070). Furthermore, BRENTOIL and MOEXFN have a bi-causality effect (P = 0.042 and 0.025, respectively), indicating that both indicators

Table 1: Dataset information

Variable	Description
BRENTOIL	Brent Oil
MOEXCH	MOEX Chemicals-Index Moscow
MOEXFN	MOEX Financials-Index Moscow
MOEXTN	MOEX Transport-Index Moscow

Table 2: ADF unit root test results

Variable	Constant I (0)	Constant i I (1)
BRENTOIL	−1.54715 (0.505)	−8.8847 (0.000)***
MOEXCH	−0.8765 (0.792)	−3.0256 (0.036) **
MOEXFN	−3.0016 (0.038)**	−4.9207 (0.000) ***
MOEXTN	−1.262 (0.644)	−9.015 (0.000)***

*,**, and *** implies 10%, 5% and 1% significance level, where: BRENT is Brent oil price

Table 3: LM-autocorrelation test

Lags	LM-Stat	Prob
1	6.770477	0.1485
2	1.549627	0.8178
3	0.932325	0.9199
4	5.739601	0.2195
5	1.361670	0.8508
6	0.671103	0.9548
7	2.387882	0.6648
8	2.882935	0.5776
9	5.758862	0.2179
10	3.659660	0.4540
11	5.311604	0.2568
12	2.441564	0.6551

Probs from Chi-square with 4 df

Table 4: Granger causality analysis

Hypothesis	Chi-sq	Probability
BRENTOIL→MOEXCH	1.859	0.0883*
MOEXCH→BRENTOIL	2.256	0.0387**
BRENTOIL→MOEXFN	2.288	0.036**
MOEXFN→BRENTOIL	2.079	0.056*
BRENTOIL→MOEXTN	1.659	0.132
MOEXFN→MOEXTN	0.504	0.828

*,**, and *** implies 10%, 5% and 1% significance level, where: BRENT is Brent Oil Price

Table 5: Toda and Yamamoto (1995) causality analysis results

Hypothesis	Chi-sq	Probability
BRENTOIL→MOEXCH	15.7903	0.027**
MOEXCH→BRENTOIL	13.016	0.070*
BRENTOIL→MOEXFN	14.556	0.042**
MOEXFN→BRENTOIL	16.016	0.025**
BRENTOIL→MOEXTN	3.531	0.8319
MOEXFN→MOEXTN	11.607	0.113

*,**, and *** implies 10%, 5% and 1% significance level, where: BRENT is Brent Oil Price

have a 5% significant feedback effect. Finally, at the 1%, 5%, and 10% significant levels (P = 0.832 and 0.113, respectively), BRENTOIL and MOEXFN do not cause one another. This demonstrates that BRENTOIL and MOEXTN have no directional feedback effect.

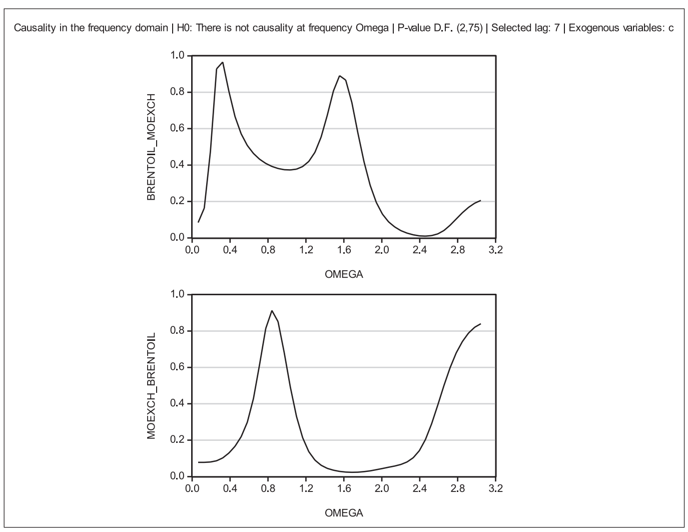
4.6. Breitung and Candelon (2006) Frequency Causality Results

Table 6 presents the Breitung and Candelon (2006) frequency and causality results. The result observed was that the frequency domain approach gives much better information on the strengths and directions of causalities between the indicators of BRENTOIL and MOEXCH, MOEXFN, and MOEXTN, respectively. According to frequency domain test results, BRENTOIL has a significant causal effect on MOEXCH in the short and long term. This is also similar to the results of BRENTOIL and MOEXFN, which also display a causal effect between BRENTOIL and MOEXFN in the short term. Lastly, BRENTOIL also has a significant causal effect on MOEXTN, albeit at a short-term level.

