# Asymmetric Impacts of the Geopolitical Risk on the Oil Price Fluctuations

**Oguzhan Ozcelebi and Kaya Tokmakcioglu**

**Abstract** In this study, the vector autoregression (VAR) model framework is enhanced by the incorporation of nonlinear effects. More specifically, this study employs a nonlinear VAR model for the post-global financial crisis (GFC) period, and thus, the impacts of the geopolitical risk on oil futures and volatility are discussed for Israel, Russia, Saudi Arabia, and Turkey. It is found that an increase in geopolitical risk will lead to an increase in oil futures, whereas the geopolitical risk changes in Israel, Saudi Arabia, and Turkey measured by 1, 2, 4, and 10 standard deviation shocks have higher impacts than that of Russia. In the case of Israel, it is revealed that the rise in geopolitical risk may lead to a steady upward trend in oil futures by reducing oil price volatility. Our study highlights the role of Israel, Saudi Arabia, and Turkey in oil prices, and it is suggested that the geopolitical risks of all countries may have symmetrical effects on oil futures. The impact of country-specific geopolitical risk shocks on oil price volatility can be considered asymmetric, and the responses are size-dependent. In this respect, we also show that the global geopolitical risk benchmark index may have an asymmetric impact on oil price volatility.

**Keywords** Oil futures · Oil price volatility · Geopolitical risk · Asymmetry · Censored VAR

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# 1 Introduction

When the economic situation of the Middle Eastern countries is considered, it is acknowledged that the oil-exporting countries in the region will be significantly affected by fluctuations in oil prices. The changes in oil prices are closely related to the macroeconomic performance of oil-importing countries, and it can be assumed that the growth rates of developing countries are also changing the oil demand. A significant portion of the studies in the scientific literature examines the relationship between the macroeconomic financial variables and the oil prices (ElFayoumi 2018; Lorusso and Pieroni 2018). Additionally, the dynamics of the oil market can also be influenced by supply conditions, and the shocks in oil production have significant impacts globally (Balke and Brown 2018; Ewing et al. 2018; Gong and Lin 2018). For instance, a decrease in oil production raises inflation on a worldwide scale via the increase in the production cost. This can be explained by the shift of the Philips curve, which is also due to the geopolitical risks. In this context, it is known that the Arab-Israeli War in 1973 significantly increased oil prices and caused structural breaks in macroeconomic and financial indicators. Therefore, explaining the relationship between geopolitical risks and oil prices will give evidence of the macroeconomic situation.

With the First Gulf War, the importance of the geopolitical risks in the Middle East has re-emerged, and the process has continued with the 9/11 terrorist attacks and with the US invasion of Afghanistan and Iraq. The annexation of Crimea by Russia and the terrorist attacks in various parts of the world, primarily in Paris, caused geopolitical risks to be evaluated within the scope of political science (Bompard et al. 2017; Korotayev et al. 2018). In addition, the Geopolitical Risk index (GPR index) developed by Caldara and Iacoviello (2016) has opened a new dimension in the scientific literature (Antonakakis et al. 2017; Balcilar et al. 2018; Aysan et al. 2019; Cheng and Chiu 2018; Dong et al. 2019; Labidi et al. 2018). On the other hand, there are differences between the economic impacts triggered by the increase and the decrease in geopolitical risks. More specifically, this situation can be analyzed within the scope of the asymmetry concept. In other words, other macroeconomic variables, especially oil prices, may increase geopolitical risks more rapidly and with severe negative reactions, but the decrease in geopolitical risks may not lead to positive responses to the same degree. This has led to the adaptation of the concept of asymmetry in advanced time series models to explain the long-term relationship between geopolitical risks and oil prices. In this study, the effects of positive and negative changes in geopolitical risk on oil futures and volatility are examined based on the approach developed by Kilian and Vigfusson (2011). However, our study differs from previous studies, which stress the GPR index in general, by examining the effects of the country-specific geopolitical risks on oil prices. More specifically, the effects of the geopolitical risk of non-oil producers and the countries that do not have close relations with the Middle East can be neglected. In this study, we used the country-specific GPR index developed by Caldara and Iacoviello (2016) for Israel, Russia, Saudi Arabia, and Turkey to study the asymmetric impacts on the basis of a VAR model with censored variables. Hence, we explore whether changes in the GPR Indices of Israel, Russia, Saudi Arabia, and Turkey have had considerable impacts on oil futures and oil price volatility. Secondly, we compare these results with the impacts of the global benchmark index on oil futures and oil price volatility. In doing so, we intend to address the issue of whether geopolitical risk can be an important determinant of oil price fluctuations. Because geopolitical risks also influence long-term expectations and have a considerable impact on future contracts, the main contribution of our study is that we analyze the asymmetric relationship between the GPR index and the WTI Crude Oil Futures. The GPR index is taken from the study by Caldara and Iacoviello (2016), and WTI crude oil futures and CBOE crude oil ETF volatility data are taken from the statistical database of Thomson Reuters. All series are seasonally adjusted with plausible techniques, and RATS 9.2 routines are used for the empirical exercise.

