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Article

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Relationship between Oil Prices and Stock Prices in BRICS-T Countries: Symmetric and Asymmetric Causality Analysis

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ABSTRACT

In this study, by considering the period between January 2010 and December 2019 of BRICS-T countries, the relationship between oil prices and stock prices was examined through the Hatemi-J asymmetric causality test (2012). The stationarity levels of the series were determined by augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Hatemi (2012) asymmetric causality test, which takes into account the presence of asymmetric information in financial markets by distinguishing positive and negative shocks, was used. Accordingly, hidden relationships that could not be detected using the symmetric causality test were revealed with the help of the asymmetric causality test.

Keywords: BRICS-T, Oil Prices, Stock Prices, Asymmetric Causality
JEL Classifications: C23, G15, Q40

1. INTRODUCTION

Oil prices, which directly or indirectly affect many sectors in the economy, are an important indicator of economic performance. The reason why the changes in the oil market or oil prices create chain interactions on both the country and the world economy is that the oil price is independent of each other or depends on many factors that affect each other. It is possible to see the chain interaction of increases in crude oil prices on macroeconomic variables such as inflation, unemployment and economic growth (Hamilton, 1983). For example, the effect of fluctuations in oil prices on economic growth and their effect on stock prices are a knock-on effect (Takashi and Bong-Soo, 1995). Oil prices can indirectly affect macroeconomic indicators and stock market returns primarily by affecting industrial production and inflation. High oil prices cause production costs to rise and then production to decrease or expected earnings to decrease (Miller and Ratti, 2009). However, oil prices can negatively affect the overall performance of the stock market, both directly and indirectly. A direct negative effect can be explained by the upward movement in oil prices creating uncertainty in financial markets, which in turn leads to a fall in share prices. As a result of the increase in oil prices, the decrease in stock prices due to low production level and higher inflation rates is an indirect negative effect (Filis, 2010).

Considering the studies in the literature investigating the effects of oil prices on the stock market index, they differ from each other in terms of their results. While some of the studies argue that there is a linear relationship between oil prices and stock market index (Phan et al, 2015; Filis and Chatziantoniou, 2014; Narayan and Sharma, 2014; Miller and Ratti, 2009; Henriques and Sadorsky, 2008; Maghyereh, 2004; Sadorsky, 2001; Papapetrou, 2001), and some mention the existence of a non-linear relationship (Park and Ratti, 2008; Chen, 2010; Broadstock et al., 2014; Narayan and Gupta, 2015; Tsai, 2015; Syzdykova, 2018). In addition, according to the direction of the relationship between oil prices and stock market index, they are divided into studies that accept negative (Cunado and de Gracia, 2014) or positive effect (Arouri and Rault, 2012). This situation may arise from the differences in the data sets and econometric methods covered by the studies. However, the differences in the internal dynamics of each country /country group cause the results of the study to be complex and the discussions on this issue continue. The aim of this study is to contribute to the literature by revealing the relationship between oil prices and stock market index by using a large data set for BRICS-T countries, considering the inconsistent results on the subject.

For this purpose, the study consists of four parts. After mentioning the relationship between variables in the introduction part, the studies on the subject in the literature are summarized in the second part. In the third chapter, the data set and econometric methodology used are included. In the fourth chapter, empirical analysis results are given. In the last part, the contribution of the study to the literature is mentioned by interpreting the analysis results.

2. LITERATURE REVIEW

Energy, financial markets and economy act in conjunction with each other in the economic growth stage of a country (Basher and Sadorsky, 2006: 225). Since oil is both an energy source and an important input in production and logistics activities, volatility in oil prices affects all units of the economy directly or indirectly.

Since the evaluation of the increase in oil prices as a negative situation by the markets causes the decrease in stock prices, it can be mentioned that there is a negative correlation between oil returns and stock returns. However, it is expected that both oil and stock prices will increase in times of economic expansion. As a different situation, in oil producing and exporting countries, there is a positive correlation between oil returns and stock returns as the increase in wealth and income in parallel with oil price increases will positively affect stock prices. Although the effect of oil on stock returns is explained by some transmission mechanisms, the opposite effect is more acute. Stock markets, acting according to future expectations, may decline before the crisis or rise before the economic recovery begins. However, as oil prices depend on supply and demand, they change simultaneously with cyclical fluctuations. Even though there are some statistical regularities among the variables, the direction of the correlation between oil returns and stock returns may change depending on the leading nature of the stock market as well as how these variables behave against cyclical fluctuations (Awartani and Maghyereh, 2013: 28, Hamma et al., 2014: 110). In studies investigating the relationship between oil prices and stock markets, different variables such as real oil price, nominal oil price, net oil price increase, oil price volatility, oil futures price increases, oil price shocks have been used. On the other hand, different findings have been made in studies conducted to examine the relationship between oil prices and stock markets.