4.7. Frequency Domain Causality

Figure 2, which corresponds to the hypothesis that the brentoil does not cause the MOEXCH at frequency w, revealed that the graph revealed that the brentoil caused the MOEXFN at frequency 0:5. This was consistent with the Granger causality test in the time domain, which revealed that the brentoil caused the MOEXCH. On the other hand, it can be seen that the MOEXCH also causes the BRENTOIL only at non-seasonal frequencies.

Figure 2: MOEXCH and BRENT OIL OMEGA test



Similar to Figures 2 and 3 also presents the Granger causality test at lag seven, which corresponds to the hypothesis that the BRENTOIL does not cause the MOEXFN at frequency w. It can be seen that the BRENTOIL causes the MOEXFN at frequency 0:5. This is also similar to the Granger causality test in the time domain, which states that the BRENTOIL causes the MOEXFN. At 0.5%, however, it is clear that the MOEXFN does not cause the BRENTOIL.

Figure 4 presents the graph that is corroborated by the hypothesis that the BRENTOIL does not cause the MOEXTN at frequency

Figure 3: MOEXFN and BRENT OIL OMEGA test

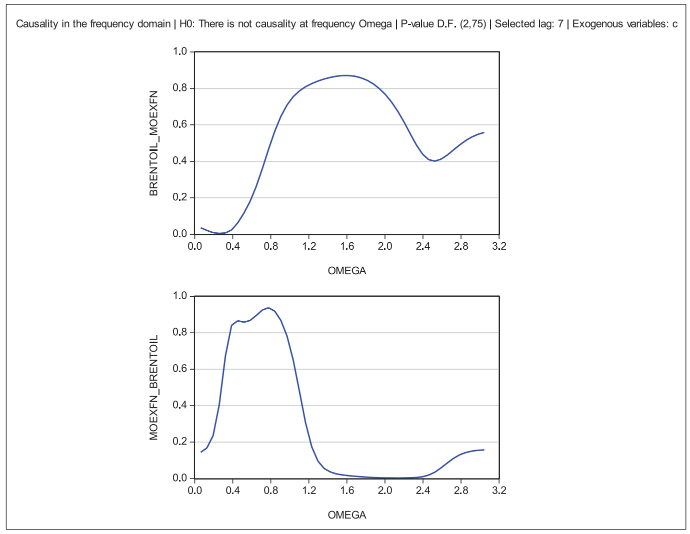


Figure 4: MOEXTN and BRENT OIL OMEGA test

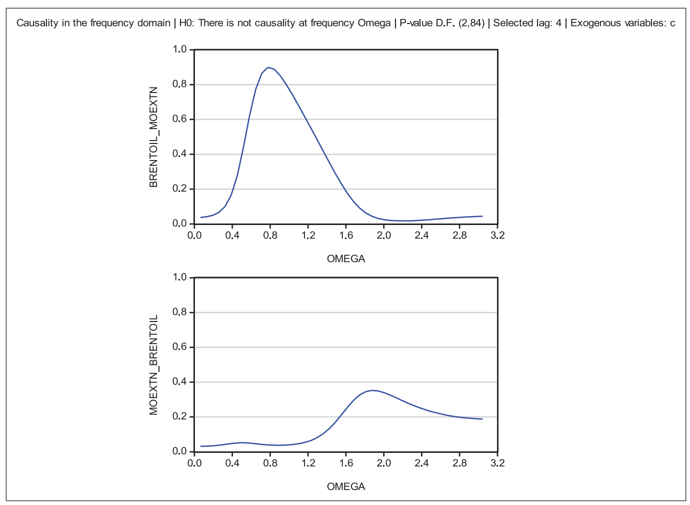


Table 6: Breitung and Candelon (2006) frequency causality results

Variables	Short term		Medium term		Long term	
ω_i	0.01	0.05	1.00	1.50	2.00	2.50
BRENTOIL→MOEXCH	0.0844*	0.5714	0.374	0.8071	0.1951	0.0097**
MOEXCH→BRENTOIL	0.0779*	0.2185	0.6819	0.0348**	0.0375**	0.2039
BRENTOIL→MOEXFN	0.0357**	0.0625*	0.709	0.866	0.7985	0.4090
MOEXFN→BRENTOIL	0.1440	0.8661	0.7809	0.025**	0.004***	0.0189**
BRENTOIL→MOEXTN	0.0006***	0.006***	0.0912*	0.578	0.673	0.308
MOEXTN→BRENTOIL	0.204	0.5787	0.287	0.2718	0.1549	0.1034

*,**, and *** implies 10%, 5% and 1% significance level, where: BRENT is Brent Oil Price

w. It can be seen that the BRENTOIL causes the MOEXTN at frequency 0:5. This is not in tandem with the Granger causality test in the time domain, which states the BRENTOIL does not cause the MOEXTN. However, it is clear that the MOEXTN does not cause the BRENTOIL.

5. CONCLUSION

In this study, the relationship between the Moscow Stock Exchange MOEX Chemicals, MOEX Transport, and MOEX Financials return indices and oil prices for the 2015:M1 and 2022:M12 periods is firstly the traditional Granger causality, Toda and Yamamoto, and then Breitung and Candelon (2006), which is stronger than these two tests. A frequency causality analysis was used. While examining the relationship between the variables used in traditional causality analyses for only