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Volatility Spillovers between Oil Prices and Stock Returns in Developing Countries

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ABSTRACT

Risk and uncertainty have always been an important issue for investors, researchers and policymakers. Thus, the explanation of the mechanism of spreading volatility between different markets has been the focus of attention by researchers. Determining the return and volatility interaction between oil prices and stock markets will be useful not only for pricing and hedging financial assets, but also for detecting and interpreting the reflection of the problems arising in the oil industry on the country's economies. In this study, the VAR-GARCH model introduced by Ling and McAleer (2003) was used to determine the interaction between oil prices and stock markets in terms of return and volatility for developing countries (BRICS-T). The reason for choosing this model is to reveal whether the shocks and volatility in these markets have a transitional effect.

Keywords: Oil Price, Stock Return, Volatility Spillovers, VAR-GARCH Model
JEL Classifications: G11, G15, Q4

1. INTRODUCTION

The oil markets in the world are known as the deepest markets in terms of the volume of transactions realized in terms of their positions. On the other hand, oil is the input material of most enterprises and factories. Therefore, any fluctuation in the oil markets affects the prices of the products produced and reflects on the stock markets. This means that there is a close relationship between capital markets and oil markets.

The share of oil in the total energy consumption in the world constitutes an undeniably large proportion. As of 2018 and 2019, 33.2% and 33.05% of the total amount of energy consumed worldwide were met from petroleum resources, respectively (BP, 2020). In fact, the fact that approximately one third of the amount of energy consumed is met from petroleum resources is an indicator that industry, production and other sectors are largely dependent on oil. Therefore, the fluctuations in the prices of oil, which has an important role as the main input of most production sectors, due to various reasons will affect the rates of return of the relevant sectors and affect the market values. When viewed rationally, the reduction of GDP by oil shocks will cause economies to shrink and as a natural result of this, the economic balances will be broken by triggering the inflation rate. Therefore, changing macroeconomic variables will indirectly affect capital markets and stock markets throughout the country.

Studies investigating the relationship between oil price movements and macroeconomic variables are more frequently encountered in the literature. In studies investigating the relationship between oil prices and stock markets, it has been found that there is generally a positive relationship between oil markets and stock markets (Sadorsky, 1999; Sadorsky, 2001; El-Sharif et al., 2005; Lescaroux and Mignon, 2008; Bjornland, 2009; Mendoza and Vera, 2010; Wang et al., 2013; Hanif, 2020). In some other studies, the existence of a negative relationship between oil markets and stock markets has been advocated (Filis, 2010; Filis et al., 2011; Cunado and Gracia Perez, 2014). In recent years, studies arguing that oil prices affect stock prices asymmetrically have increased (Tsai, 2015; Narayan and Gupta, 2015; Syzdykova, 2018; Mokni, 2020; Chang, 2020; Chang et al., 2020).

When looking at the shocks and crises experienced in the oil market in recent years, it is seen that it has reached regional even global dimensions due to the contamination effect. The spreading mechanism of this effect, also known as the domino effect, has been a matter of curiosity. This has led to the investigation of issues such as the causes of volatility, its effect and the mechanism of spreading. In this study, the interaction between oil markets and stock markets is analyzed with the help of the VAR-GARCH model introduced by Ling and McAleer (2003). The reason for choosing this model is to reveal whether the shocks and volatility in these markets have a transitional effect. For this purpose, the relationship between the stock markets of developing countries and oil markets has been investigated.

2. LITERATURE REVIEW

Studies examining the relationship between oil price and stock markets on the basis of country or country groups differ from each other in terms of their results. In the literature, concepts such as interaction, transmission, propagation, and pass-through are used to express the relationship between cross markets.

Malik and Hammoudeh (2007) reported the existence of volatility and shock interaction between the oil market (WTI) and the stock market of the USA and three different Gulf countries (Bahrain, Kuwait and Saudi Arabia) with data for the period between February 14, 1994 and December 25, 2001. They researched it with the GARCH model. The authors found evidence that there is a significant relationship between the oil market and the second moment of the US stock market, and that there is a volatility interaction from the oil market to the stock market in Bahrain, Kuwait and Saudi Arabia in all circumstances. In addition, the researchers, stating that there is volatility interaction from the Saudi Arabian stock market to the oil market, state that the news and shocks in the US stock market affect the stock market volatility of the Gulf countries.

