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Interplay between oil prices, country risks, and stock returns in the context of global conflict: A PVAR approach

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ABSTRACT

Employing the panel vector autoregressive (PVAR) modeling, we analyze the interplay among oil prices, country risks, and stock returns across twenty-nine economies from February 2005 to August 2020. We find that, in the short run, rising oil prices temporarily boost stock prices by reducing country risk. However, over longer horizons, reductions in country risk are linked to lower stock returns. Moreover, in the interaction between stock and oil markets we identify the heterogeneity of three forms of country risk: economic, financial, and political, particularly when comparing developed and developing economies. Findings, offering new insights into the linkages between oil and stock markets, especially in the context of increased global conflict context, are of much value for investment strategies and policy formulations aimed at mitigating risk.

1. Introduction

Recent decades have seen a substantial increase in global conflicts, which have increased country risks and promoted spill-overs in global financial and energy markets (Zhao et al., 2016; Boubaker et al., 2022). The term 'country risks' refers to the overall exposure of various countries to political, economic, financial, and other multidimensional risk factors that significantly impact regional development and prosperity (Qazi, 2023). The increasing global conflict also strengthens global resource competition, with the adverse outcome of leading countries into situations of continuous instability and intense transformation (Abdel-Latif and El-Gamal, 2020; Yang et al., 2021; Boubaker et al., 2022; Saâdaoui et al., 2022; Saâdaoui et al., 2022).

As an important natural resource, oil plays a vital role in the global economy, serving as the main fuel power in most industries (Corbet et al., 2020; Huang et al., 2020; Liu and Gong, 2020). Some studies suggest that higher oil prices may increase country risk by increasing geopolitical risks and macroeconomic uncertainty within and across countries (Sharif et al., 2020; Yang et al., 2021; Zhang et al., 2022). However, other research suggests that increasing oil prices can be perceived as a demand-driven signal that is positively related to economic prosperity, which may decrease country risk (Ivanovski and Hailemariam, 2022). Reversely, country risk may also affect the transaction behaviour of investors in global financial markets (Suleman et al., 2017). Such investors make investment strategies that consider changes in country risk, which in turn are closely connected with stock markets.

Despite extensive discussions on the relationship between oil prices, stock markets and country-level risks (Fiszeder et al., 2023; Rahman, 2022; Sadeghi and Roudari, 2022), the results of analyses remain inconsistent due to divergence in the research context and

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time period. One possible cause of this inconsistency may be discrepancies in country risk. To fill the resulting research gap, we examine the interplay between oil prices, stock returns, and different types of country risk across 29 economies between 2005 and 2020.

In addition, it is found that most current studies adopt a single-country context rather than multiple ones. Though it helps identify the specific links among these variables, it may suffer an issue of generalization in explaining the effects more systematically (Liu et al., 2016). To understand the connections between country risks and global financial and oil markets, this paper intends to explore the systemic relationship between oil prices, country risks, and stock markets using a panel vector autoregression (PVAR) with data across twenty-nine economies.

Existing research has not put these three variables together due to neglecting the possibility that the interaction between oil and the stock market may transfer through country risks. It is particularly important in the current global political situation under which oil prices are closely related to uncertainties and global conflicts (Abdel-Latif and El-Gamal, 2020; Lee et al., 2017; Liu et al., 2016). To fill this research gap, the study integrates the three variables and examine the relationships between oil prices, country risks and stock returns within a comprehensive theoretical framework.

Our study incorporates the three variables of oil prices, stock returns, and country risk within a theoretical framework considering that the interaction between oil and the stock markets may transfer through country risks. This investigation is particularly important in the current global political situation, wherein oil prices are closely related to uncertainty and global conflict (Abdel-Latif and El-Gamal, 2020; Lee et al., 2017; Liu et al., 2016).

The current study contributes to the literature in three ways. First, this study examines the interplay of oil price, stock returns and country risks within a comprehensive theoretical framework. We thus empirically reveal the simultaneous interdependence among the three variables. In contrast, prior studies are limited to a single type of country risk, such as geopolitical risk. We address this limitation by differentiating a country's political, economic, and financial risks.

Second, we conduct our analysis using cross-country data and a panel vector autoregressive (PVAR) model. Most studies use a vector autoregressive (VAR) or structural VAR (SVAR) model and are conducted in a single-country context (Sims, 1980). In contrast to the VAR and SVAR models, the PVAR model not only takes all variables as endogenous, and thus can analyse the relationship between them, but also allows us to gather more observations across different individual dimensions using panel data, thereby enhancing the reliability of our model's outcomes (Love and Zicchino, 2006). Furthermore, adopting a PVAR model also helps to control for the interference of individual factors, thereby reducing the impact of heterogeneity caused by individual effects (Ma et al., 2021). Finally, the proposed method of analysis allows us to compare groups of developed and developing countries, rather than individual countries, which may provide us with additional implications regarding the differences between these groups.

Third, based on the theoretical framework and results of empirical analysis conducted in this study, we offer policy suggestions regarding how the government can resist country risks and alleviate fluctuations in the financial market. We also provide practical implications for investors, suggesting that they pay particular attention to different types of country risk and their impact on financial markets. In contrast, prior studies mainly assess country risks in a single dimension and do not discuss the diverging impact of different types of country risk. This study offers novel insights into relevant policy and investment practices.

The rest of the paper is organised as follows. Section 2 reviews the relevant literature. Section 3 presents the sample data and research methodology. Section 4 presents the results. Section 5 presents the discussion. Finally, Section 6 concludes the study.

2. Literature review

2.1. Oil prices and stock returns

The close interconnection between the oil and stock markets is well-documented in the literature (Cifarelli and Paladino, 2010; Sadorsky, 1999). From the standpoint of production costs, there exists a negative correlation between oil prices and stock prices. As oil is a fundamental input in the production process, an increase in oil prices can lead to higher production costs, subsequently reducing expected cash flows for enterprises (Ceylan et al., 2020). Furthermore, rising production costs may contribute to inflation, thereby diminishing both output and expected income (Lee et al., 2017). This perspective is supported by a range of empirical studies that provide robust evidence of the negative impact of rising oil prices on stock market performance (Diaz et al., 2016).

However, it can be argued that an increase in oil prices may also be interpreted as a positive signal, particularly when associated with rising oil demand. In such cases, oil prices might positively influence stock prices. Kilian and Park (Kilian and Park, 2009), in their seminal paper, were the first to decompose oil price shocks into three categories: oil supply shocks, aggregate oil demand shocks, and oil-specific demand shocks. Their findings indicate that the negative correlation between oil prices and stock returns only arises when oil price increases are driven by oil market-specific demand shocks, such as precautionary demand due to concerns about future crude supply shortages. On the other hand, when high oil prices are a result of global economic expansion, they tend to have a sustained positive impact on stock returns in the short term. Specifically, the stock market tends to thrive despite rising oil prices, due to the prevailing stimulative effects in the short run. Kilian and Park (Kilian and Park, 2009) thus conclude that oil prices can indeed exert a positive influence on stock prices. This conclusion has been further corroborated by subsequent studies (Cheema and Scrimgeour, 2019).