one test statistic, the frequency causality test performs the said tests for different frequencies over time. In this regard, traditional linear causality tests look at causality over the entire period, whereas nonlinear asymmetric causality tests look at causality during expansion and contraction periods. This is in contrast to the implicit assumption of traditional causality analyses that a single test statistic summarises the relationship between variables (Ciner, 2011). The frequency domain causality test, on the other hand, examines the causal relationship in the form of short, medium, and long terms based on the whole period. In this context, it can be said that Breitung and Candelon's (2006) frequency causality analysis is a stronger test (Karaoğlan et al., 2022).

According to Granger causality analysis, bidirectional causality was observed between the BRENTOIL and MOEX Chemistry and MOEX Finance Indices. However, there is no Granger causality between BRENTOIL and the MOEX Transport index.

According to the Toda Yamamoto causality test, which shows the short-term causality and effect between the variables, it is seen that Brent Oil and the MOEX Chemistry Index have 5% and 10% significant bidirectional causality, respectively. Likewise, it has a double causality effect at the 5% significant level with the Brent Oil and MOEX Finance indices. It appears that Brent Oil and MOEX Transport are not related.

However, according to the Breitung and Candelon (2006) frequency causality analysis results, which gave stronger and more reliable results than these tests, Breitung and Candelon (2006) found that the frequency domain approach was determined by the causality between the Brent Oil and MOEX Chemistry, MOEX Finance, and MOEX Transport indicators, respectively. It has been observed that it gives much better information about its power and direction. According to the frequency domain test results, it is seen that Brent oil has a significant causal effect on the MOEX Chemistry index in the short and long term. This is similar to the result of BRENTOIL and MOEXFN, which shows a causality effect between BRENTOIL and MOEXFN in the short run. Finally, BRENTOIL also has a significant causal effect on MOEXTN only in the short term.

This study shows that national and international investors should consider oil prices while investing in the Moscow Stock Exchange.

REFERENCES

Abdioğlu, Z., Değirmenci, N. (2014), Petrol fiyatları-hisse senedi fiyatları ilişkisi: Bist sektörel analiz. Kafkas Üniversitesi İktisadi Ve İdari Bilimler Fakültesi Dergisi, 5(8), 1-24.