Driesprong et al. (2008), using daily data for the period between October 1973 and April 2003, examined the interaction between the stock market returns of developed and developing countries and oil prices with the GARCH model. The researchers stated that if oil prices increase compared to the previous month, stock market returns tend to decrease, and if oil prices decrease, stock market returns tend to increase, because investors react to information about the oil price. However they found that an increase in oil prices would greatly reduce stock market returns in the upcoming period. The findings obtained show that oil prices allow us to make predictions for stock market returns, and this prediction is more meaningful and powerful for developed country stock markets.

Constantinos et al. (2010) investigated the yield interaction between the Greek stock market and oil prices with the VAR model and the volatility interaction with the EGARCH model. The authors identified a positive and statistically significant causal effect from oil price returns and oil price volatility to stock market returns. Also, it is determined that there is a bidirectional causality relationship between stock market returns and stock market volatility.

Chang et al. (2013), using CCC-GARCH, DCC-GARCH, VARMA-GARCH and VARMA-AGARCH models, investigated the conditional correlation and volatility interaction between spot, futures and forward oil returns and FTSE 100, NYSE, Dow Jones and S&P 500 index returns. The researchers, based on the daily data of January 1998 - November 2009, found that the conditional correlation estimated for returns between markets according to the CCC model is low and not statistically significant, and the conditional correlation estimated in the DCC model is significant. Although the VARMA-GARCH and VARMA-AGARCH models provide less information about the volatility interaction between markets; The asymmetric effect of equally sized positive and negative Shocks on conditional variance shows that the VARMA-AGARCH model is a more effective model.

Hamma et al. (2014) examined the relationship between oil prices (WTI and Brent) and the Tunisian Stock Exchange (Tunindex) industry indices and the volatility interaction with multivariate GARCH models (BEKK, VEC, CCC-GARCH). They aimed to determine the rate of protection and the best prevention strategy. As a result of the analysis, they determined that there is a one-way relationship from the petroleum market to the Tunisian Stock Exchange, that the sector's stock returns are affected by the stock market volatility and the oil markets, and the BEKK-GARCH method is the most effective method to minimize the risk of the portfolio of oil and stocks.

Gomes and Chaibi (2014) examined the shock and volatility interaction between 21 frontier markets and oil prices using the bivariate BEKK-GARCH(1,1) model. The authors used weekly returns from February 8, 2008 to February 1, 2013, as a result they found a significant shock and volatility spread between oil prices and some markets. Moreover, this spillover effect is bi-directional for some markets.

Khalfaoui et al. (2015) investigated the volatility interaction between oil prices and the stock markets of G-7 countries (USA, Germany, France, England, Italy, Japan and Canada) with daily data for the period between 2 June 2003 and 7 February 2012. The authors have obtained strong evidence that volatility changes over time for markets examined with the BEKK-GARCH model. They determined that oil prices and stock market prices were directly affected by their own news and volatility, and indirectly by other market price volatility.

Ewing and Malik (2016) studied the volatility interaction between oil prices and US stock market prices using univariate and bivariate GARCH models, including structural breaks, in their study based on daily data for the period between 1 July 1996 and 30 June 2013. According to the research findings; When the structural breaks in the variance in the model are ignored, the researchers stated that there is no volatility interaction between oil prices and the US stock market, and after the structural breaks were calculated in the model, they found a strong volatility interaction between the two markets.

Yu et al. (2020) investigated the volatility interaction between the crude oil market (WTI) and the US and Chinese stock markets with data for the 1991-2016 period. In the study in which VAR-BEKK-GARCH method was used; It has been determined that the oil market triggered rapid and continuous fluctuations in market dependencies, which emerged most sharply after the 2008 Financial Crisis and showed the increasing interdependence between oil and stock markets.