Moreover, several studies suggest that the relationship between oil prices and stock prices may exhibit dynamic evolution over time (Martínez-Cañete et al., 2022). These varied findings imply that the nature of the relationship between oil prices and the stock market may be contingent upon factors such as whether a country is an oil-importing or oil-exporting nation, along with its market mechanisms, economic structure, and the impact of significant events (Ceylan et al., 2020; Chang et al., 2020).

2.2. Oil prices and country risks

The relationship between oil prices and country risks has attracted significant attention, especially in the context of heightened global conflicts. Fluctuations in oil prices are widely recognized for their substantial impact on key macroeconomic variables, including economic growth, inflation, money supply, and government policies across various nations (Jiménez-Rodríguez, 2022; Banerjee, 2024; Yang et al., 2023). These price shocks frequently compel governments to implement macroeconomic policy adjustments, which in turn elevate levels of uncertainty (Liu et al., 2016; Yang et al., 2021). Moreover, the volatility in oil prices can aggravate political risks by intensifying competition for resources (Abdel-Latif and El-Gamal, 2020; Ivanovski and Hailemariam, 2022).

Recent research shows that countries respond differently to oil price shocks. Rising oil prices may increase revenues for oil-exporting nations while negatively impacting oil-importing countries. Monetary policy theories suggest that oil-importing countries might adopt expansionary policies to offset the economic effects of rising oil prices, while also tightening policies to control inflation (De Jesus et al., 2020; Chkir et al., 2020). As a result, the impact of oil price shocks on country risks can vary significantly. Lee et al. (Lee et al., 2017) found that higher oil prices generally reduce risks for oil-exporting countries but increase risks for oil-importing nations.

Additionally, the relationship between oil prices and country risks may be reciprocal. Recent studies highlight the role of geopolitical risk shocks in influencing oil prices. An increase in geopolitical risks can drive up oil prices, as conflicts and wars disrupt economic activity and oil production, affecting future supply and demand (Zhang et al., 2022). Chen et al. (Chen et al., 2016), using the political risk index from the International Country Risk Guide (ICRG), found a positive correlation between geopolitical risk and oil prices in OPEC countries.

2.3. Country risks and stock returns

The relationship between country risks and stock markets has been widely studied, yet findings remain inconsistent (Bajaj et al., 2022). For example, Sari et al. (Sari et al., 2013) found that in Turkey, political, financial, and economic risks are significantly correlated with stock markets in the long term, while only political and financial risks are significant in the short term. Liu et al. (Liu et al., 2013) observed that in BRICS nations, the impact of country risks on stock markets varies depending on the type and direction of the risk shock. Suleman et al. (Suleman et al., 2017) also noted that country risks can predict stock returns and volatility, though the relationship is nonlinear.

Overall, the literature presents mixed results on the interactions between oil prices, stock market returns, and country risks. Some studies point to a negative correlation between oil prices and stock prices due to higher production costs, while others suggest that rising oil prices driven by demand can signal economic growth, positively impacting stock returns in the short term. Additionally, oil price shocks can influence country risks, and vice versa, especially in major oil-exporting or importing nations. These complex dynamics highlight the need for further research using an integrated framework. To address this, we propose a comprehensive model that simultaneously examines oil prices, stock returns, and country risks, with a detailed analysis of the different components of country risks.

3. Methodology

3.1. Sample and data

For our study, we utilize monthly data spanning from February 2005 to August 2020. This period was selected in part due to the completeness of the data, as many economic datasets prior to 2005 contain gaps. Additionally, this timeframe includes several significant events that have had a profound impact on country risks, such as the global financial crisis, the European sovereign debt crisis, the Ukraine crisis, and the COVID-19 pandemic. Our analysis focuses on a sample of 29 economies. These economies are selected from the trading index pool of the widely recognized China Stock Market & Accounting Research (CSMAR) database (Kong et al., 2021; Wu et al., 2021). The CSMAR database offers data at various frequencies (daily, monthly, and yearly) from 49 stock market indices across 31 of the world's most significant economies. Specific data points include the date, opening index, closing index, and trading volume. Out of the 31 economies in the index pool, we ultimately selected 29 for our sample based on data completeness. These 29 economies include Argentina, Austria, Australia, Brazil, Germany, Russia, France, the Philippines, South Korea, the Netherlands, Canada, Malaysia, the United States, Mexico, Japan, Switzerland, Spain, Singapore, India, Indonesia, the United Kingdom, China, Taiwan (China), Hong Kong (China), Sweden, Israel, Norway, Italy, and New Zealand. This sample encompasses both developed economies and those of countries in transition. The prominent roles of these economies in the global financial market likely correspond to their influence in global economic and capital markets.

The data resources and measurement of three variables, namely oil returns, country risk changes, and stock returns, are as follows.

Oil returns are calculated as the first-order logarithmic difference of oil prices, adjusted by each country's exchange rate. This variable reflects the actual rate of oil price changes experienced by each country (Antonietti and Fontini, 2019). The exchange rate is determined based on the monthly average price, expressed in units of the national currency per US dollar. For the benchmark analysis, we use Brent oil prices, while West Texas Intermediate (WTI) oil prices are employed for the robustness check. The oil price data are sourced from the Energy Information Administration, and the exchange rate data are obtained from the China Entrepreneur Investment Club database. This database is widely recognized as the most comprehensive macroeconomic resource globally, known for its

rigorous standards of data operability and quality control, and has been utilized in related studies (Bal and Mohanty, 2021; Zhang et al., 2022).

Country risk changes are measured as the first-order log difference between country risk ratings (Lee et al., 2017). As some country risk ratings and their components are unstable, we use the first-log differences of scores, ensuring stable data for analysis (Lee et al., 2017). Country risks are divided into three subcomponents: political, economic, and financial. The higher the rating, the lower the risk it represents.[2] Data on country risk ratings are obtained from the ICRG, which surveys the country risk level ratings of nearly 140 countries once a month and publishes a widely used dataset (Suleman et al., 2017).

Stock returns are measured by the first-order log difference of the stock indexes of each sample country (Akhtaruzzaman et al., 2021). The data of stock indexes are obtained from CSMAR. As some economies have more than one representative index, such as the Shanghai Composite Index and CSI 300 Index in China, in such cases we choose the more representative index for inclusion in the analysis. The specific indexes used to represent the 29 economies are listed by name in Table A1 in the appendix.