## 2 Literature Review

In the era of the globalization, the economic policy uncertainty causes significant fluctuations in the macroeconomic situation. One of the important determinants of the economic uncertainty is the political uncertainty which have reached high levels due to the geopolitical risk. In this context, the approach by Azzimonti (2018) differentiated political uncertainty from economic policy uncertainty. One of the main determinants of political uncertainty is the geopolitical risk of the countries, which has significant effects on economic activity. In this context, Cheng and Chiu (2018) estimated the structural vector autoregression (SVAR) model for 38 developing countries, assuming that global geopolitical risks have significant effects on business cycles of developing countries. The variables of the SVAR model used in the study are the GPR index, the real output per capita, the real gross investment per capita, the real private consumption per capita, the real exchange rate, and the trade balance. The model is enhanced by the terms of trade, the US interest rate spreads, the US EPU index, and the US stock market volatility. The authors concluded that the increase in the geopolitical risk leads to significant economic contractions, but according to Cheng and Chiu (2018), global geopolitical risks account for at least 10% of the average weight of the output variation. However, it has been confirmed that geopolitical risks should be assessed in terms of country-specific factors, and they found that each developing country is subject to a considerable geopolitical risk. Along with the real business cycles, global geopolitical risk has indispensable effects on foreign trade volume, which is also an important indicator of the course of the global economy. In this respect, Gupta et al. (2019) employed a classical gravity model, assessing the influences of geopolitical risks on the trade flows for developing and developed countries geopolitical risks on the global trade flows. Gupta et al. (2019) found that the geopolitical risks cause negative impacts on the global trade flows, whereupon it was suggested policymakers should implement policies to sustain trade flows during the times of higher geopolitical risks.

Geopolitical risks significantly affect the financial market dynamics as well as business cycles and may have impacts on asset prices, leading to a deterioration in financial stability. In this regard, Balcilar et al. (2018) used the nonparametric causality-in-quantiles tests to analyze the effect of geopolitical uncertainty on return and volatility dynamics in the BRICS stock markets. They confirmed that geopolitical risks can be heterogeneous across the BRICS stock markets. Moreover, it was found that the increase in geopolitical risk in the countries considered, except Russia, does not significantly raise the stock returns, but increases the volatility. While geopolitical risks are determinant of economic uncertainties, the evaluation of other indicators of the economic uncertainty and the time-related effects between macroeconomic and financial variables is another crucial issue. On the basis of this assumption, Labidi et al. (2018) analyzed the cross-quantile dependence between developed and emerging market stock returns with recursive sample estimations. According to their results, there was a heterogeneous quantile relation for the USA, UK, German, and Japanese stock returns. Moreover, the indicators implying the systematic risk (the US Economic Policy Uncertainty index, the US Equity Market-Related Economic Uncertainty index, the Chicago Board of Exchange Volatility index and the GPR index) did not reveal the cross-country dependence structure. Herein, stock returns are related to macroeconomic variables and economic uncertainties, as well as other financial market dynamics. Considering the phenomenon of global financial development, it is assumed that the stock markets, especially in developing countries, are closely related to oil prices. Antonakakis et al. (2017) developed this approach and assumed that the relationship between the stock and the oil market depends on geopolitical risk. In their study, the relationship between the Standard & Poors (S&P) 500 stock index and the WTI oil index real returns was analyzed using the volatility modeling approach. Taking into consideration the time-varying stock-oil covariance, their returns, and their variances, they found that geopolitical risk leads to a negative effect on oil returns and volatility. Moreover, Antonakakis et al. (2017) stressed that the relationship between these two markets weakened. In a similar approach, Dong et al. (2019) confirmed that there exists a long-term relationship between crude oil, global economic activity, and geopolitical risk by using cointegration analysis.

Although the effect of the increase and decrease in oil prices on macroeconomic and financial variables cannot have the same magnitude, macroeconomic and financial developments may not have symmetrical effects on oil prices. In this context, the role of asymmetry in explaining the interaction between the oil prices and macroeconomic financial variables is increasing in importance in the scientific literature (Karaki 2017; Apergis and Vouzavalis 2018; Kang et al. 2019). However, some recent studies have examined oil price uncertainty (Wang et al. 2017; Dutta et al. 2017; Phan et al. 2019; Xiao et al. 2018), as oil market dynamics show considerable uncertainties due to various factors. In terms of oil price dynamics, it can be argued that the interplay between the economic indicators of the Middle East and oil price uncertainty may even be higher. In this context, Dutta et al. (2017) studied the impacts of oil market uncertainty indicated by the implied crude oil volatility index (OVX) on the realized volatility of Middle East and African stock markets. By using a generalized autoregressive conditional heteroskedasticity (GARCH)-type model, they found that oil market uncertainty has considerable effects on the realized volatility. Moreover, the GARCH-jump model revealed that stock returns are generally sensitive to the fluctuations in the OVX, which highlights the time-varying impacts on the stock returns. On the other hand, Xiao et al. (2018) employed quantile regression analysis to study the effects of crude oil volatility on the Chinese aggregate and sectoral stock returns. They decomposed the OVX according to the positive and negative sums, whereupon Xiao et al. (2018) found that the OVX changes mainly show significantly negative effects on the aggregate and sectoral stock returns in the bearish market. More specifically, they implied the role of the asymmetric effects by showing that the positive shocks of the OVX are more dominant than that of the negative shocks.