Park and Ratti (2008) analyzed the effect of oil price shocks and oil price volatility on the real stock returns of the USA and 13 European countries using the VAR model using monthly data from January 1986 to December 2005. Stating that oil price shocks have a statistically significant and negative effect on real stock returns in the same month or the next month, the researchers state that these shocks and the increase in oil price volatility have a strong effect on stock returns in all European countries except the USA. Unlike other countries, Norway, which is an oil exporter, has a positive response to real stock returns to the oil price shock increases. The result of the analysis of variance decomposition shows that oil price shocks explain 6% of real stock return volatility.

Cong et al. (2008) used the multivariate VAR model in their study based on January 1996 and December 2007 monthly data to examine the interaction between oil price shocks and volatility and the Chinese stock market. As a result of the analysis, it was concluded that the oil price shocks do not have a statistically significant effect on the Chinese stock market index returns, except for the production index and the oil companies. Significant oil price shocks affect the stock prices of oil companies, and the increase in oil price volatility increases the mining and petrochemical industry index returns. Gay (2008) used the ARIMA model to analyze the relationship between oil price and exchange rate and the stock market index prices of Brazil, Russia, India and China. In the study using monthly data between March 1999 and June 2006, it is revealed that there is no significant relationship between the oil price and exchange rate and the stock market index prices of Brazil, Russia, India and China, and the past stock prices do not have an effect on the current price of the stocks.

Ono (2011), investigating the effect of oil prices on Brazil, Russia, India and Russia stock market returns for the period January 1999 - September 2009, used the multivariate VAR model. It has been found that oil price changes positively affect the stock market returns of China, India and Russia, and that there is no significant effect on the Brazilian stock market. Variance segregation analysis result is; It shows that the impact of oil price shocks on China and Russia stock market return volatility is large and statistically significant. In addition, it has been determined that oil price shocks have an asymmetric effect only for the Indian stock market.

Filis et al. (2011) used the DCC-GARCH-GJR model for the time-varying correlation between the stock prices and oil prices of oil-importing (USA, Germany and Netherlands) and oil-exporting countries (Canada, Mexico and Brazil) for the period January 1987 and December 2009.. They stated that, except for the 2008 financial crisis period, oil prices had a negative effect on stock markets and the correlation that changed over time was not different for oil exporting countries and oil importing countries. However, they argue that non-economic crises create a stronger negative correlation between oil prices and stock markets, while economic crises trigger a strong positive correlation between variables. They determined that precautionary demand shocks cause negative correlation, aggregate demand shocks cause a positive correlation, while supply side shocks do not affect the relationship between oil prices and stock markets. According to the researchers, in times of economic turmoil, the oil market is not considered as a tool to reduce potential losses of investors.

Wang et al. (2013), using the monthly data for the period January 1999 - December 2011, investigated the effects of oil price shocks on the stock markets of oil-exporting and oil-importing countries using structural VAR analysis. The size, duration and direction of the response of the country's stock markets to oil price shocks vary depending on whether the country is a net importer or exporter in the world oil market and the changes in oil prices arise from supply or total demand. The relative contribution of oil price shocks to the national economy is related to its net position in the oil market and the importance of oil. Cunado and de Gracia (2014), in their study for 12 European oil-importing countries (Germany, Austria, Belgium, Denmark, Finland, France, the Netherlands, England, Spain, Italy, Luxembourg, Portugal), the response of real stock returns to oil prices is negative. They also found that the aforementioned reactions varied greatly depending on the underlying reasons for the oil price change. In Table 1, studies investigating the symmetrical and asymmetrical relationships between oil prices and stock market indices are presented in summary.

3. DATA SET AND METHODOLOGY

3.1. Data Set

In this study, the relationship between stock market indices from developing countries with exchange rates in Brazil, Russia, India, China, Turkey and South Africa (BRICS-T) has been investigated using monthly data. In the study, the closing prices of the main stock market index of each country are used to represent the stock price variable, and the Brent type crude oil prices to represent the oil prices. The monthly data set used in the analysis for countries covers the period January 2010-December 2019. In addition, oil price data were obtained from the International Energy Agency (IEA), and stock market index data were obtained from the Bloomberg database.

3.2. Econometric Methodology

Hacker and Hatemi (2006) use the Toda-Yamamoto causality test (1995) to determine the causality between variables in the bootstrap granger causality test, but the critical values are obtained by bootstrap mounted carlo simulation against the possible risk of normal distribution of errors. However, the drawback of this model is that it cannot distinguish between positive and negative shocks. In this context, in the asymmetric causality test developed by Hatemi (2012), in the presence of asymmetric information in financial markets and heterogeneity of market participants, the results of this test may be misleading because the participants do not give similar responses to positive and negative shocks of the same magnitude. In this context, the Hatemi-J asymmetric causality test (2012) Hacker and Hatemi (2006) is the decomposition of positive and negative shocks of the bootstrap granger causality test. In other words, this method is very suitable for studies using financial time series.