Table 1 presents the descriptive statistics of the variables. We obtain 5423 observations from the 29 included economies. In Table 1, the oil returns show the highest variance, followed by stock returns and, finally, country risk changes. The average stock returns and oil returns are positive, indicating a stock market boom and global rise in oil prices, respectively. The average changes in country risks and the three subcomponent risks are all negative, signifying an increase in country risks during the study period. The last two columns present the panel correlation test results. The correlations between the stock returns, oil returns, and changes in the four types of risk are significant, supporting further analysis.

3.2. Models

A PVAR model is used to assess the relationship between oil returns, stock returns, and country risk changes. Compared with VAR models, which are widely used in this type of research (Sims, 1980), PVAR models can better handle multi-variable analysis. In a PVAR model, an endogenous system is built, and all variables are treated in an unrestricted way; this approach is more appropriate for exploring strong correlations and interactions between variables (Ouyang and Li, 2018); (Zouaoui and Zoghlami, 2020). A regression analysis of oil prices, country risk, and stocks may involve such a scenario, as the literature shows a possible two-way causal relationship between any two of these three variables. In addition, a PVAR model using panel data can obtain a greater variety of observations compared with a VAR model. By using information from intertemporal dynamics and individuals, panel data may enable control of interference caused by missing variables (Love and Zicchino, 2006). This dual (i.e., individual/time) dimension can better capture the complexity of market behaviour (Ma et al., 2021).

We take a general case of a PVAR model. We assume that the matrix form of the *p*-order PVAR model with *k* variables is as follows:

$$Y_{it} = C_i + A_1 Y_{i,t-1} + A_2 Y_{i,t-2} + \cdots + A_p Y_{i,t-p} + \Xi_{it} \quad , \mathrm{i} = 1, 2, \ldots 17; \mathrm{t} = \mathrm{T_i} \tag{1}$$

where $Y_{it} = \begin{bmatrix} Y_{1it} \\ Y_{2it} \\ \cdots \\ Y_{kit} \end{bmatrix}$, $C_i = \begin{bmatrix} C_{1i} \\ C_{2i} \\ \cdots \\ C_{ki} \end{bmatrix}$, $\Xi_{it} = \begin{bmatrix} \varepsilon_{1it} \\ \varepsilon_{2it} \\ \cdots \\ \varepsilon_{kit} \end{bmatrix}$, $A_p = \begin{bmatrix} A^p_{11} & \cdots & A^p_{1k} \\ \vdots & \ddots & \vdots \\ A^p_{k1} & \cdots & A^p_{kk} \end{bmatrix}$

Here, Y_{it} represents the column vector of *k* observable variables. C_i represents the individual fixed effect. Ξ_{it} is the residual term. A_p is the to-be-estimated coefficient of the *p*-order lag terms. *i* represents the individual, and *Ti* represents the time. Unlike the VAR model with *k*-variable and *p*-order lags, which estimates the coefficients of $k*p+1$, the PVAR model estimates the coefficients of $k*p+k$. Although only a small number of generation estimation coefficients are added in the latter model, the total volume of data increases several times, making the estimation more reliable.

In this study, we focus on the response of one variable in the system to the change of another variable using the impulse response function; therefore, it is important to determine the order of the variables in the system. The exogenous variable should generally be at the front of the system (Ouyang and Li, 2018). Reviewing the literature, we find that studies tend to first take the perspective of the impacts of oil prices on country risks and stocks and the impact of national risks on stocks (Lee et al., 2017; Liu et al., 2016; Suleman et al., 2017). It is reasonable to consider oil price returns as more exogenous than national risk changes and equity returns. In summary, we determine the appropriate order of the variables to be oil price returns, country risk changes, and stock returns.

The analysis in this study is further divided into two steps. First, we conduct a Generalized Method of Moments (GMM) estimation and a Granger causality test. Second, we produce a dynamic shock response diagram to explain the reaction of variables to shocks. Following the Bayesian information criterion (BIC), the lag order of the model is 2. We use the PVAR2 command in stata15 for the analysis (Ma et al., 2021).

[2] Specific indicators of country risk composition can be reviewed at https://www.prsgroup.com/.

Table 1
Descriptive statistics.

Variable	Abbr	N	Mean	Sd	stock	oil_bre
Stock returns	stock	5423	0.0044	0.0525		
Oil returns	oil	5423	0.0014	0.1071	0.3910***	
Country risk changes	risk	5423	−0.0004	0.0096	0.1341***	0.1317***
Economic risk changes	risk_eco	5423	−0.0014	0.0288	0.0219*	0.1088***
Financial risk changes	risk_fin	5423	−0.00004	0.0184	0.1460***	0.0426***
Political risk changes	risk_pol	5423	−0.0002	0.0086	0.0990***	0.0757***

4. Empirical results

4.1. Preliminary tests

Regarding the unit root, the GMM estimator is affected by the weak tool problem, which may cause false regression of the model (Abrigo and Love, 2016). The panel data used in this paper may cause the sample data to have a cross-sectional dependence issue (Ouyang and Li, 2018; Shobande and Asongu, 2022). Therefore, before performing the unit root test, we perform a cross-sectional dependence test according to Pesaran (Pesaran, 2007). This pre-test of cross-sectional dependence allows for the testing of individual variables. The results of the cross-section dependence test are shown in Table 2. According to the results for all variables, the null hypothesis is significantly rejected, indicating the existence of cross-sectional dependence in the data.

Consequently, we performed the unit root test using CADF (Cross-sectionally ADF) and CIPS (Cross-sectionally IPS) according to Sharma et al. (Sharma et al., 2021) and Shobande and Asongu (Shobande and Asongu, 2022). Table 3 presents the results of our stationarity test using two methods. When using either method and considering either Intercept or Intercept & trend, the panel unit root test results for all variables refute the null hypothesis at the 1 % significance level, showing that our variables are stable and can be used to perform subsequent analyses.

A Granger causality test is conducted to examine causality between the variables. Table 4 presents the results of this test. All of the results refute the null hypothesis. Instead, they suggest that the latter (X) is the Granger cause of the former (Y). These results show that bi-directional causal relationships exist between oil returns and stock returns, between oil returns and country risk changes, and between country risk changes and stock returns. In other words, the interactions between oil price returns, country risk changes, and stock returns are confirmed, and thus further analysis of these relationships is necessary.