In this study, we assume that geopolitical risk is the major driving force of the dynamics of long-term oil prices and oil price volatility. More specifically, we analyze the impacts of the benchmark GPR index and the GPR indices of Israel, Russia, Saudi Arabia, and Turkey on crude oil futures and crude oil volatility, incorporating the role of asymmetric impacts in the estimation process of the VAR model with censored variables similar to Kilian and Vigfusson (2011). We employ a censored VAR model to take the advantage of impulse-response tools and to detect the influences of the GPR index on positive and negative changes in the crude oil futures and the crude oil volatility in the following periods. In this respect, the censored variables approach allows us to capture the positive changes in the GPR index, while the negative changes are assumed to be zero. We follow the empirical methodology of Kilian and Vigfusson (2011) and apply Mork and Wald's slope-based tests to determine whether there are considerable differences in the impulse responses due to positive and negative shocks. Our empirical exercise covers the period after the 2008–2009 GFC and differs from the work of Antonakakis et al. (2017) and Dutta et al. (2017), who used GARCH modeling, because our primary concern is to detect asymmetry via slope-based tests.

## 3 Methodology of Analysis

### *3.1 Empirical Model*

Departing from the vector autoregression (VAR) model framework, we employ nonlinear VAR modeling in line with Kilian and Vigfusson (2011) to show the asymmetric relationship between the effects of positive and negative changes in the geopolitical risk and the oil futures and the volatility. For this purpose, the global benchmark GPR index ($gpr_t^{glb}$) and the GPR indices of Israel, Russia, Saudi Arabia, and Turkey ($gpr_t^{il}, gpr_t^{ru}, gpr_t^{sa}, gpr_t^{tr}$), the crude oil volatility index ($ovx_t$), the crude oil futures ($ofu_t$) are employed, respectively. All the variables are (2010 = 100) and they are in logarithms. In this respect, we estimate censored VAR models for the period from 2010:01 to 2018:08, whereupon impulse response functions and slope-based tests are performed. Our sample coincides the period after the GFC where expansionary monetary policies are implemented by major central banks. Thus, a period in which the effects of geopolitical risks on oil prices have been prominent is evaluated.

More precisely, we use the approach of Kilian and Vigfusson (2011) which derived from the linear and symmetric and asymmetric data generating processes. Censored variable VAR model constitutes a base for the computation of the nonlinear VAR model's impulse-response functions.[1] The relevant model can be expressed as below;

$$x_t = b_{10} + \sum_{i=1}^{p} b_{11,i}x_{t-i} + \sum_{i=1}^{p} b_{12,i}y_{t-i} + \varepsilon_{1,t} \tag{1}$$

$$y_t = b_{20} + \sum_{i=1}^{r} b_{21,i}x_{t-i} + \sum_{i=1}^{r} b_{22,i}y_{t-i} + \sum_{i=1}^{r} g_{21,i}x_{t-i}^{+} + \varepsilon_{1,t} \tag{2}$$

The equation (1) is a linear VAR model showing the influences of $\boldsymbol{x_t}$ on $\boldsymbol{y_t}$, whereas the equation (2) exposes both the impacts of $\boldsymbol{x_t}$ and $\boldsymbol{x_t^+}$ on $\boldsymbol{y_t}$. Accordingly, the dynamic responses of $\boldsymbol{y_t}$ to positive and negative changes in $\boldsymbol{x_t}$ can be computed. A set of equations having both censored variables, and thus, nonlinear VAR model can be identified as below;

$$s_t = b_{10} + \sum_{k=1}^{p} b_{11,k}s_{t-k} + \sum_{k=1}^{p} b_{12,k}\lambda_{t-k} + \varepsilon_{1,t} \tag{3}$$

$$\lambda_t = b_{20} + \sum_{k=1}^{p} b_{21,k}s_{t-k} + \sum_{k=1}^{p} b_{22,k}\lambda_{t-k} + \sum_{k=1}^{p} g_{21,k}s_{t-k}^{+} + \varepsilon_{2,t} \tag{4}$$

where $p$ denotes the lag order of the VAR model and $s_t$ corresponds to the variable whose possible asymmetric impacts are searched for. $\lambda_t$ vector contains variables that can be affected by the $s_t$. Equation (3) is a linear symmetric model with $s_t$, while equation (2) includes both $s_t$ and censored variable of $s_t^+$. The $s_t^+$ shows the positive changes and it can be assumed that; $s_t^+ = \begin{cases} s_t & s_t > 0 \\ 0 & s_t \leq 0 \end{cases}$. Additionally, $b_{10}$ and $b_{20}$ in