Sarwar et al. (2020) analyzed the volatility spread between oil prices and the stock exchanges of Karachi, Shanghai and Bombay using the bivariate BEKK-GARCH model with data for the period 1997-2014. The study looks at the role of spreading volatility in different economic scenarios by dividing it into pre and post-crisis periods. According to the results of the study, there is no significant difference between the spread between oil prices and stock markets, and the spread before and after the crisis. On the other hand, the estimated results vary according to the data frequencies used (daily, weekly and monthly).

3. DATA SET AND METHODOLOGY

3.1. Data

Different indices are used for oil prices at the international level. In this study, European brent spot prices are used for crude oil prices per barrel. Representing the developing countries in the study; Brazil (iBovespa), Russia (MICEX), India (SENSEX), China (Shanghai), South Africa (JALSH) and Turkey (BIST 100) have been selected exchanges. The data of the stock market indices of the countries were obtained from the Bloomberg database and the oil price data from the US Energy Information Agency. Between January 2010 and December 2019, logarithmic return series were created based on monthly data and analyzes were carried out using Eviews and Stata package programs.

3.2. Method: Bivariate VAR (1) - GARCH (1,1) Model

The model introduced by Ling and McAleer (2003) has some important advantages over traditional multivariate GARCH models. In the implementation of this model, there is less complexity in calculation and estimation compared to other volatility pass-through models. It also follows a very flexible process in explaining the mutual conditional effects and volatility pass-through between different series. In particular, the VAR (1) - MGARCH (1.1) model has recently confirmed its power in revealing the mutual volatility pass-through between different markets.

Based on the VAR (1) - MGARCH (1,1) model regarding the basic stock market index returns of developing countries included in the study and oil price returns, the conditional average equation has the following properties for each series:

$$\begin{cases} R_t = \mu + \phi R_{t-1} + \varepsilon_t \\ \varepsilon_t = H_t^{1/2}\eta_t \end{cases} \tag{1}$$

Where, $R_t = (r_t^{stock}, r_t^{oil})'$, r_t^{stock} ve r_t^{oil} denote stock and oil price index return vectors, respectively. In the conditional mean equation, ϕ representing the coefficients consists of a 2X2 dimensional diagonal matrix $\phi = \begin{pmatrix} \phi_1 & 0 \\ 0 & \phi_2 \end{pmatrix}$.

$\varepsilon_t = (\varepsilon_t^{stock}, \varepsilon_t^{oil})'$, ε_t^{stock} and ε_t^{oil} shows the error terms vector obtained from the conditional average equations of sub-stock market index returns and oil price index returns, respectively. $\eta_t = (\eta_t^{stock}, \eta_t^{oil})'$ denotes the random errors vector showing an independent and homogeneous distribution (i, i, d).

$$H_t = \begin{pmatrix} H_t^{stock} & H_t^{stock-oil} \\ H_t^{stock-oil} & H_t^{oil} \end{pmatrix}$$

forms the conditional variance matrix of stock and oil returns. Based on the above definitions, r_t^{stock} and r_t^{oil} equations are as follows:

$$\begin{bmatrix} r_t^{stock} \\ r_t^{oil} \end{bmatrix} = \begin{bmatrix} \mu^{stock} \\ \mu^{oil} \end{bmatrix} + \begin{bmatrix} \phi_1 & 0 \\ 0 & \phi_2 \end{bmatrix} \begin{bmatrix} r_{t-1}^{stock} \\ r_{t-1}^{oil} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^{stock} \\ \varepsilon_t^{oil} \end{bmatrix}$$
$$\begin{bmatrix} r_t^{stock} \\ r_t^{oil} \end{bmatrix} = \begin{bmatrix} \mu^{stock} \\ \mu^{oil} \end{bmatrix} + \begin{bmatrix} \phi_1 r_{t-1}^{stock} \\ \phi_2 r_{t-1}^{oil} \end{bmatrix} + \begin{bmatrix} \varepsilon_t^{stock} \\ \varepsilon_t^{oil} \end{bmatrix} \tag{2}$$