4.2. Basic results

Fig. 1 presents the results of the impulse response analysis with a lag order of two steps. The graphs show the responses during the first 10 months (periods on the horizontal axis), during which all responses converge to zero. The upper and lower lines of the impulse response represent the 95th percentile bounds after 200 Monte Carlo simulations (Ouyang and Li, 2018).

The first column in the figure presents the impulse responses of country risk changes and stock returns to an oil return shock. The results show that an oil return shock significantly impacts country risk changes. Specifically, an oil return shock leads to an increase in the country risk score; this impact peaks in the first month and wanes in approximately 4 months. The higher the country risk score, the lower the level of country risk, demonstrating that rising oil prices reduce country risks. We find no evidence that an increase in oil prices drives an increase in country risk; instead, we find an inverse relationship. This finding is logical. Kilian and park (2009) shows that the rise in oil prices in recent years is mostly driven by demand. Rising oil prices may be a positive signal of economic prosperity, and good macroeconomic development naturally drives a decrease in country risks, consistent with the conclusions of Liu et al. (2016) and Wu and Zhang (Wu and Zhang, 2014). The stock returns are shown to respond positively to the oil return shock in the first month, followed by a rapid decrease. The impact of the oil return shock on stock returns becomes negative after 3 months, indicating that rising oil prices only increase stock returns in the short term. The positive relationship between oil prices and stock returns is also demonstrated by Cheema and Scrimgeour (2019)). In particular, the relationship between oil prices and stock returns is positive only in the short term, becoming negative in the long term.

The second column presents the impulse responses of oil and stock returns to the shock of country risk changes. First, this shock has a negative and significant impact on oil returns. This result indicates that decreasing country risks leads to a decrease in oil prices. Few studies discuss the impact of country risks on oil prices, as international oil prices do not seem to be determined by the risks in a single country. Even if it does have an impact, it might mainly be from significant oil-producing or oil-importing countries. However, considering that country risks may spillover and transfer across countries and the international exchange rate factor, the impact of

Table 2
Results of the cross-section dependence test.

var	stock	oil	risk	risk_eco	risk_fin	risk_pol
CD-test	188.68***	267.95***	46.69***	53.16***	39.83***	11.38***

Note: ***, **, * represent statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

Table 3
Results of the CIPS and CADF tests.

	CIPS		CADF	
	Intercept	Intercept & trend	Intercept	Intercept & trend
stock	−6.026***	−6.235***	−4.215***	−4.542***
oil	−6.170***	−6.391***	−4.053***	−4.141***
risk	−6.158***	−6.355***	−4.891***	−4.931***
risk_eco	−5.656***	−5.828***	−5.239***	−5.300***
risk_fin	−6.082***	−6.28***	−4.872***	−4.912***
risk_pol	−6.181***	−6.402***	−4.498***	−4.521***

Note: ***, **, and * represent statistical significance at the 1 %, 5 %, and 10 % levels, respectively.

Table 4
Results of Granger causality testing.

H0: X is not the Granger cause of Y.		χ^2	p	Accept/Reject
Y	X			
stock	oil	8.17	0.017	Reject
	risk	17.82	0.000	Reject
risk	oil	14.84	0.001	Reject
	sock	37.04	0.000	Reject
oil	risk	16.39	0.000	Reject
	stock	134.8	0.000	Reject

Note: 'Accept' or 'reject' indicates acceptance or rejection of the null hypothesis.

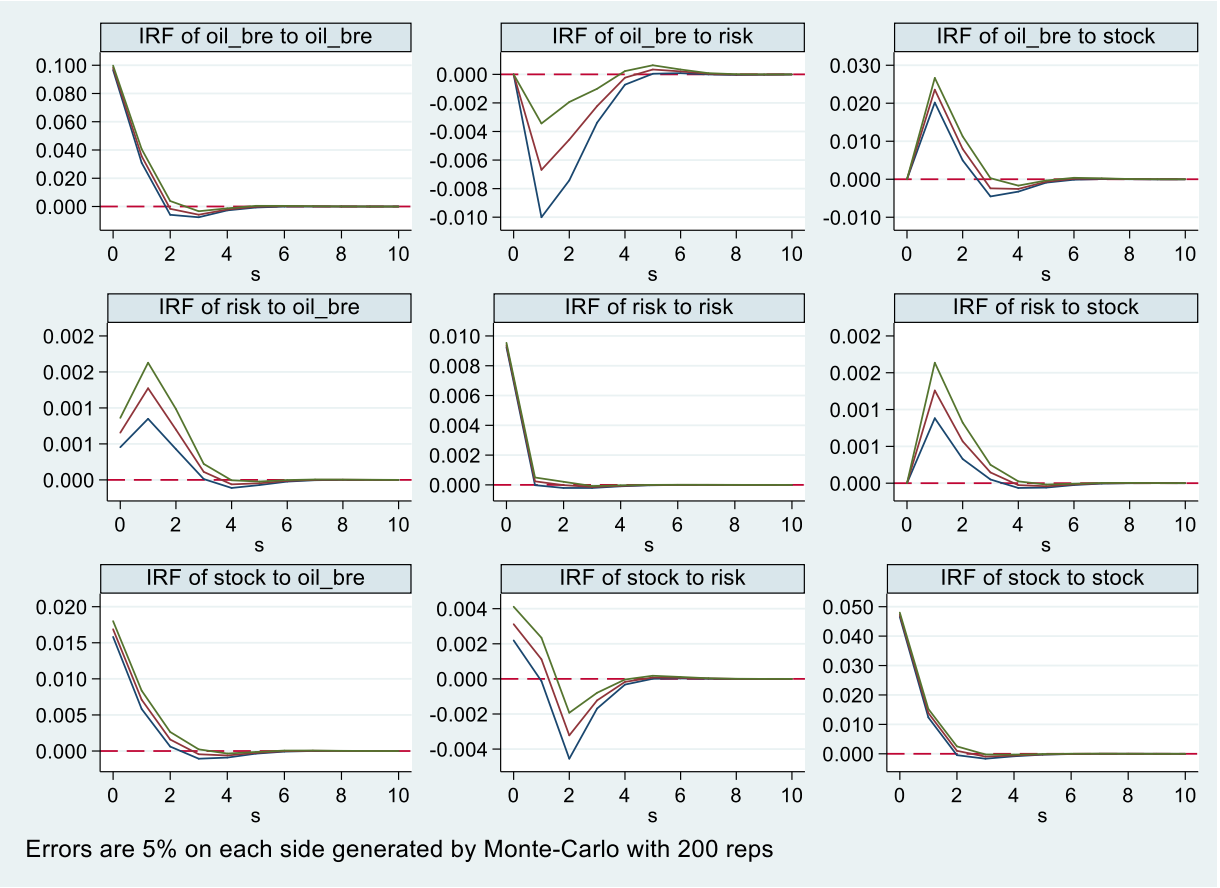

Fig. 1. Impulse responses of oil returns, country risk changes and stock returns.

country risks on oil prices can thus be explained and verified (Liu et al., 2016). The second column further shows that country risk changes and stock returns are positively related in the first month, but this relationship becomes negative in the second month. This result indicates that a decrease in country risks only positively impacts stock returns in the short term, in line with most research findings (Liu et al., 2016; Sari et al., 2013). A decrease in country risks suggests that a country's prospects are good, which encourages investment in the stock markets. In addition, country risks are an important determinant of a country's capital flow, and these two variables are inversely related. That is, a decline in country risks may improve a country's capital liquidity, thus increasing its stock market's returns (Fiess, 2003).