Hacker and Hatemi (2006) causality test examines the causality relationship between variables with the Toda-Yamamoto causality test, but the critical values used are obtained by the bootstrap method against the possibility of normal distribution of errors. The following Vector Autoregressive (VAR) model is used to test the causality relationship between variables with the Hacker and Hatemi causality test.

$$y_t=\alpha+A_i\,y_{t-1}+\ldots+A_p\,y_{p-1}+u_t \quad (1)$$

y_t used in the model indicates the variable vector and A indicates the parameter vector. In order to obtain the Wald statistics to be used, the VAR model shown in the equation can be written as follows.

$$Y=NZ+\delta \quad (2)$$

The variables in the model are expressed as follows, respectively.

$$X=\left(x_1^+,x_2^+,x_3^+,\ldots,x_T^+\right), \qquad (n\times T) \quad (3)$$

$$N=(v,\ A_1,\ A_2,\ A_3,\ldots,\ A_p), \qquad (n\times(1+n(p+d)))$$

$$Z=(Z_0,\ Z_1,\ Z_2,\ldots,\ Z_{T-1}), \qquad (1+n(p+d)\times T)$$

$$Z_t=\begin{bmatrix}1\\ x_t^+\\ x_{t-1}^+\\ .\\ .\\ x_{t-p+1}^+\end{bmatrix}, \qquad \left(\left(1+n\left(p+d\right)\right)\times 1\right), \quad t=1,\ldots\ ,T \quad (4)$$

$$\delta=\left(u_1^t,u_2^t,u_3^t,\ldots,u_T^t\right), \qquad (n\times T) \quad (5)$$

The Wald statistic used to test causation is as follows (Hacker and Hatemi, 2006:).

$$W=(C\beta)'\ [C((Z'\ Z)^{-1})\otimes S_u)\ C'\ ]^{-1})\ (C\beta) \quad (6)$$

The asymmetric decomposition technique developed by Granger and Yoon (2002) was applied by Hatemi (2012) in causality analysis. Hatemi (2012) set out from the following random walk process for causality analysis (Hatemi, 2012: 449).

$$Y_{1t}=Y_{1t-1}+\varepsilon_{1t}=Y_{1,0}+\sum_{i=1}^{t}\varepsilon_{1i} \quad (7)$$

$$Y_{2t}=Y_{2t-1}+\varepsilon_{2t}=Y_{2,0}+\sum_{i=1}^{t}\varepsilon_{2i} \quad (8)$$

Where, Y_{1t} and Y_{2t} show the initial values of $Y_{1,0}$ and $Y_{2,0}$, being two integrated series. In order to examine the causality relationship between the components of the variables, positive and negative shocks are defined as follows.

$$\varepsilon_{1i}^+=\max\left(\varepsilon_{1i},0\right),\varepsilon_{1i}^-=\min\left(\varepsilon_{1i},0\right) \quad (10)$$

$$\varepsilon_{2i}^+=\max\left(\varepsilon_{2i},0\right),\varepsilon_{2i}^-=\min(\varepsilon_{2i},0) \quad (11)$$

The equations for these two variables including positive and negative shocks are formed as follows:

Table 1: Summary of empirical literature review

Authors	Country/country group	Method	Variables	Results
		Studies on the symmetrical assumption		
Alzyoud et al. (2018)	Canada	Johansen Cointegration and VECM	Crude oil prices, exchange rate and stock market return	There is no cointegration relationship between variables. However, the regression analysis results showed that the oil price and exchange rate and their changes have a positive and significant effect on Canadian stock returns
Basher et al. (2018)	Canada, Norway, Russia, Kuwait, Saudi Arabia and UAE	Markov model	World oil supply, global real economic activity, global crude oil stocks, oil prices and stock market indices	Oil price shocks in oil exporting countries have a non-linear relationship with stock returns. Peculiar oil shocks affect stock returns in Norway, Russia, Kuwait, Saudi Arabia and UAE. Oil supply shocks are important for the UK, Kuwait and UAE. Mexico is the only country where stock market returns are not affected by oil market shocks
Phan et al. (2015)	USA	GARCH (1,1)	WTI crude oil prices, index prices of various sectors	Rising oil prices raise oil producers 'stock prices, while lowering oil consumers' stock prices
Filis and Chatziantoniou (2014)	UK, Germany, Italy, Spain, Netherlands, Portugal, Russia, Norway	VAR method	Brent crude oil prices, CPI, short term interest rates, stock market indices	While oil-importing countries' stock markets reacted negatively to the increases in oil prices, the opposite is true for oil-exporting exchanges. The magnitude of responses to changes in oil prices is higher in newly established and/or less liquid stock markets (such as Russia and Norway)
Degiannakis et al. (2013)	EU countries	Diag-VECH GARCH model	Brent crude oil prices, stock market basic and sub-sector indices	There is a time-varying relationship between oil and stock returns for all oil consuming countries
Arouri and Rault (2012)	Bahrain, Oman, Kuwait, Qatar, Saudi Arabia, UAE	Bootstrap panel cointegration and SUR	Stock market indices, OPEC spot prices	There is a long-term and positive relationship between oil prices and the stock markets of the Gulf countries
Al-Fayoumi (2009)	Turkey, Tunisia and Jordan	Johansen cointegration and VECM	Oil prices and stock returns	It is concluded that the change in oil prices in these countries has no effect on stock returns
Gay (2008)	BRIC countries	Box-Jenkins ARIMA model	Exchange rate, oil prices and stock returns	As a result of the analysis, no relationship was found between oil prices and stock returns
		Studies on the asymmetric assumption		
Al-hajj et al. (2018)	Malaysia	Nonlinear ARDL	Oil price, basic and sub-sector indices, interest rate, exchange rate, industrial production index, and inflation	He concluded that oil price shocks negatively affect stock market returns. It has shown that the Malaysian stock exchange is very sensitive to fluctuations in oil prices. In addition, the findings found a long-term asymmetric link between oil price shocks, interest rate, exchange rate, industrial production, inflation and stock market returns in most cases, both at the aggregate and industry level
Benkraiem et al. (2018)	England, Germany, France and Italy	Quantile ARDL model	WTI oil prices and stock market indices	The findings show that the distinction between short and long term, quantities and countries is of particular importance
Narayan and Gupta (2015)	USA	Linear regression models	S&P 500 stock index, positive and negative WTI crude oil price returns	Negative changes in oil prices provide a better forecast of stock prices compared to positive changes
Broadstock et al. (2014)	Japan, India, Korea, Taiwan	CAPM-GARCH	WTI Crude oil prices, Japan, India, Korea, Taiwan basic and sub-stock market indices	Stock exchanges are more responsive to increases in oil prices (eg Tokyo, Korea and Taiwan)
Wang et al. (2013)	9 oil importers and 7 oil exporters	VAR model	WTI oil prices, industrial production, real economic activity index and stock prices	It is concluded that the magnitude, duration and even the direction of the response of stock prices varies depending on whether the country to which it is an oil exporter or importer, and whether the price shock is caused by demand/supply

Source: created by authors

$$Y_{1t} = Y_{1t-1} + \varepsilon_{1t} = Y_{1,0} + \sum_{i=1}^{t}\varepsilon_{1i}^{+} + \sum_{i=1}^{t}\varepsilon_{1i}^{-} \quad (12)$$

$$Y_{2t} = Y_{2t-1} + \varepsilon_{2t} = Y_{2,0} + \sum_{i=1}^{t}\varepsilon_{2i}^{+} + \sum_{i=1}^{t}\varepsilon_{2i}^{-} \quad (13)$$

The positive and negative shocks for the causality test of Hatemi (2012) are generated in cumulative form as follows:

$$Y_{1i}^{+} = \sum_{i=1}^{t}\varepsilon_{1i}^{+}, \quad Y_{1i}^{-} = \sum_{i=1}^{t}\varepsilon_{1i}^{-}, \quad Y_{2i}^{+} = \sum_{i=1}^{t}\varepsilon_{2i}^{+} \quad ve \quad Y_{2i}^{-} = \sum_{i=1}^{t}\varepsilon_{2i}^{-} \quad (14)$$

After this step, to find the causality relationship between positive components with the assumption that $Y_t^{+} = (Y_1^{t^+}, Y_2^{t^+})$, the VAR model with p delay is defined as follows.

$$Y_t^{+} = \alpha + A_1 Y_{t-1}^{+} + \ldots + A_p Y_{t-1}^{+} + u_t^{+} \quad (15)$$

Where, p shows the delay number, Y_t (2×1) size variable vector, and A_r is (2×2) dimensional r-order parameter matrix. Likewise, the causality relationship between negative components can be tested with the following p lagged VAR model with the assumption $Y_t^{-} = \left(Y_{1t}^{-}, Y_{2t}^{-}\right)$.