[1] The data generation process of $x_t$ can both be assumed as symmetric and asymmetric in the context of the regression model; $x_t = \alpha_1 + \varepsilon_{1,\ t}$. Accordingly, the substitution of negative values of $x_t$ with zero exposes a censored variable $x_t^+$. The censored variable can be defined as; $x_t^+ = \begin{cases} x_t^+ & x_t > 0 \\ 0 & x_t \leq 0 \end{cases}$.

**Table 1** Lumsdaine-Papell unit root test results

| Variables | Test statistic | Number of lagged differences by AIC | Suggested break date |
|---|---|---|---|
| $ovx_t$ | −6.5635 | 2 | 2011:07, 2014:09 |
| $\Delta ovx_t$ | −10.4106 | 0 | 2011:10, 2016:02 |
| $ofu_t$ | −4.9339 | 1 | 2012:04, 2014:09 |
| $\Delta ofu_t$ | −9.2868 | 0 | 2014:06, 2016:01 |
| $gpr_t^{glob}$ | −5.3392 | 0 | 2014:02, 2017:03 |
| $\Delta gpr_t^{glob}$ | −9.0091 | 2 | 2014:09, 2016:01 |
| $gpr_t^{il}$ | −8.9044 | 0 | 2013:09, 2015:11 |
| $\Delta gpr_t^{il}$ | −7.6211 | 4 | 2014:05, 2017:03 |
| $gpr_t^{ru}$ | −5.6696 | 2 | 2011:11, 2014:02 |
| $\Delta gpr_t^{ru}$ | −11.0232 | 1 | 2013:02, 2014:05 |
| $gpr_t^{sa}$ | −4.1660 | 2 | 2016:01, 2017:06 |
| $\Delta gpr_t^{sa}$ | −10.9588 | 1 | 2013:01, 2014:05 |
| $gpr_t^{tr}$ | −5.2506 | 1 | 2013:09, 2017:01 |
| $\Delta gpr_t^{tr}$ | −8.8086 | 2 | 2014:05, 2016:06 |

Note: According to 1%, 5%, 10% significance level, the critical values of the test are −6.74, −6.16, −5.89, respectively
Source: Authors' calculations

(1) and (2) are the vector of intercept and dummy variables, respectively. The coefficients of the changes in $s_t$ are included in $b_{12}$ and $b_{22}$vectors. $g_{21}$ signifies the vector of the coefficient of the censored variable and finally, $\varepsilon_{1,\,t}$ and $\varepsilon_{2,\,t}$ denotes the residual vectors of (3) and (4). In this context, four VAR models are considered and each bivariate VAR model can be written as $\left(gpr_t^{country,+}, ofu_t\right)'$ $\left(gpr_t^{country,+}, ovu_t\right)'$ $\left(gpr_t^{country,-}, ofu_t\right)'$ $\left(gpr_t^{country,-}, ovu_t\right)'$, respectively. Thus, $gpr_t^{country,+}$ and $gpr_t^{glb,+}$ are derived by negative values to zero. In other words, it is assumed that only increases have impact on the other variable of the model via censored variables approach. Herein, it should also be noted that the VAR models are determined in line with the unit root test results of $gpr_t^{glb}$, $gpr_t^{il}$, $gpr_t^{ru}$, $gpr_t^{sa}$, $gpr_t^{tr}$, $ovx_t$, and $ofu_t$.

## 3.2 *Empirical Data*

In order to determine the unit root properties of the variables under consideration, the Lumsdaine-Papell unit root test allowing multiple structural breaks is performed. Table 1 shows the unit root properties of the series and the break dates that each variable may have. Moreover, the Zivot-Andrews and Lee-Strazicich unit root tests with multiple break tests are parallel to the Lumsdaine-Papell unit root test for the model variables.

On the other hand, no cointegration relationship is found for all cases based on the vector specifications as; $\left(gpr_t^{glob}, ofu_t\right)'$, $\left(gpr_t^{glob}, ovx_t\right)'$, $\left(gpr_t^{country}, ofu_t\right)'$ and $\left(gpr_t^{country}, ovx_t\right)'$ with the help of at least one of the cointegration tests in the literature. The Lumsdaine-Papell unit root tests suggest that each variable may have different structural breakdown data from the other; in this regard, Bai-Perron tests have also verified that there can be multiple and different structural breaks for the model variables. Accordingly, we do not divide the full sample into particular sub-samples, and VAR models with censored variables for each country are computed on the full sample. As a result of the Lumsdaine-Papell unit root test, the variables included in the empirical exercise are the percentage change in the global benchmark GPR index $\Delta gpr_t^{glb}$ and the percentage changes in GPR indices of Israel, Russia, Saudi Arabia, and Turkey ($\Delta gpr_t^{il}, \Delta gpr_t^{ru}, \Delta gpr_t^{sa}, \Delta gpr_t^{tr}$), the percentage change in the crude oil volatility index ($\Delta ovx_t$), the percentage change in the crude oil futures ($\Delta ofu_t$).