The third column presents the impulse responses of oil returns and country risk changes to a stock return shock. It shows that a stock return shock positively impacts oil returns, which reach a peak in the first month and decline afterwards. This result may verify that oil prices rise when stock markets show signs of prosperity. The results further suggest that a stock return shock positively impacts country risk changes, suggesting that rising stock returns reduce country risks. This result is consistent with the conclusion reached by Sari et al. (Sari et al., 2013). Stock returns and prices are directly related to a country's economic and financial risks, which are the main components of overall country risks.

4.3. Further results for the subcomponents of country risks

We examine the three subcomponents of country risks, namely, economic, financial, and political risks, to understand the differences within the overall country risks. We replicate our analysis using these three subcomponents instead of the overall country risks. We conduct a Granger causality test preliminarily.

Table 5 presents the Granger causality test results. Consistent with the composite country risks, economic risk changes are the Granger cause of the oil returns and stock returns; oil returns and stock returns are also the Granger causes of economic risk changes. However, there are some divergences in financial risks. The results show that financial risk changes and stock returns interact mutually causal. However, although oil returns are identified as the Granger cause of financial risk changes, financial risk changes are not the Granger cause of oil returns. We identify only stock returns as the Granger cause of political risk changes. Oil returns are not the Granger cause of political risk changes, and political risk changes are not the Granger cause of stock returns. Therefore, economic risks are more significantly related to stock and oil returns than are financial and political risks.

We next analyse the relationships between the three types of risks and oil and stock returns. Fig. 2 presents the results of the relevant impulse response analysis.

The first column presents the impulse responses of the three subcomponents of country risks to an oil return shock. All three subcomponents exhibit a positive response to the oil return shock, indicating that rising oil prices contribute to a reduction in economic, financial, and political risks. The impulse response pattern of economic risks aligns closely with that of overall country risks, though the magnitude of the impact is more pronounced for economic risks. Among the subcomponents, the oil return shock exerts the greatest influence on economic risks, followed by financial risks, with political risks being the least affected.

The second column displays the impulse responses of stock returns to shocks induced by changes in the three subcomponents of country risk. The results of this analysis reveal varying effects. Firstly, a shock resulting from changes in economic risks negatively impacts stock returns, with this effect peaking in the second period. This finding suggests that a reduction in economic risks leads to a decline in stock returns. Secondly, a shock arising from changes in financial risks initially has a positive effect on stock returns, but this relationship turns negative in the second month. This indicates that a reduction in financial risks contributes to an increase in stock returns in the short term, mirroring the trends observed for overall country risks. Lastly, a shock from changes in political risks has a positive impact on stock returns, although the analysis shows that political risks are not the Granger cause of stock returns.

The third column presents the impulse responses of oil returns to shocks induced by changes in the three subcomponents of country risks, revealing differing impacts depending on the type of risk. A shock resulting from changes in economic risks is associated with a relatively rapid decline in oil returns, suggesting that a reduction in economic risks leads to a decrease in oil prices. This downward trend reaches its lowest point in the first period and dissipates by the third period. In contrast, a shock from changes in financial risks has a positive effect on oil returns, indicating that a reduction in financial risks results in an increase in oil prices. Lastly, the shock from changes in political risks has a negative impact on oil returns, although this effect is not statistically significant.

The fourth column illustrates the impulse responses of the three subcomponents of country risks to a shock in stock returns. All three subcomponents exhibit a negative response to a positive shock in stock returns, aligning with the results observed for overall

Table 5
Results of Granger causality testing of subcomponents of country risks.

H0: X is not the Granger cause of Y.		Economic risk			Financial risk			Political risk		
Y	X	Chi2	p	Accept /reject	Chi2	p	Accept /reject	Chi2	p	Accept /reject
Stock	oil	7.93	0.019	Reject	12.60	0.002	Reject	12.53	0.002	Reject
	risk	14.17	0.001	Reject	20.04	0.000	Reject	0.53	0.768	Accept
Risk	oil	9.11	0.011	Reject	18.45	0.000	Reject	0.94	0.625	Accept
	stock	13.66	0.001	Reject	6.63	0.036	Reject	32.01	0.000	Reject
Oil	risk	22.52	0.000	Reject	0.45	0.800	Accept	4.25	0.120	Accept
	stock	132.81	0.000	Reject	122.11	0.000	Reject	12.68	0.000	Reject

Note: 'Accept' or 'reject' indicates the acceptance or rejection of the null hypothesis, respectively.