Ahmadov, F., Memmedova, G. (2016), Azerbaycan'da yöneticilerin yerel işletmelerde örgütsel bağlılık üzerinde inceledikleri stratejiler üzerinde analiz. Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, Özel Sayı, 175-187.

Ahmed, S., Mohammad, K.U. (2022), The relationship between oil price fluctuations, power sector returns, and Covid-19: Evidence from Pakistan. The Journal of Asian Finance, Economics and Business, 9(3), 33-42.

Ajala, K., Sakanko, M.A., Adeniji, S.O. (2021), The asymmetric effect of oil price on the exchange rate and stock price in Nigeria. International Journal of Energy Economics and Policy, 11(4), 202-208.

Alamgir, F., Amin, S.B. (2021), The nexus between oil price and stock market: Evidence from South Asia. Energy Reports, 7, 693-703.

Anyalechi, K.C., Ezeaku, H.C., Onwumere, U.J., Okereke, E.J. (2019), Does oil price fluctuation affect stock market returns in Nigeria? International Journal of Energy Economics and Policy, 9(1), 194-199.

Arouri, M.E.H., Jouini, J., Nguyen, D.K. (2011), Volatility spillovers between oil prices and stock sector returns: Implications for portfolio management. Journal of International Money and Finance, 30(7), 1387-1405.

Asaad, Z.A. (2021), Oil price, gold price, exchange rate and stock market in Iraq pre-during COVID-19 outbreak: An ARDL approach. International Journal of Energy Economics and Policy, 11(5), 562-671.

Atif, M., Rabbani, M.R., Bawazir, H., Hawaldar, I.T., Chebab, D., Karim, S., AlAbbas, A. (2022), Oil price changes and stock returns: Fresh evidence from oil exporting and oil importing countries. Cogent Economics Finance, 10(1), 2018163.

Bashir, M.A., Sheng, B., Doğan, B., Sarwar, S., Shahzad, U. (2020), Export product diversification and energy efficiency: Empirical evidence from OECD countries. Structural Change and Economic Dynamics, 55, 232-243.

Bashir, M.F. (2022), Oil price shocks, stock market returns, and volatility spillovers: A bibliometric analysis and its implications. Environmental Science and Pollution Research, 29(16), 22809-22828.

Bastianin, A., Conti, F., Manera, M. (2016), The impacts of oil price shocks on stock market volatility: Evidence from the G7 countries. Energy Policy, 98, 160-169.

Bayat, T., Özcan, B., Taş, Ş. (2015), Türkiye'de döviz kuru geçiş etkisinin asimetrik nedensellik testleri ile analizi. Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 10(2), 7-30.

Breitung, J., Candelon, B. (2001), Is there a common european business cycle? new insights from a frequency domain analysis. Vierteljahrshefte Zur Wirtschaftsforschung, 70(3), 331-338.

Breitung, J., Candelon, B. (2006), Testing for short-and long-run causality: A frequency-domain approach. Journal of Econometrics, 132(2), 363-378.

Chen, C.T.A., Millero, F.J. (1986), Thermodynamic properties for natural waters covering only the limnological range 1. Limnology and Oceanography, 31(3), 657-662.

Ciner, Ç. (2011), Eurocurrency ınterest rate linkages: A frequency domain analysis. International Review of Economics and Finance, 20, 498-505.

Cong, R.G., Wei, Y.M., Jiao, J.L., Fan, Y. (2008), Relationships between oil price shocks and stock market: An empirical analysis from China. Energy Policy, 36(9), 3544-3553.

Das, S. (2021), The time-frequency relationship between oil price, stock returns and exchange rate. Journal of Business Cycle Research, 17(2), 129-149.

Dickey, D.A., Fuller, W.A. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association, 74(366a), 427-431.

Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: Journal of the Econometric Society, 49, 1057-1072.

El-Sharif, I., Brown, D., Burton, B., Nixon, B., Russell, A. (2005), Evidence on the nature and extent of the relationship between oil prices and equity values in the UK. Energy Economics, 27(6), 819-830.