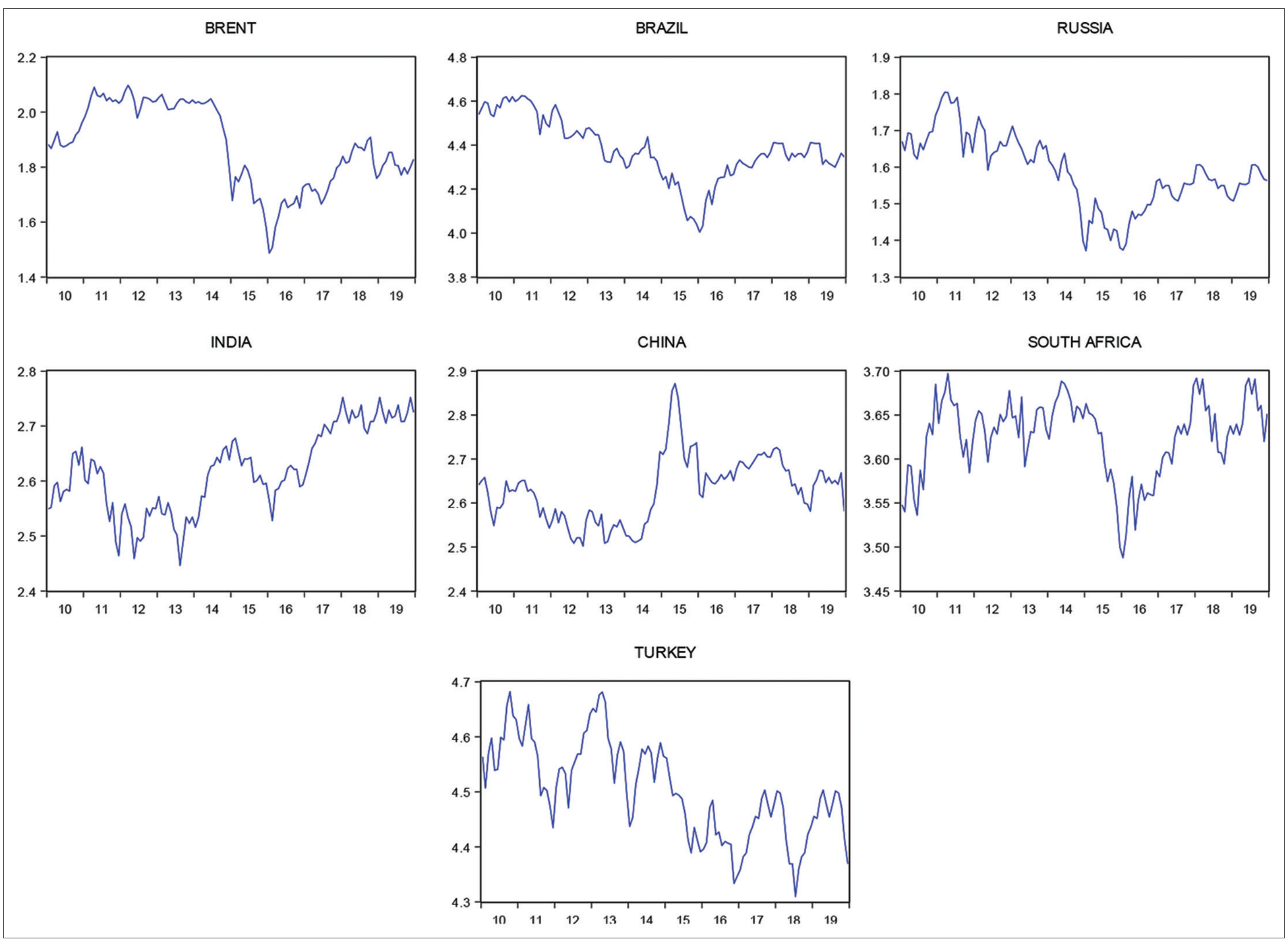
$$Y_t^{-} = \alpha + A_1 Y_{t-1}^{-} + \ldots + A_p Y_{t-1}^{-} + u_t^{-} \quad (16)$$

The Wald statistics to be used for the test are obtained with the help of the VAR model used in the Hacker and Hatemi causality test, and the causality test is performed following the same path.

4. RESULTS

Since the data set is a financial time series, the stationarity structures of the price series and logarithmic return series must first be determined. Since the probability of the occurrence of false relationships in the analyzes made with non-stationary time series will affect the reliability of the estimation results, the stationary condition must be met (Syzdykova et al., 2020). The graph of price series regarding the variables is shown in Figure 1. When the graphics are analyzed, it is observed that all series contain trend movements. On the other hand, the decline in oil prices that started in 2014 is parallel to the decline in the oil exporter Russia,

Figure 1: Graph of price series



Brazil and South Africa stock markets. All series show a fluctuating course in the long run. Based on this effect, it is possible to say that the series is not static.