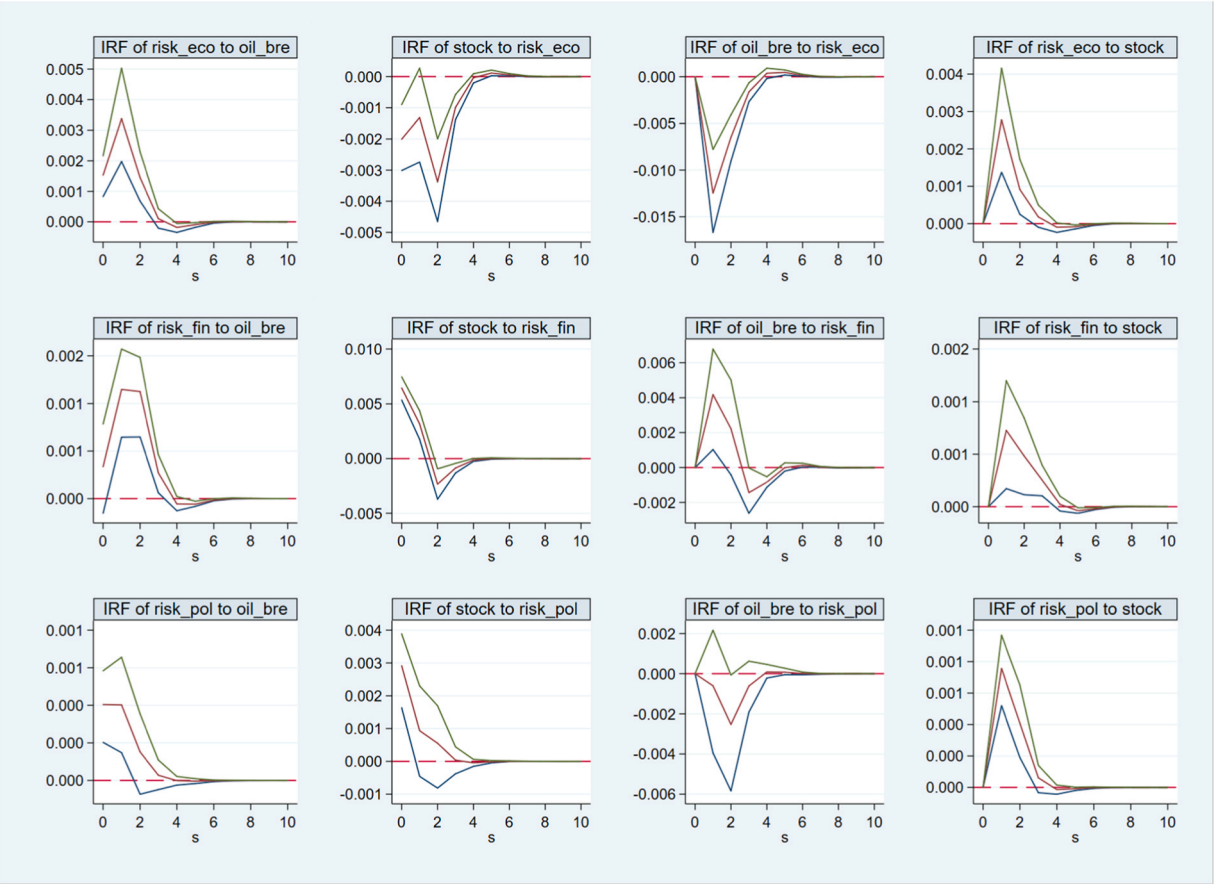

Fig. 2. Impulse responses of the three subcomponents of country risks.

country risks. This indicates that an increase in stock returns leads to a reduction in economic, financial, and political risks. However, the magnitude of these impacts varies. Similar to the effects observed with an oil return shock, the impact of a stock return shock is most pronounced on economic risks, followed by financial risks, with political risks experiencing the least impact.

4.4. Robustness check and additional tests

The stability conditions of the PVAR model are further checked. These conditions assume that the PVAR model has an infinite-order vector moving average and is reversible (Abrigo and Love, 2016; Zouaoui and Zoghlami, 2020). A common method for determining whether the PVAR model is stable involves calculating whether the modulus of each eigenvalue of the estimated model is less than 1. The data in Fig. 3 are obtained using the method developed by Abrigo and Love (Abrigo and Love, 2016). We observe that all the eigenvalues are within a circle of radius 1, indicating that the modulus of each is less than 1; therefore, our PVAR estimation model satisfies the stability condition.

We conduct a series of further analyses to check the robustness of our original analysis. First, we substitute the Brent oil price with the WTI price. Like the Brent oil price, the WTI oil price is one of three benchmark prices in the world oil market and is widely used in this context (Gharib et al., 2021). The results of this analysis are consistent with our original measurements (see Appendix Fig. A1).

Second, we divide the full sample of countries into two subgroups, namely developed and developing countries, according to the criteria of the International Monetary Fund.[3] The results obtained for both subgroups are generally similar, although they vary slightly in the extent of the impacts of the variables (see Appendix Figs. A2, A3). For example, although rising oil prices reduce country risks in both subgroups, this impact is more significant in developed countries than in developing countries. One possible reason for this difference is that developed countries consume the majority of oil supplies. Oil price increases driven by demand reflect economic prosperity, which leads to a decrease in country risks. However, the impact of country risks on stock returns is stronger in developing countries than in developed countries. This may be because developing countries are more vulnerable and sensitive to country risks, and changes in country risks cause turbulence in the stock market. In comparison, the financial markets of developed countries are

[3] https://www.imf.org/en/Home

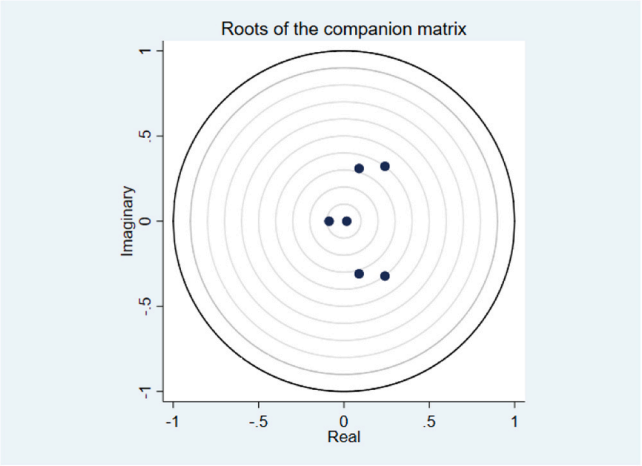

Fig. 3. Stability test of the PVAR model.

more stable and better able to resist changes in country risks.

5. Conclusion, limitations, and future study

Research has demonstrated that oil price fluctuations over the past decade are closely linked to the global economic cycle, which in turn influences capital markets (Chen et al., 2016). The growing uncertainties in this era of re-globalization have heightened country risks, which further interact with global oil and stock markets. Despite this, few studies have simultaneously examined the relationships between country risks, oil prices, and stock market returns. In this study, we employ a PVAR model to explore the correlations among these three variables concurrently. Our findings indicate that rising oil prices tend to reduce country risks and enhance stock market returns. On the other hand, an increase in country risks can lead to higher oil prices and a decline in stock market returns. Additionally, a stock market boom appears to lower country risks and drive up oil prices. We further dissect the subcomponents of country risks—economic, financial, and political—and discover significant heterogeneity in how these risk subcomponents interact with the stock and oil markets.

These findings indicate that governments should closely monitor the underlying causes of rising oil prices. Research indicates that recent oil price increases have been primarily demand-driven (Liu et al., 2016), a scenario that tends to reduce country risks, enhance stock market returns, and foster economic growth. Conversely, if an increase in country risks drives up oil prices, the resulting impact on the stock market could be significantly negative. Consequently, governments should proactively work to mitigate country risks to maintain the stable and efficient functioning of the national economy.