From the simplification of the above matrices, the conditional average equations of stock and oil price returns are obtained as follows:

$$\begin{cases} r_t^{stock} = \mu^{stock} + \phi_1 r_{t-1}^{stock} + \varepsilon_t^{stock} \\ r_t^{oil} = \mu^{oil} + \phi_2 r_{t-1}^{oil} + \varepsilon_t^{oil} \end{cases} \tag{3}$$

Also, when coefficient matrices for variance equations are defined as:

$$A = \begin{bmatrix} r_t^{stock} \\ r_t^{oil} \end{bmatrix} \begin{pmatrix} \alpha_{stock1}^2 & \alpha_{stock2}^2 \\ \alpha_{oil2}^2 & \alpha_{oil1}^2 \end{pmatrix} \text{and } B = \begin{bmatrix} r_t^{stock} \\ r_t^{oil} \end{bmatrix}$$
$$\begin{pmatrix} \beta_{stock1}^2 & \beta_{stock2}^2 \\ \beta_{oil2}^2 & \beta_{oil1}^2 \end{pmatrix} \tag{4}$$

h_t^{stock}, h_t^{oil} and $h_t^{stock-oil}$ equations can be obtained as follows:

$$\begin{bmatrix} h_t^{stock} \\ h_t^{oil} \end{bmatrix} = \begin{bmatrix} c_{stock}^2 \\ c_{oil}^2 \end{bmatrix} + \begin{bmatrix} \alpha_{stock1}^2 & \alpha_{stock2}^2 \\ \alpha_{oil2}^2 & \alpha_{oil1}^2 \end{bmatrix} \begin{bmatrix} \left(\varepsilon_{t-1}^{stock}\right)^2 \\ \left(\varepsilon_{t-1}^{oil}\right)^2 \end{bmatrix}$$
$$+ \begin{bmatrix} \beta_{stock1}^2 & \beta_{stock2}^2 \\ \beta_{oil2}^2 & \beta_{oil1}^2 \end{bmatrix} \begin{bmatrix} h_{t-1}^{stock} \\ h_{t-1}^{oil} \end{bmatrix}$$
$$\begin{bmatrix} h_t^{stock} \\ h_t^{oil} \end{bmatrix} = \begin{bmatrix} c_{stock}^2 \\ c_{oil}^2 \end{bmatrix} + \begin{bmatrix} \alpha_{stock1}^2 \left(\varepsilon_{t-1}^{stock}\right)^2 + \alpha_{stock2}^2 \left(\varepsilon_{t-1}^{oil}\right)^2 \\ \alpha_{oil2}^2 \left(\varepsilon_{t-1}^{stock}\right)^2 + \alpha_{oil1}^2 \left(\varepsilon_{t-1}^{oil}\right)^2 \end{bmatrix}$$
$$+ \begin{bmatrix} \beta_{stock1}^2 h_{t-1}^{stock} + \beta_{stock2}^2 h_{t-1}^{oil} \\ \beta_{oil2}^2 h_{t-1}^{stock} + \beta_{oil1}^2 h_{t-1}^{oil} \end{bmatrix} \tag{5}$$

From the simplification of the above matrices, the conditional equations of variance of stock sectors and oil price returns are obtained as follows:

$$h_t^{stock} = c_{stock}^2 + \alpha_{stock1}^2 \times \left(\varepsilon_{t-1}^{stock}\right)^2 + \alpha_{stock2}^2 \times \left(\varepsilon_{t-1}^{oil}\right)^2$$
$$+\beta_{stock1}^2 \times h_{t-1}^{stock} + \beta_{oil2}^2 \times h_{t-1}^{oil} \quad (6)$$

$$h_t^{oil} = c_{oil}^2 + \alpha_{oil1}^2 \times \left(\varepsilon_{t-1}^{oil}\right)^2 + \alpha_{oil2}^2 \times \left(\varepsilon_{t-1}^{stock}\right)^2$$
$$+\beta_{oil2}^2 \times h_{t-1}^{stock} + \beta_{oil1}^2 \times h_{t-1}^{oil} \quad (7)$$