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were used to determine whether oil prices and stock index series are stable. The hypothesis established for the unit root test will be as follows:

- H_0: Series is not stationary (has a unit root)
- H_1: Series is stationary (has no unit root).

Analysis results of the unit root tests of Brent oil prices and the price and return series of BRICS-T countries' stock markets are summarized in Table 3. Since the t-statistics values obtained as a result of the test for price series are higher than the critical value of MacKinnon at the significance level of 0.10, it was concluded that the price series is not stationary and the series contains unit root. In order to accurately determine the interaction between oil prices and BRICS-T countries' stock markets, their returns must be calculated. For this purpose, the monthly return rates of oil and stock markets are calculated by taking the first logarithmic difference of price indices with the help of the formula below:

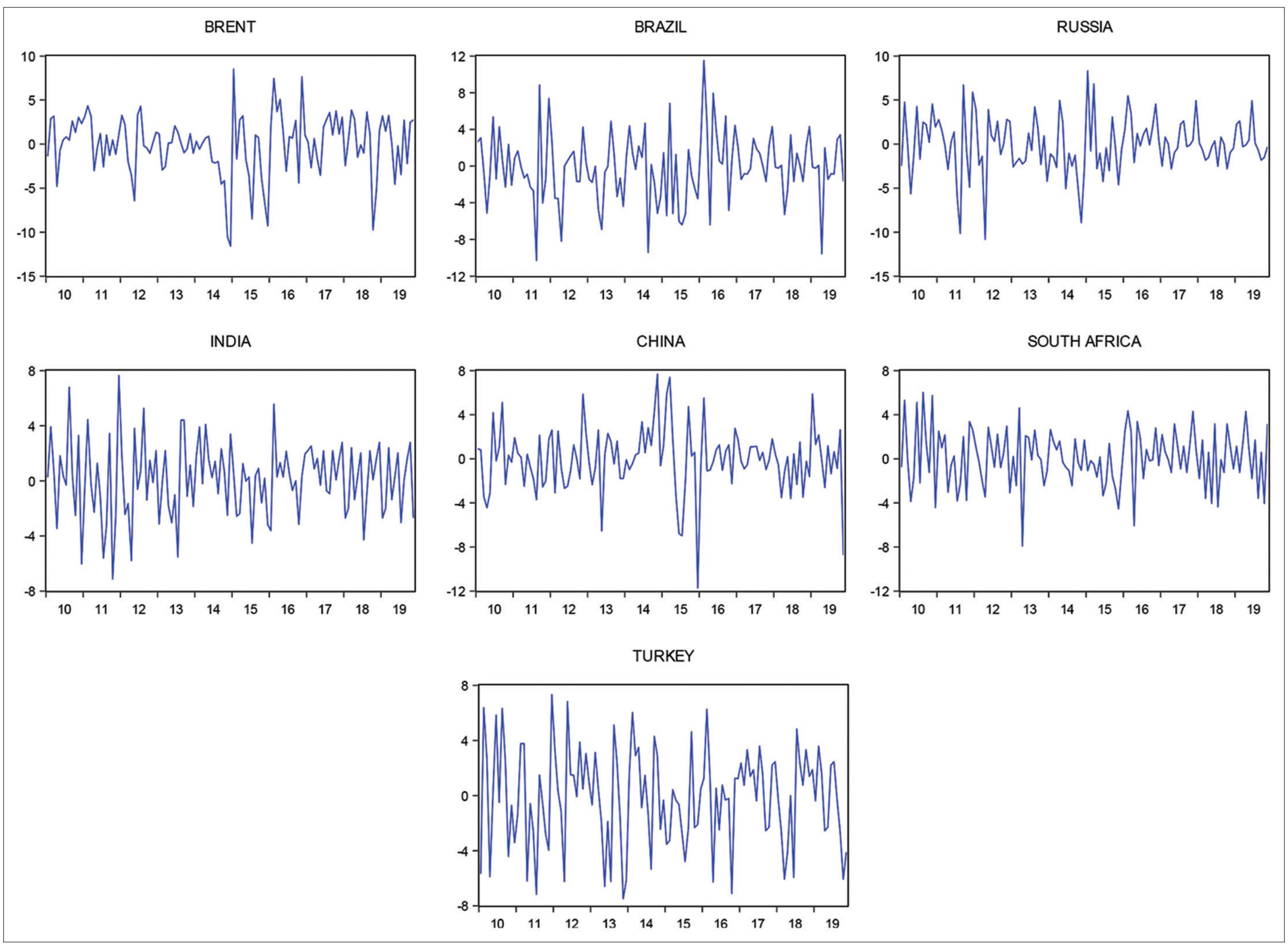
$$R_t = \log\left(\frac{P_t}{P_{t-1}}\right)\times 100 \quad (17)$$

R_t is the monthly return of the oil markets on day t or the stock markets of BRICS-T countries, and P_t indicates the closing value of the index on day t. The purpose of the creation of the yield series is to ensure stability by eliminating the seasonal and trend effect in the financial time series. The graphics of the yield series are shown in the Figure 2.