## 4 Empirical Results

Changes in geopolitical risk closely affect investor behavior, and financial asset prices show significant variations due to increased geopolitical risk. In the context of financial market fluctuations, oil is accepted as the most rapidly responding commodity to short- and long-term geopolitical risks. Additionally, it can be argued that the effects of geopolitical risks on financial asset prices will not be the same. In other words, it can be suggested that the rise in geopolitical risks for the Middle Eastern countries will have more serious effects on oil prices given the dynamics of the world economy. The effects of changes in geopolitical risks are assumed to be asymmetrical, and the increase/decrease in geopolitical risk may not have the same magnitude. In accordance with Kilian and Vigfusson's (2011) approach, we estimate a VAR model with censored variables, and the presence of asymmetric effects is also examined with Mork and Wald's slope-based tests. Accordingly, *p*-values of both tests show that the country-specific do not have asymmetric effects on oil prices. However, the Mork and Wald tests have produced opposite results in terms of the effects of the global benchmark GPR index on the oil price volatilities. According to the 10% significance level, the impact of the global benchmark GPR index on oil price volatilities can be considered asymmetric, while the Wald test points out that the effect could be symmetric. Slope-based tests can be used to measure the possible asymmetric effects of one variable on another variable and cannot be regarded as a determinant factor on the direction and magnitude of the relationship.

In this study, we examine whether the effects of the country-specific and global GPR indices on oil prices could be symmetrical by impulse-response functions, parallel to Kilian and Vigfusson (2011). In line with the work of Kilian and Vigfusson (2011), 1, 2, 4, and 10 standard deviation positive/negative shocks computed as shown in Fig. 1. In this respect, the censored variables approach is used to investigate the effects of positive/negative geopolitical risk shocks on oil futures, and it is found that the rise in geopolitical risks in Russia, Saudi Arabia, and Turkey led to an increase in oil prices in the long term. These findings can be interpreted as potential risks associated with Turkey's and Russia's involvement in the Syrian civil war, which may have considerable impacts on oil prices. In addition, it can be claimed that the risks for Russia in terms of its own geography may increase oil prices. In this context, it can be inferred that Russia's relations with Ukraine and possible terrorist acts may have a boosting effect on oil prices. The political turmoil in Saudi Arabia, the Yemeni-Saudi relations, and the murder of journalist Jamal Khashoggi have made the kingdom an important country in terms of financial markets. Our findings suggest that the rise in the geopolitical risk of Saudi Arabia may raise the oil prices in the long run. In our study, the effects of the increase in the geopolitical risk of Israel, which has been experiencing serious problems with its neighbors since its foundation, were also examined. In this respect, it was revealed that positive shocks in the GPR of Israel led to an increase in oil futures. On the other hand, when the responses of the oil futures to the 10 standard deviation positive country-specific geopolitical risk shocks (represented by the gray line) are evaluated with respect to the magnitude of the coefficients, it has been revealed that the increase in geopolitical risks of Russia would be less impactful than the other

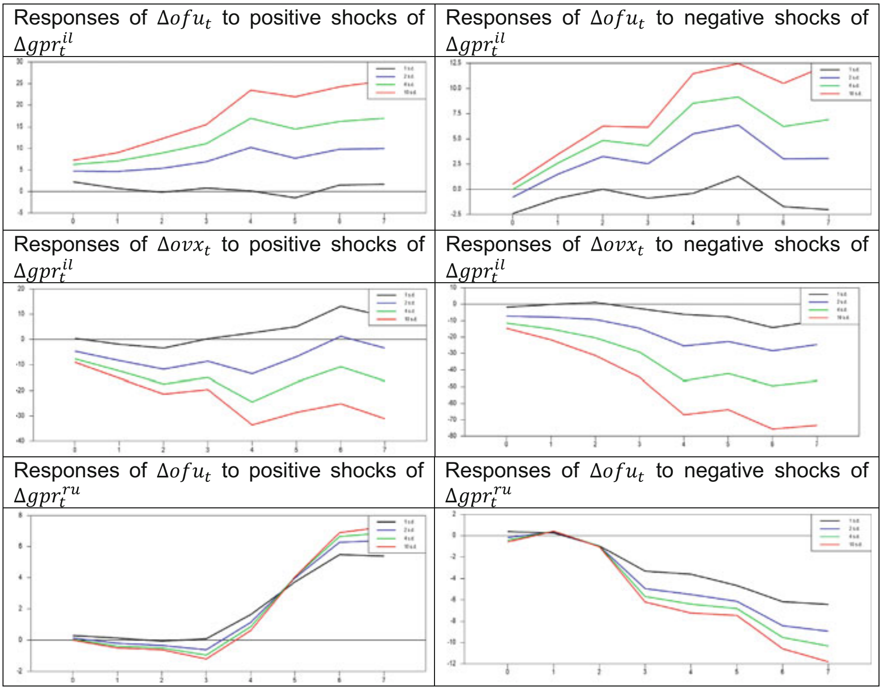


**Fig. 1** Responses of oil futures and oil price volatility to positive and negative shocks of country-specific GPR index. Source: Authors' calculations