Furthermore, country risk assessments play a critical role for investors. Ratings agencies such as the ICRG, Moody's, and Standard & Poor's regularly perform national risk evaluations, providing valuable insights that help governments and businesses formulate optimal strategies (Qazi, 2023). For investors, closely monitoring the level of country risk is essential in deciding whether to enter a specific market. Moreover, understanding the intricate relationships between oil prices, country risks, and the stock market can enhance investors' decision-making processes, particularly in navigating the uncertainties brought about by fluctuations in oil prices and country risks. This is especially pertinent given our findings on the varying impacts of different risk subcomponents.

This study acknowledges two limitation that point to important opportunities for future research. Our analysis of country risks is limited to economic, financial, and political risks. To provide a more comprehensive understanding, future studies should consider incorporating geopolitical risks, which have a direct and profound impact on global oil and capital markets. Second, while we recognize that oil price fluctuations are driven by a variety of factors. Expanding the scope to examine the different drivers of oil price changes would offer deeper insights into their effects on country risks and market dynamics.

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CRediT authorship contribution statement

Qingyuan Dong: Writing – original draft, Validation, Software, Methodology, Formal analysis. **Qunyang Du:** Investigation, Funding acquisition, Data curation, Conceptualization. **Anna Min DU:** Writing – review & editing, Supervision, Resources, Project administration, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Appendix

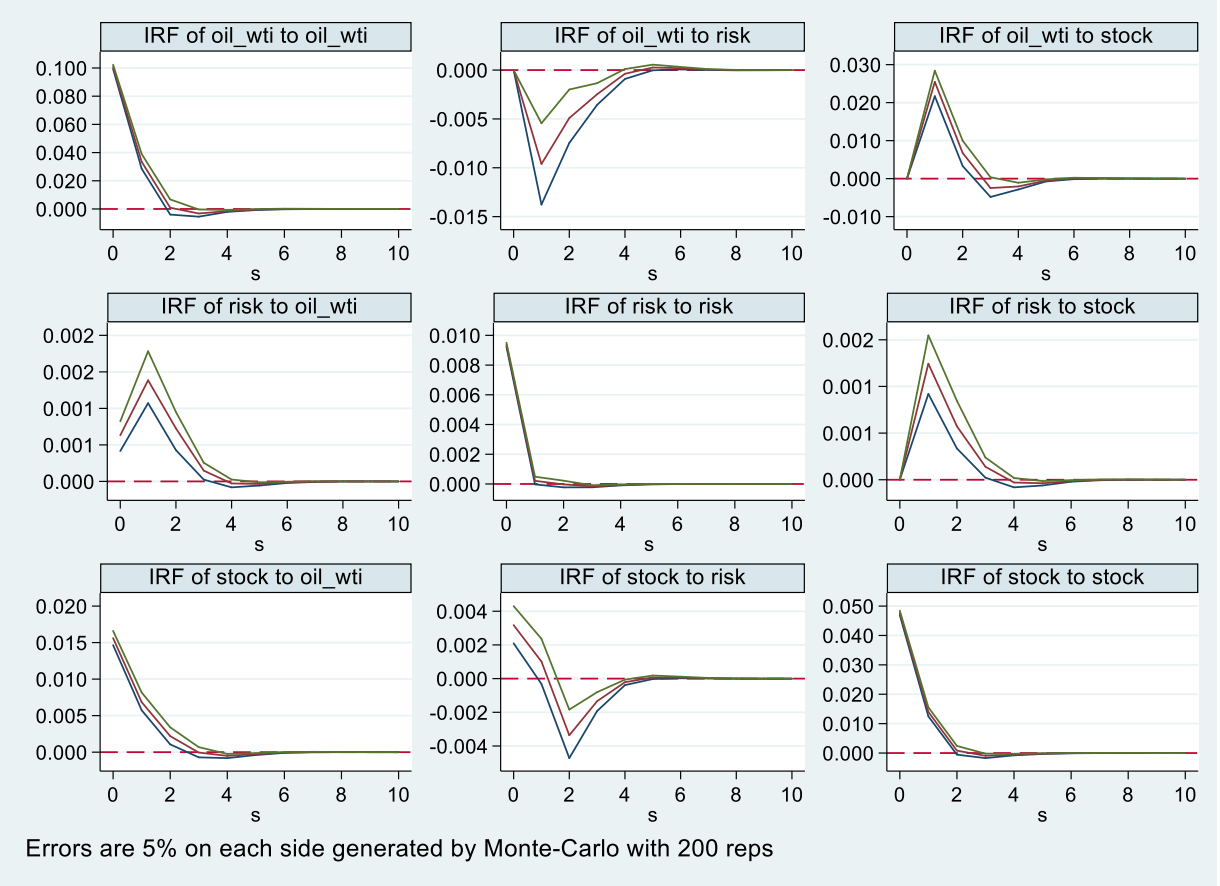

Figure A1. Impulse responses of oil returns (wti), country risk changes and stock returns