As can be seen in (6) and (7), the quadratic inclusion of all coefficients in the variance equations provides the positivity of the equations. It is assumed here that negative and positive shocks of equal magnitude have the same effects on conditional variances. Depending on the time, volatilities in stock and oil markets for period t are directly affected by the delays of their shocks $\left[\left(\varepsilon_{t-1}^{stock}\right)^2, \left(\varepsilon_{t-1}^{stock}\right)^2\right]$ and indirectly by the lagged shocks of each other. In addition, the volatilities in the said markets are affected by both their own volatility (h_{t-1}^{stock} ve h_{t-1}^{oil}) and reciprocal lagged volatility. Therefore, this model has a more advantageous position in analyzing possible volatilities in terms of dynamic shocks and volatilities in the market.

In order to guarantee stationarity in VAR (1) - bivariate GARCH (1,1) model, the roots of the $\left|I_2 - AL - BL\right| = 0$ equation must remain outside the unit circle. Here L is the polynomial delay value and I_2 is the 2 × 2 dimensional unit matrix. In this model, ρ is taken as the constant conditional correlation independent of time. Therefore, taking into account ρ, it is possible to explain the conditional common variance between these bilateral markets as follows:

$$h_t^{stock-oil} = \rho \times \sqrt{h_t^{stock}} \times \sqrt{h_t^{oil}} \quad (8)$$

Although the constant conditional correlation assumption is seen as a restrictive assumption under changing economic conditions, the statistical properties for the dynamic conditional correlation for the VAR-MGARCH model have not yet been analyzed theoretically. However, it has been emphasized in previous studies that this model is a possible model in terms of providing the permanence of long-term fluctuations and the transmission of volatility and shock between oil and stock markets included in the study. The parameters of the bivariate VAR (1) -GARCH model used as the basic model are estimated by the quasi-maximum likelihood method. The Quasi-maximum likelihood method is a robust method against all kinds of deviation and convergence problems in normality conditions (Ling and McAleer, 2003).

4. RESULTS

In this study, which investigates the shock and volatility spread between oil markets and stock markets in developing countries, first some basic statistics are included. First of all, descriptive statistics and correlation table of the variables were presented and then the stationarity of the variables was examined with the unit root test.

From the descriptive statistics in Table 1, it is seen that the average return of Brent oil is higher than all other developing countries except Brazil. However, it also appears to be even more risky. For this reason, those who will invest in this market should closely monitor the variables that affect oil prices, the policies followed and the existence of the markets it is affected by. In addition, whether the riskiness in oil markets spreads to stock markets or not is important for stock investors.

Looking at the correlation relationship in Table 2; compared to other countries, it is seen that a high correlation between the India-Brazil-Turkey and Turkey. In addition, it is seen that the country with high correlation with the oil price is Russia, followed by Brazil. After basic statistics, we will look at the stationarity of variables. It is important that the variables are stationary in order to avoid spurious regression in the models

Table 1: Descriptive statistics

	Brent	Brazil	Russia	India	China	South Africa	Turkey
Mean	−0.045130	−0.162836	−0.089348	0.147743	−0.050594	0.087180	−0.163553
Median	0.473759	−0.114509	−0.205055	0.269789	−0.024328	−0.077921	0.000000
Maximum	8.511181	11.50221	8.289696	7.643441	7.667250	6.001519	7.311989
Minimum	−11.57025	−10.27799	−10.82758	−7.128142	−11.72918	−7.919362	−7.489669
SD	3.457602	3.745150	3.189083	2.680377	2.922102	2.566163	3.505569
Skewness	−0.797760	−0.040906	−0.345481	−0.091206	−0.480121	−0.188313	−0.176999
Kurtosis	4.464080	3.677143	4.338015	3.222459	5.410388	3.054474	2.447288