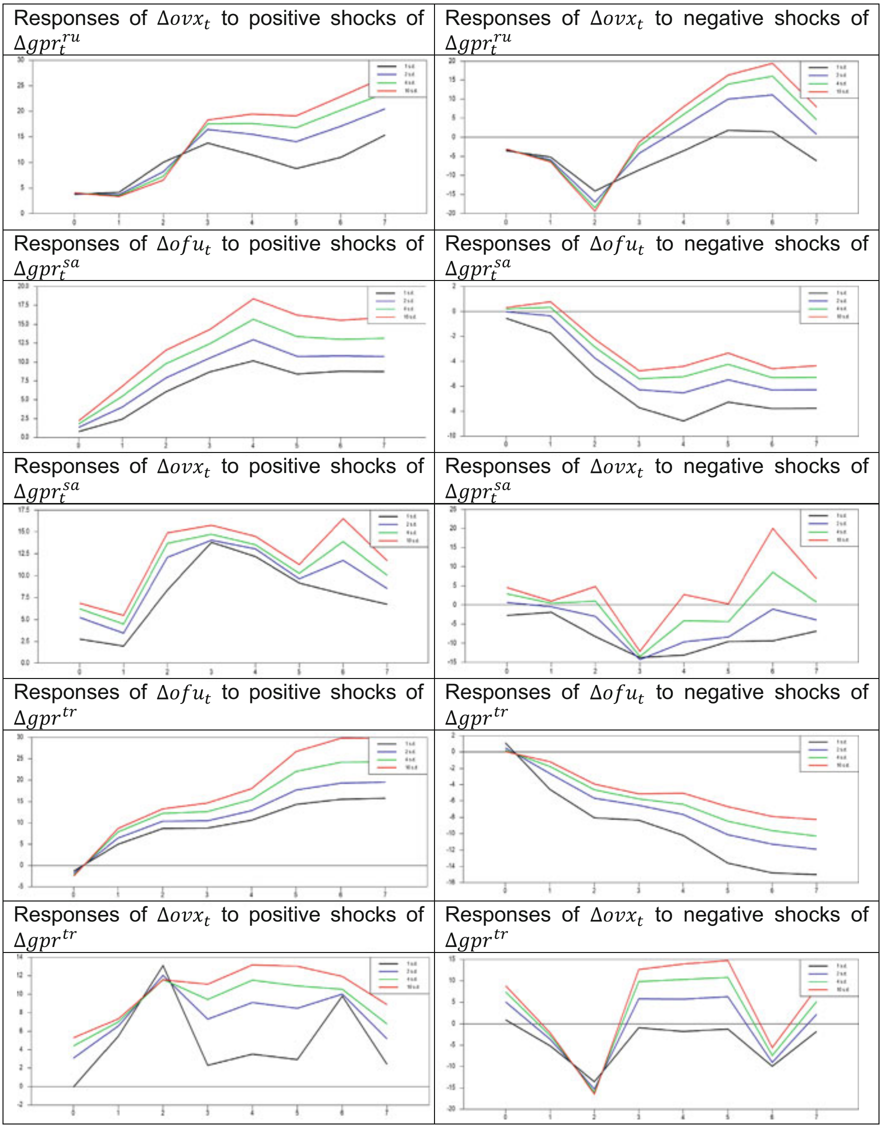


**Fig. 1** (continued)

countries. These findings confirm that the geopolitical risks in the Middle East can be acknowledged as the major driving force for the rise in oil prices.

The *p*-values of the slope-based Mork and Wald statistics indicate that the effects of the GPR index shocks for all countries are not asymmetrical; in other words, they can be regarded as symmetrical. In addition to this, the existence of asymmetry via the coefficients of the responses of oil futures to the negative country-specific geopolitical risk shocks was also examined. Accordingly, it was detected that the 1, 2, 4, and 10 standard deviation negative shocks in Russia, Saudi Arabia, and Turkey's GPR indices led to a downtrend in oil futures for the following periods. When the direction of impulse-response functions on oil futures is considered to determine whether the shocks in the country-specific GPR indices create asymmetric effects on oil futures, positive/negative shocks will lead to an increase/decrease in oil prices, in line with theoretical expectations. In this context, it can be suggested that the geopolitical risk shocks in Russia, Saudi Arabia, and Turkey may be symmetrical. On the other hand, the analysis upon impulse-response functions indicates that the geopolitical risk shocks in Israel may be asymmetrical. As a result of the 2, 4, and 10 standard deviation negative shocks for the case of Israel, it was found that oil prices would increase in contrast to the theoretical expectations, while the line with values close to zero corresponds to the 1 standard deviation shock in Fig. 1. However, the characteristics of 2, 4, and 10 standard deviation shocks in Israel have not generated robust results concerning the symmetrical relationship. Thus, our findings indicated that Russia, Saudi Arabia, and Turkey can be more crucial actors in the oil market compared to Israel, when their large population are considered.