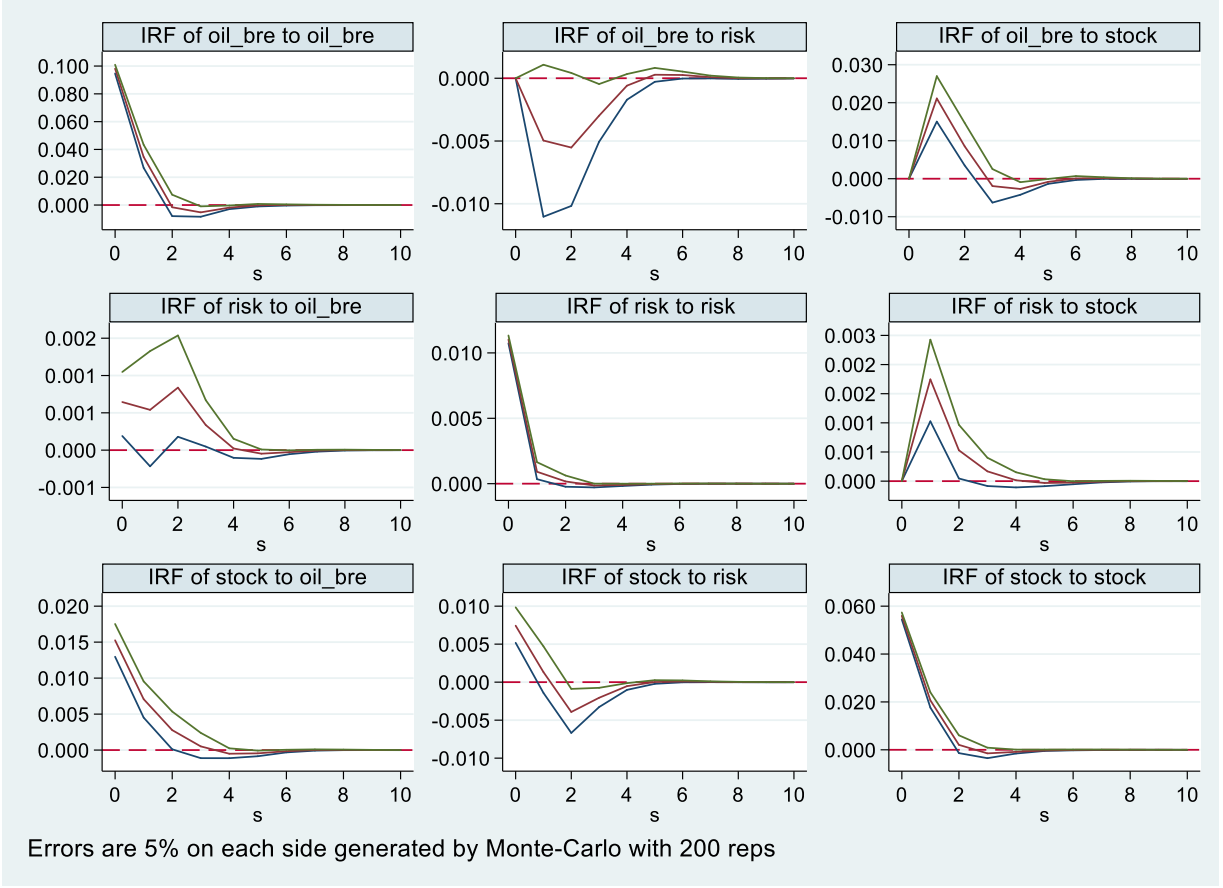

Figure A2. Impulse responses in developing countries

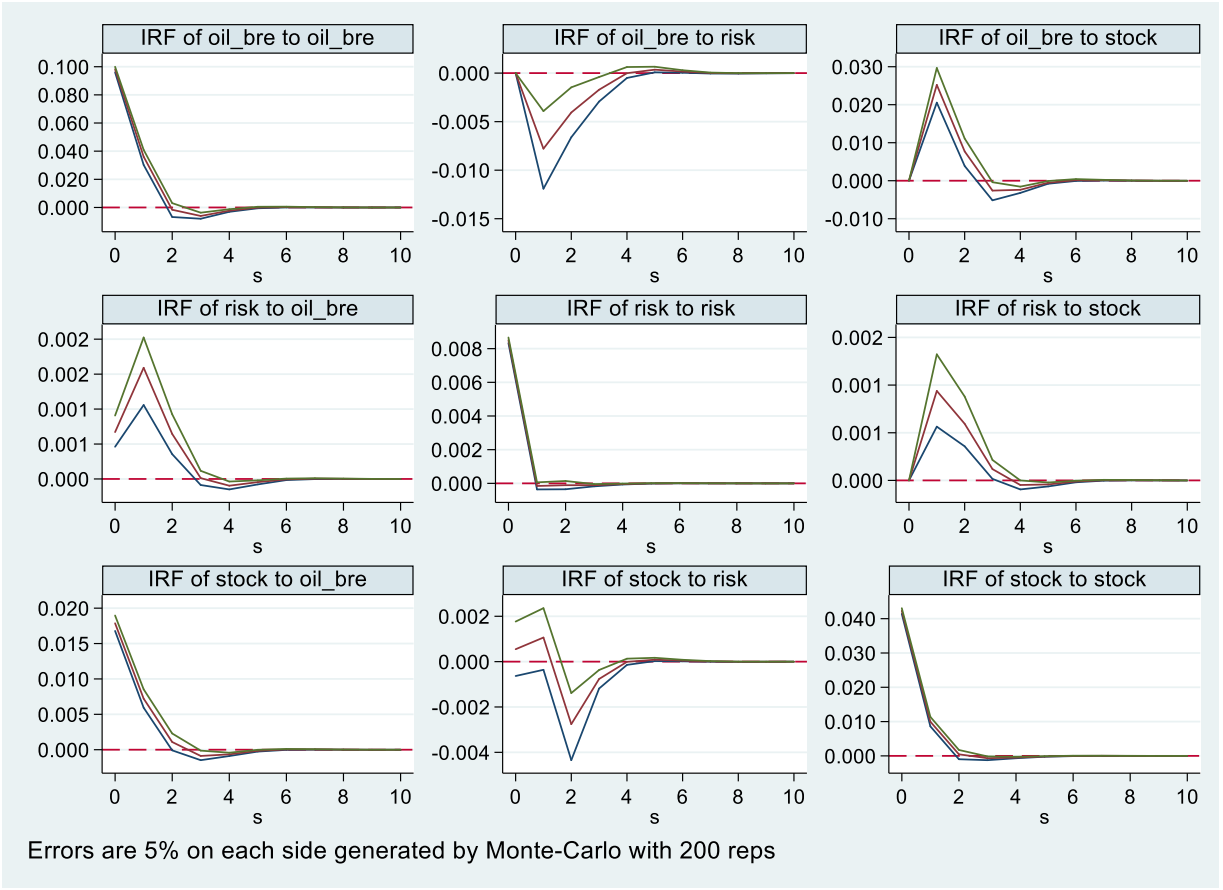

Figure A3. Impulse responses in developed countries

Table A1
Chosen stock indexes for the sample countries (regions)

Region	Index	Period
Argentina	Argentina MERV Index	Feb 2005–Aug 2020
Austria	Austrian ATX Index	
Australia	Australian Common Stock Index	
Brazil	Sao Paulo IBOVESPA Index	
Germany	Frankfurt DAX Index	
Russia	Russia RTS Index	
France	France Paris CAC40 Index	
Philippines	Philippines Manila Composite Index	
South Korea	Korea Composite Index	
Netherlands	Netherlands AEX Index	
Canada	Toronto Stock Exchange Composite Index	
Malaysia	Malaysia Kuala Lumpur Index	
United States	New York Stock Exchange Composite Index	
Mexico	Mexico MXX Index	
Japan	Tokyo Nikkei 225 Index	
Switzerland	Zurich Market Index	
Spain	Madrid SMSI Index	
Singapore	Singapore Straits Index	
India	Mumbai, India Sensex30 Index	
Indonesia	Indonesia Jakarta Composite Index	
U.K	London Financial Times 100 Index	
China	Shanghai Composite Index	
Taiwan, China	Taiwan Weighted Index	
Hong Kong, China	Hang Seng Index	
Sweden	Sweden OMXSPI Index	

(*continued on next page*)

Table A1 (*continued*)

Region	Index	Period
Israel	Israel TA−100 Index	
Norway	Norway OSEAX Index	
Italy	Italy MIB Index	
New Zealand	New Zealand NZ50 Index	

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