Table 2: Correlation matrix

	Brent	Brazil	Russia	India	China	South Africa	Turkey
Brent	1	0.3198	0.4674	0.1534	0.1918	0.1160	0.1116
Brazil	0.3198	1	0.6148	0.5512	0.3377	0.4473	0.4773
Russia	0.4674	0.6148	1	0.4174	0.2566	0.4039	0.3911
India	0.1534	0.5512	0.4174	1	0.2131	0.3989	0.4935
China	0.1918	0.3377	0.2566	0.2131	1	0.0751	0.2577
South Africa	0.1160	0.4473	0.4039	0.3989	0.0751	1	0.4172
Turkey	0.1116	0.4773	0.3911	0.4935	0.2577	0.4172	1

used in the study. Misleading results are obtained when experimental analysis is performed between non-stationary series (Syzdykova et al., 2021). For this reason, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were applied to test stationarity in the study.

In Table 3, it is seen from the ADF and PP unit root test results that all return series are stable at level value and 99% reliability level. The results of the VAR (1) - GARCH (1,1) model that will measure the impact of shock and volatility spillover between oil markets and stock markets after stabilization are presented in Table 4.

Table 4 shows the results of VAR (1) -GARCH (1,1) estimates made for developing countries. Looking at the average equation results, it is seen that the lagged value of oil returns has an effect on the stock market indices of all countries except Russia. This effect Brazil and South Africa while creating a positive impact on stock index returns, India, China and Turkey constitute a negative impact on stock market index returns. That increase in the return of oil to China, Turkey and India while decreasing returns in the stock market, causing an increase in yields in Brazil and South Africa markets. The obvious conclusion from this is that the increase in oil returns in oil-importing developing countries has a negative effect. In Turkey, South Africa, Brazil and India, equity returns are affected by both self-and oil returns. The impact of oil returns in Turkey and India is seen to be greater than the impact of stock returns. The impact of stock returns in South Africa is greater than the impact of oil returns. In China, however, it seems that only oil returns have an effect on stock returns.

In the conditional variance equation, when the persistence degree of short term shocks is examined, it is seen that the permanence degree of short term oil shocks in Russia (0.3349) and the degree of permanence of stock shocks (0.3045) is higher. Stock shocks are more effective in all other countries. While the persistence of short-term oil shocks is low in South Africa and China, this effect is stronger in other countries.

According to the shock and volatility pass-through results, the shock pass-through from the stock market to the oil markets was determined only in China. A shock that will occur in the stock markets of other countries has no significant effect on the oil markets. South of shocks in the oil market in Africa, China, and Russia were identified significant effect on Turkey. Oil markets, volatility when the stock market right pass-through only examined were found to be a positive influence in Turkey and Brazil.

In the conditional variance equation, it is seen that the ARCH and GARCH coefficients are significant in all countries except India. In these countries, it is observed that the previous period shock and volatility had a strong impact on both the stock and oil markets in the current period. Past shocks are changing the volatility of developing countries more rapidly. Looking at the GARCH coefficients, it is seen that the volatility in the past period has a strong effect on the current period in all countries except India. It is seen that the fixed conditional correlation coefficients are significant in all countries. This indicates the relationship between oil markets and stock markets. However, the coefficients obtained are generally small values.

Table 3: Unit root test results

	ADF unit root test		PP unit root test	
	Intercept	Trend and intercept	Intercept	Trend and intercept
Brent	−8.453586*	−8.420041*	−8.251997*	−8.211873*
Brazil	−11.05401*	−11.05208*	−11.06099*	−11.06110*
Russia	−10.38852*	−10.34535*	−10.62113*	−10.57288*
India	−10.28590*	−10.27440*	−12.30450*	−12.27718*
China	−9.162510*	−9.116206*	−9.071232*	−9.022504*
South Africa	−13.94756*	−13.91233*	−14.15977*	−14.12797*
Turkey	−9.677585*	−9.657140*	−9.717914*	−9.681629*
Test critical values				
1% level	−3.486551	−4.037668	−3.486551	−4.037668
5% level	−2.886074	−3.448348	−2.886074	−3.448348
10% level	−2.579931	−3.149326	−2.579931	−3.149326