Endri, E., Rinaldi, M., Arifian, D., Saing, B., Aminudin, A. (2021), Oil price and stock return: Evidence of mining companies in Indonesia. International Journal of Energy Economics and Policy, 11(2), 110-114.

Eyüboğlu, K., Eyüboğlu, S. (2016), Doğal gaz ve petrol fiyatları ile bıst sanayi sektörü endeksleri arasındaki ilişkinin incelenmesi. Journal of Yaşar University, 11(42), 150-162.

Fasanya, I.O., Oyewole, O.J., Adekoya, O.B. Badaru, F.O. (2021), Oil price and stock market behaviour in GCC countries: Do asymmetries and structural breaks matter? Energy Strategy Reviews, 36, 100682.

Filis, G., Degiannakis, S., Floros, C. (2011), Dynamic correlation between stock market and oil prices: The case of oil-importing and oil-exporting countries. International Review of Financial Analysis, 20(3), 152-164.

Golder, U., Islam, M. N., Kayser, M.S. (2020), Impact of foreign exchange reserve, exchange rate and crude oil price on Dhaka stock exchange index: An empirical evidence from vector error correction model. Indian Journal of Finance and Banking, 4(1), 134-143.

Granger, C.W., Yoon, G. (2002), Hidden Cointegration. U of California, Economics Working Paper, (2002-02).

Granger, C.W.J. (1969), Investigating causal relations by econometric models and cross spectral methods. Econometrica, 37, 424-438.

Gujarati, D.N. (2013) Basic Econometrics. 4th ed. New York: Mcgraw-Hill International.

Güler, S., Nalın, H.T. (2013), Petrol fiyatlarının İMKB endeksleri üzerindeki etkisi. AİBÜ-İİBF Ekonomik Ve Sosyal Araştırmalar Dergisi, 9, 79-97.

Hamao, Y. (1988), An empirical examination of the arbitrage pricing theory: Using Japanese data. Japan and the World Economy, 1(1), 45-61.

Hashmi, S.M., Chang, B.H., Huang, L., Uche, E. (2022), Revisiting the relationship between oil prices, exchange rate, and stock prices: An application of quantile ARDL model. Resources Policy, 75, 102543.

Hatemi-J, A., Irandoust, M. (2012), Asymmetric interaction between government spending and terms of trade volatility: New evidence from hidden cointegration technique. Journal of Economic Studies, 39, 368-378.

Huang, R.D., Masulis, R.W., Stoll, H.R. (1996), Energy shocks and financial markets. Journal of Futures Markets, 16(1), 1-27.

Humbatova, S.I., Ahmadov, F.S., Seyfullayev, Ý.Z., Hajiyev, N.G.O. (2020), The Relationship between electricity consumption and economic growth: Evidence from Azerbaijan. International Journal of Energy Economics and Policy, 10(1), 436-455.

Jawadi, F., Sellami, M. (2021), On the effect of oil price in the context of Covid-19. International Journal of Finance Economics, 27, 3924-3933.

Jones, C.M., Kaul, G. (1996), Oil and the stock markets. The Journal of Finance, 51(2), 463-491.

Kang, W., de Gracia, F.P., Ratti, R.A. (2017), Oil price shocks, policy uncertainty, and stock returns of oil and gas corporations. Journal of International Money and Finance, 70, 344-359.

Karaoğlan, S., Görgün, M.R., Barut, A., Demirtaş, F., Alpsülün, M.S. (2022), Petrol fiyatları ve BİST sanayi endeksi ilişkisi: Frekans nedensellik analizi. Avrasya Dosyası Dergisi, 13(2), 163-180.

Katsampoxakis, I., Christopoulos, A., Kalantonis, P., Nastas, V. (2022), Crude oil price shocks and European stock markets during the Covid-19 period. Energies, 15(11), 4090.

Kaya, M., Güneş, H. (2022), BİST endeksleri ile brent petrol fiyatları arasındaki ilişkinin analizi. Uluslararası Finansal Ekonomi ve Bankacılık Uygulamaları Dergisi, 3(2), 71-95.