In terms of the country-specific GPR indices, it was found that the 1, 2, 4, and 10 standard deviation positive shocks in the indices of Russia, Saudi Arabia, and Turkey would increase oil price volatility as shown in Fig. 1. When considered together with the responses of oil futures, the increase of geopolitical risk in Russia, Saudi Arabia, and Turkey would generate a volatile uptrend in oil prices. More specifically, it can be claimed that some investors may realize their profits in terms of oil futures due to the increasing geopolitical risks and rising oil prices. As a result of country-specific negative geopolitical risk shocks, it was revealed that the crude oil volatility index did not exhibit a significant trend for the cases of Russia, Saudi Arabia, and Turkey. The 1, 2, 4, and 10 standard deviation negative GPR index shocks in Russia, Saudi Arabia, and Turkey indicate a downtrend, where the oil price volatility does not reach high levels. We also found that the 1 standard deviation of positive/negative shocks in Israel's geopolitical risk would increase/decrease the oil price volatility in the upcoming periods. However, the result— that the 2, 4, and 10 standard deviation positive/negative shocks in the GPR index of Israel would reduce crude oil volatility index—can be interpreted as showing that Israel's geopolitical risk may have asymmetrical impacts. Nevertheless, the Mork and Wald tests for Israel have not confirmed the existence of any asymmetric relationship. The empirical findings of our study emphasize that the weights of the geopolitical risks of Russia, Saudi Arabia, and Turkey in oil futures and the crude oil volatility index are higher than those of Israel.

In addition to the country-specific GPR indices, the global benchmark GPR index may also have a considerable impact on oil prices. The effects of the global benchmark GPR index should also be taken into account, especially considering the terrorist acts around the world. As shown in Fig. 2, the finding that the increases in global geopolitical risk will raise oil prices and the impulse-response analysis revealed that the effect of the global geopolitical risk on oil prices may be asymmetrical. Additionally, it was suggested that the changes in global geopolitical risk

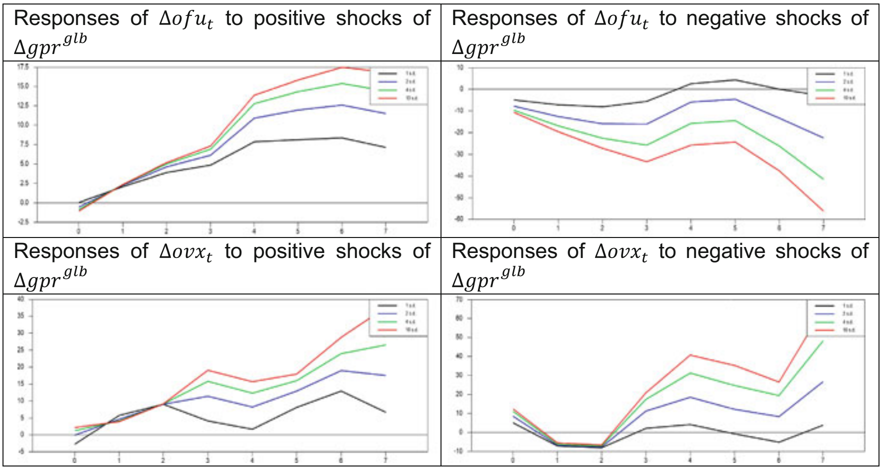


**Fig. 2** Responses of oil futures and oil price volatility to positive and negative shocks of global benchmark GPR index. Source: Authors' calculations