*Is statistically significant at 99% confidence level

Table 4: VAR (1) - GARCH (1,1) estimation results

	Brazil		Russia		India		China		South Africa		Turkey	
	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock
Conditional mean equation												
Constant	0.1329*	−0.1287	0.0719	0.1870*	0.2009	−0.0531	0.1034*	0.0310	0.1309*	0.0305	0.1397*	0.2401
Oil (1)	0.0290	0.1520*	0.0345	0.0230	0.3029*	−0.2034*	−0.0021	−0.2043*	0.1506*	0.1303*	0.0213*	−0.1423*
Stock (1)	0.0530	0.1540*	0.0512	0.0408	0.0912	0.2620*	−0.0231	0.0523	0.0941	0.2175*	0.0031	0.1321*
Conditional variance equation												
Constant	0.2095*	0.3213*	0.3003*	0.1601*	2.1390	2.1094	0.0902*	0.0029	0.0690*	0.0421*	0.0312*	0.0897**
$(\varepsilon_{t-1}^{stock})^2$	0.0021	0.4023*	0.0456	0.3045*	−0.2032	0.4560*	0.0901*	0.1306*	0.0612	0.1590	0.0201	0.1009*
$(\varepsilon_{t-1}^{oil})^2$	0.3098*	−0.0071	0.3349**	−0.1025	0.0233	−0.0677	0.0204*	0.0713*	0.0897**	0.0926*	0.1020*	−0.0876*
$\varepsilon_{t-1}^{stock})$	0.1087	0.5023*	0.0032	0.6710*	−0.2787	0.4054	−0.7307	0.6087*	0.6012	0.7634*	0.1200	0.7891**
$(\varepsilon_{t-1}^{oil})$	0.6256*	0.2304**	0.6341*	−0.0765	0.9680	0.0987	0.9267*	1.1230	0.8529*	−0.0207	0.8321*	0.2709*
JB	72.90*	83.05*	45.09*	125.02	52.90*	150.50*	80.34*	90.80*	40.30*	90.24*	60.50*	95.07*
LB-Q (10)	6.5	12.04	10.93	15.05	12.50	8.01	7.8	6.40	20.33*	16.19	6.90	10.02
LBQ2 (10)	7.01	13.90	9.91	11.08	8.05	5.90	8.03	18.07	14.84	10.91	7.90	12.76
Log likelihood	−5090.401		−5502.03		−5003.40		−3605.56		−4802.76		−5809.36	
Akaike	7.9030		8.9035		8.0105		-8.0701		-8.2071		7.9020	
CCC	0.1505*		0.0780*		0.0906*		0.1590		0.1302		0.1401**	

CCC: Constant Conditional Correlation Coefficient, LB: Ljung-Box, JB: Jarque-Bera, (*,**) indicates the rejection of the zero hypothesis at 1%, 5% significance level, respectively

5. CONCLUSION

According to the findings of the study, the significant effect of oil markets on the stock markets of countries except Russia was determined. It has been found to have a positive effect for Brazil and South Africa and a negative effect for other countries. The negative impact in these countries is an indicator of the countries' dependence on oil. Although there is no significant relationship in the Russian market, it is thought that the spillover effect of oil shocks in the Russian market may also affect this market indirectly, though not directly.

It is seen that oil shocks have a significant effect on the stock markets of other countries except India and Brazil. Looking at the volatility spread, no spread from stock markets to oil could be detected. Turkey and Brazil on the other hand the stock market has seen the oil market is right to spread. When the fixed conditional correlation coefficients are examined, it is seen that it is significant in all countries. Since the coefficients are not very large, it can be said that they are not the most important determinant of the stock markets, but one of the important factors.

Addressing the volatility phenomenon against oil prices on the basis of sectors will provide important advantages in presenting different perspectives. Such studies will provide opportunities for investors to create more effective portfolios, as they will provide an opportunity for effective diversification at the international level. In other words, in this case, the sub-sectors will present a more Transparent perspective for researchers and investors by demonstrating their direct reactions to oil Shocks according to their structural characteristics. This will provide additional information on building effective portfolios.

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