Kelikume, I., Muritala, O. (2019), The impact of changes in oil price on stock market: Evidence from Africa. International Journal of Management, Economics and Social Sciences (IJMESS), 8(3), 169-194.

Kendirli, S., Çankaya, M. (2016), Ham petrol fiyatlarının bist 100 ve bist ulaştırma endeksleri ile ilişkisi. Kastamonu University Journal of Economics Administrative Sciences Faculty, 12, 136-141.

Lütkepohl, H. (1991), Introduction to Multiple Time Series Analysis. Berlin: Springer-Verlag.

Ma, F., Wang, R., Lu, X., Wahab, M.I.M. (2021), A comprehensive look at stock return predictability by oil prices using economic constraint approaches. International Review of Financial Analysis, 78, 101899.

Nguyen, T.N., Nguyen, D.T. Nguyen, V.N. (2020), The impacts of oil price and exchange rate on Vietnamese stock market. The Journal of Asian Finance, Economics and Business, 7(8), 143-150.

Nwosa, P.I. (2021), Oil price, exchange rate and stock market performance during the COVID-19 pandemic: Implications for TNCs and FDI inflow in Nigeria. Transnational Corporations Review, 13(1), 125-137.

Özmerdivanlı, A. (2014), Petrol fiyatları ile BIST 100 endeksi kapanış fiyatları arasındaki ilişki. Akademik Bakış Dergisi, 43, 1-12.

Papapetrou, E. (2001), Oil price shocks, stock market, economic activity and employment in Greece. Energy Economics, 23(5), 511-532.

Park, J.W. (2007), Oil Price Shocks and Stock Market Behavior: Empirical Evidence for the US and European Countries (Doctoral Dissertation, University of Missouri--Columbia).

Sadorsky, P. (1999), Oil price shocks and stock market activity. Energy Economics, 21(5), 449-469.

Sarkhanov, T. (2022), The effect of oil prices on Azerbaijan's economy (2009-2018). Economy of Regions, 18(4), 1287-1300.

Scholtens, B., Wang, L. (2008), Oil risk in oil stocks. The Energy Journal, 29(1), 89-112.

Şener, S., Yılancı, V., Tıraşoğlu, M. (2013), Petrol fiyatları ile borsa istanbul'un kapanış fiyatları arasındaki saklı ilişkinin analizi. Sosyal Ekonomik Araştırmalar Dergisi, (26), 231-248.

Shahzad, S.J.H., Bouri, E., Rehman, M.U., Naeem, M.A., Saeed, T. (2021), Oil price risk exposure of BRIC stock markets and hedging effectiveness. Annals of Operations Research, 313, 145-170.

Shi, Z., Kong, D. (2021), Oil price-stock market nexus during the COVID-19 pandemic: Evidence from China. Energy Research Letters, 2(4), 28131.

Suleymanli, J., Mammadov, I., Ahmadov, F., Aliyev, T. (2022), Investigation of the relationship between fuel prices and fuel consumption in Turkey. International Journal of Energy Economics and Policy, 12(6), 473-480.

Tien, T.H. (2022), Oil price shocks and Vietnam's macroeconomic fundamentals: Quantile-on-quantile approach. Cogent Economics Finance, 10(1), 2095767.

Toda, H.Y., Yamamoto, T. (1995), Statistical inference in vector autoregressions with possibly integrated processes. Journal of Econometrics, 66(1), 225-250.

Yildırım, M., Bayar, Y., Kaya, A. (2014), Enerji fiyatlarının sanayi sektörü hisse senedi fiyatları üzerindeki etkisi: Borsa istanbul sanayi sektörü şirketleri. Journal of Accounting Finance, (62), 93-108.

Yun, X., Yoon, S.M. (2019), Impact of oil price change on airline's stock price and volatility: Evidence from China and South Korea. Energy Economics, 78, 668-679.

Zortuk, M., Bayrak, S. (2016), Ham petrol fiyat şokları-hisse senedi piyasası ilişkisi: ADL eşik değerli koentegrasyon testi. Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 11(1), 7-22.