In the unit root tests for the return series, large negative values were obtained for each case. Considering all return series, the null hypothesis was rejected because the ADF and PP test statistics were higher than the MacKinnon critical values at the 1% significance level in intercept and trend and intercept models, and therefore the return series was determined to be stationary. All variables have unit roots in price series values and are stationary in return series values (Table 2).

After this stage, the causality relationships between the series were examined with symmetric and asymmetric causality tests. Table 3 shows the results of symmetrical and asymmetrical

Figure 2: Graph of return series



causality from oil price to stock price. Accordingly, a causality relationship from oil price to stock price has been determined in all BRICS-T countries. In addition, the asymmetrical relations determined between the variables can be explained as follows: (i) According to the asymmetric causality result for Brazil, there is a causality relationship between the positive shocks from oil price to stock price, but not for negative shocks. (ii) There is no asymmetric relationship between variables in Russia and South Africa, the relationship is symmetrical. (iii) A causality relationship from oil price to stock price has been identified for both positive and negative shocks for India and China. (iv) There was no symmetrical relationship between the variables for Turkey. Asymmetrically, a causality relationship between specific shocks from oil price to stock price has been found.

Table 4 shows the results of symmetrical and asymmetrical causality from stock price to oil price in BRICS-T countries. According to the results, there is no symmetrical relationship from stock price to oil price in any of the BRICS-T countries. Asymmetric causality are as follows: (i) Brazil, an asymmetric relationship between variables is not the case for South Africa and Turkey. (ii) There is a causality relationship from stock price to oil price among positive shocks at the 10% significance level for Russia. There is no causality relationship between negative shocks. (iii) A causality relationship from stock price to oil price has been identified for negative shocks in India and China.

Table 5 summarizes the symmetric and asymmetric causality test results. Accordingly, hidden relationships that could not be

Table 2: Unit root test results

Variables	Price Series		Return Series	
	ADF	PP	ADF	PP
Brent				
Intercept	–1.6306	–1.6150	–8.1558*	–8.1504*
Trend and intercept	–2.4816	–2.5033	–8.208*	–8.2171*
Brazil				
Intercept	–1.1569	–1.6590	–11.942*	–11.331*
Trend and intercept	–1.3481	–1.2322	–11.143*	–11.402*
Russia				
Intercept	–1. 1456	–1.8223	–10.419*	–10.887*
Trend and intercept	–1.5715	–1.6039	–10.509*	–10.855*
India				
Intercept	–1.6419	–1.6107	–12.122*	–12.103*
Trend and intercept	–1.7462	–1.8248	–12.117*	–12.113*
China				
Intercept	–1.7532	–1.7478	–10.951*	–10.942*
Trend and intercept	–2.2126	–2.1295	–10.002*	–10.011*
South Africa				
Intercept	–1.6403	–1.5335	–12.444*	–12.010*
Trend and intercept	–2.405	–2.4222	–12.469*	–12.062*
Turkey				
Intercept	–2.0202	–2.0364	–10.084*	–10.135*
Trend and intercept	–2.2105	–2.3345	–10.106*	–10.122*
MacKinnon P–value		1%	5%	10%
Intercept		–3.4865	–2.8860	–2.5799
Trend and intercept		–4.0369	–3.4480	–3.1491

*İs statistically significant at 99% confidence level

Table 3: Symmetric and asymmetric causality test results (oilp→stockp)

Countries	Hypothesis	Wald stat.	1%	5%	10%
Brazil	$oilp \nrightarrow stockp$	7.709**	11.603	5.302	3.679
	$oilp^{+}stockp^{+}$	11.911***	10.540	5.529	3.773
	$oilp^{-}stockp^{-}$	0.473	14.707	9.155	5.632
Russia	$oilp \nrightarrow stockp$	17.170***	9.541	5.003	3.615
	$oilp^{+} \nrightarrow stockp^{+}$	20.045	11.837	5.090	3.626
	$oilp^{-} \nrightarrow stockp^{-}$	6.641	13.333	5.921	3.191
India	$oilp \nrightarrow stockp$	3.260	9.433	5.078	3.693
	$oilp^{+} \nrightarrow stockp^{+}$	5.553**	8.031	4.228	2.928
	$oilp^{-} \nrightarrow stockp^{-}$	5.305**	7.394	3.853	2.806
China	$oilp \nrightarrow stockp$	2.264	9.968	5.244	3.770
	$oilp^{+} \nrightarrow stockp^{+}$	2.965***	9.487	5.818	3.330
	$oilp^{-} \nrightarrow stockp^{-}$	9.502**	11.843	8.075	6.323
South Africa	$oilp \nrightarrow stockp$	19.005***	9.637	5.151	3.636
	$oilp^{+} \nrightarrow stockp^{+}$	47.347	13.365	7.283	3.573
	$oilp^{-} \nrightarrow stockp^{-}$	19.279	13.840	7.093	5.020
Turkey	$oilp \nrightarrow stockp$	34.205	9.817	5.150	3.653
	$oilp^{+} \nrightarrow stockp^{+}$	23.207**	7.559	4.142	2.928
	$oilp^{-} \nrightarrow stockp^{-}$	15.323	13.769	7.305	3.936