**Table 2** Slope-based test results

| | Mork test | | Wald test | |
|---|---|---|---|---|
| Shock: $\Delta gpr_t^{il}$ | F-test | *p*-value | F-test | *p*-value |
| Response: $\Delta ofu_t$ | 1.1748 | 0.3195 | 0.0158 | 0.9999 |
| Response: $\Delta ovx_t$ | 0.3868 | 0.8181 | 0.0022 | 0.9999 |
| Shock: $\Delta gpr_t^{ru}$ | F-test | *p*-value | F-test | *p*-value |
| Response: $\Delta ofu_t$ | 0.1898 | 0.9438 | 0.0043 | 0.9999 |
| Response: $\Delta ovx_t$ | 0.6990 | 0.5924 | 0.0047 | 0.9999 |
| Shock: $\Delta gpr_t^{sa}$ | F-test | *p*-value | F-test | *p*-value |
| Response: $\Delta ofu_t$ | 0.4812 | 0.7495 | 0.0076 | 0.9999 |
| Response: $\Delta ovx_t$ | 0.7963 | 0.5272 | 0.0043 | 0.9999 |
| Shock: $\Delta gpr_t^{tr}$ | F-test | *p*-value | F-test | *p*-value |
| Response: $\Delta ofu_t$ | 0.2337 | 0.9194 | 0.00992 | 0.9999 |
| Response: $\Delta ovx_t$ | 0.1408 | 0.9670 | 0.00316 | 0.9999 |
| Shock: $\Delta gpr_t^{glb}$ | F-test | *p*-value | F-test | *p*-value |
| Response: $\Delta ofu_t$ | 2.0780 | 0.0807 | 0.0382 | 0.9992 |
| Response: $\Delta ovx_t$ | 3.7032 | 0.0051 | 0.02269 | 0.9997 |

Note: *p*-values 0.01, 0.05 and 0.10 corresponds to the statistical significance at 1%, 5%, and 10%, respectively
Source: Authors' calculations

could cause fluctuations in oil prices. In terms of the impulse-response functions estimated in our study, we can infer whether there are asymmetric effects. This phenomenon was strengthened by the help of slope-based tests, indicated in Table 2. Considering the Mork test, it can be said that the shocks in the global benchmark GPR index will have asymmetric effects on oil futures and oil price volatility at a

10% significance level. However, the Wald test revealed that those relationships may be symmetrical. Considering the impulse-response functions, it can be claimed that the impact of the shocks in the global benchmark GPR index on the oil futures may be symmetrical, while the effect on the oil price volatility may be asymmetric.

## 5 Conclusion

It is acknowledged that the increase in geopolitical risk may create significant changes in oil prices over the short- and long-term. However, it can be assumed that the increase in the geopolitical risk of some countries will have a higher impact on oil prices compared to other countries. In this study, the asymmetric impacts of the country-specific geopolitical risks, which are related to the countries that have close relationships with the Middle East, on oil futures and oil price volatility, were examined with the help of slope-based tests and impulse-response functions. In this context, Israel, Russia, Saudi Arabia, and Turkey were accepted as crucial countries in terms of oil prices. According to the slope-based tests, it was implied that the changes in the geopolitical risk of those countries could not have asymmetric effects on oil futures and oil price volatility.

However, due to the importance of time-specific characteristics of the asymmetric effects, the impacts of the country-specific positive and negative geopolitical risk shocks were investigated separately. As a result of the positive country-specific geopolitical risk shocks, the responses of the oil futures in Israel, Saudi Arabia, and Turkey suggested that the rise in geopolitical risk could lead to an uptrend in oil prices in the long run. Similar findings were obtained for Russia, and the impact of the factors on the oil futures in Israel, Saudi Arabia, and Turkey increasing the geopolitical risk was found to be higher than that of Russia. In line with the theoretical expectations, it was detected that the increase in the country-specific risk would raise the oil price volatility in Russia, Saudi Arabia, and Turkey, and thus, it can be suggested that the increase in the country-specific risk for those countries may cause an uptrend, which also contains falls in oil prices. When the impulse-response functions were examined, it was seen that the rise in the geopolitical risk in Israel has led to a consistent uptrend in oil prices, where oil price volatility was decreasing. Therefore, we emphasize the role of other Middle Eastern countries having problems with Israel, which may increase the geopolitical risks associated with Israel. In this context, it is generally acknowledged that solving the problems originating from the West Bank and the Gaza Strip by peaceful means will decrease geopolitical risks; however, the impulse-response functions highlight the fact that decreasing the geopolitical risk does not lower oil prices. According to our results, it can be claimed that the decrease in the geopolitical risk of Israel will have asymmetric impacts on oil prices. However, we also found that negative geopolitical risk shocks in Russia, Saudi Arabia, and Turkey lower oil futures, and according to the slope-based test results, it can be suggested that there exist symmetrical effects of the geopolitical risk on the oil prices for those countries.

In our study, it was also found that the country-specific positive geopolitical risk shocks would increase the oil price volatility. This finding is in line with the theoretical expectations, and it was confirmed that the decrease in the country-specific geopolitical risk would not lower the oil price volatility for Israel, Russia, Saudi Arabia, and Turkey. Therefore, we showed that the impact of the country-specific geopolitical risk shocks on oil price volatility may be asymmetric based on the impulse-response functions. The impact of the country-specific GPR index on oil price volatility may be considered sticky, and the Mork slope-based test revealed that the effect of the global GPR index on oil futures and oil price volatility may be asymmetric. This finding was verified by the impulse-response analysis, and it was determined that the positive and negative shocks in the global GPR index would not oppositely affect oil price volatility. However, in accordance with the theoretical expectations, the effects of the shocks in the global GPR index on oil futures could be accepted as symmetrical by taking the coefficients of the impulse-response functions into account.

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