↛ İndicates no causation. *, ** and *** show the existence of a causality relationship between series at 1%, 5% and 10% significance levels, respectively

Table 4: Symmetric and asymmetric causality test results (stockp→oilp)

Countries	Hypothesis	Wald stat.	1%	5%	10%
Brazil	$stockp \nrightarrow oilp$	0.020	11.138	5.377	3.728
	$stockp^{+} \nrightarrow oilp^{+}$	6.756	11.084	5.483	3.738
	$stockp^{-} \nrightarrow oilp^{-}$	0.309	18.811	7.522	3.769
Russia	$stockp \nrightarrow oilp$	0.295	8.684	5.257	3.635
	$stockp^{+} \nrightarrow oilp^{+}$	3.075*	8.766	5.052	2.810
	$stockp^{-} \nrightarrow oilp^{-}$	2.770	10.838	5.741	3.008
India	$stockp \nrightarrow oilp$	0.412	8.388	5.027	3.725
	$stockp^{+} \nrightarrow oilp^{+}$	0.432	7.680	3.850	3.301
	$stockp^{-} \nrightarrow oilp^{-}$	3.004**	7.743	4.345	2.693
China	$stockp \nrightarrow oilp$	5.966	8.882	5.278	3.773
	$stockp^{+} \nrightarrow oilp^{+}$	0.674	8.838	5.370	3.553
	$stockp^{-} \nrightarrow oilp^{-}$	26.076***	13.280	8.450	3.570
South Africa	$stockp \nrightarrow oilp$	3.266	8.518	5.255	3.637
	$stockp^{+} \nrightarrow oilp^{+}$	1.366	8.546	5.735	2.862
	$stockp^{-} \nrightarrow oilp^{-}$	6.192	11.508	5.973	3.856
Turkey	$stockp \nrightarrow oilp$	0.131	8.561	5.170	3.638
	$stockp^{+} \nrightarrow oilp^{+}$	0.001	6.331	3.715	3.791
	$stockp^{-} \nrightarrow oilp^{-}$	1.217	15.445	5.510	3.717

↛ İndicates no causation. *, ** and *** show the existence of a causality relationship between series at 1%, 5% and 10% significance levels, respectively

Table 5: Summary of symmetric and asymmetric causality test results

Countries	Symmetrical		Asymmetrical			
			Positive		Negative	
Country	op→sp	sp→op	op→sp	sp→op	op→sp	sp→op
Brazil	✓	✗	✓	✗	✗	✗
Russia	✓	✗	✗	✓	✗	✗
India	✗	✗	✓	✗	✓	✓
China	✗	✗	✓	✗	✓	✓
South Africa	✓	✗	✗	✗	✗	✗
Turkey	✗	✗	✓	✗	✗	✗

op is oil price, sp is stock price

detected using the symmetric causality test were revealed with the help of the asymmetric causality test.

5. CONCLUSION

In this study, the relationship between Brent crude oil prices and stock prices is analyzed using the January 2010-December 2019 period data for BRICS-T countries. Symmetric and asymmetric causality tests were used to compare the causality results of the relationships between variables. According to the asymmetric causality results, the results are as follows: (i) Asymmetric causality relationship from oil price to stock price; Brazil, and the positive shock for Turkey, India and China relations said to have been detected in both positive and negative shocks. (ii) An asymmetric causality relationship from the stock price to the oil price was determined among the positive shocks in Russia, while it was determined among the negative shocks in India and China.

As a result, considering that the responses of economic variables to positive and negative shocks may be different, it is observed that symmetrical tests are insufficient in revealing the causality relationships between variables such as oil prices and stock prices. In this case, a test that can distinguish the responses of variables to economic shocks should be used. Therefore, using asymmetric tests instead of symmetric tests in economic and financial time series where volatility is high is of great importance in order to obtain more reliable results. The combination of symmetric and asymmetric causality test to compare the results in the study separates the study from the existing studies in the literature. This situation can be seen as a positive contribution of the study to the literature.

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