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The Stock Market Response to Oil Price Shocks in Selected Oil-Importing Countries

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Abstract
As one of the most important components of the financial market, the stock market plays a significant role in facilitating the transfer of financial resources to the productive sector; therefore, identifying the factors that influence this market and the response of this market to shocks that occur has always attracted the interest of policymakers and analysts. The present study focuses on the response of stock market returns of major oil-importing countries to the oil price shock, oil supply shock, and aggregate demand shock over the period 2010-2019 using the Panel Vector Autoregressive (PVAR) method. Based on the extracted impulse response functions (IRFs), the response of the stock market index to the oil price shock and the oil supply shock is negative, while the response of the stock market index to the aggregate demand shock is generally positive. The results of variance analysis show that the oil price shock, oil supply shock, and aggregate demand shock have the largest impact on the fluctuations of the stock market index, and indicate the selected oil-importing countries have taken measures to hedge their stock market against the oil price shock during the crisis period.

Keywords: Oil Price Shock, Stock Market, Oil-Importing Countries, PVAR.
JEL Classification: C58, E44, G10, Q43

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1. Introduction

The stock market, as one of the most important subsets of the financial market, plays a crucial role in directing financial resources from the non-productive sector to the productive sector, and its index can be considered one of the most important components of the economic situation of countries (Wu, Hou, & Cheng, 2010). The stock market, as an indexed market, is influenced by several economic and non-economic factors, so any change in these factors can cause micro and macro changes in this market (Subing & Kusumah, 2017). There are different types of economic shocks, which can be divided into: 1) environmental shocks, such as natural disasters (earthquakes, hurricanes, floods), 2) exogenous shocks, such as shocks related to trade and exchange rate, instability of prices of imported goods and oil price, etc., and 3) endogenous shocks, such as shocks related to political instability and unpredictable policy changes (Guillamont, 2010). It would be important for large and small investors to know the impact of the macroeconomic variables shock on the stock market to have a more balanced portfolio that could save their capital from spoiling (Kang, Ratti, & Yoon, 2015). The analysis of the response of different economic variables to the oil price shock has always been one of the most interesting topics for economists; therefore, different studies have been conducted based on different modeling methods in the context of time-series studies and panel data (Bergmann, 2019; Bashar, Haug, & Sadorsky, 2016; Ordóñez, Monfort, & Cuestas, 2019). The stock market and securities are some of the most important markets that have been very sensitive to oil shocks (Maboudian & Seyyed Shokri, 2015).

Policymakers and economic planners are eager to improve the conditions of the stock market, a dynamic market that plays an important role in the economic growth and development of countries. Moreover, since the stock market is closely intertwined with other financial markets, including gold, foreign exchange, consumer durables, and the banking system, the influence of oil prices on the stock market could be transmitted to other financial markets and create new economic conditions in the country (Gokmenoglu & Fazlollahi, 2015). Increasing returns and reducing risks attract more resources to stock markets; therefore, it is important to identify the factors that can sometimes increase the return or decrease the risk in the form of shock. Unpredictable events that lead to impulses in the economy (shocks) can also have important short and medium-term effects on the economy (Guillamont, 2010). In this regard, several studies have found that risk and return in equity markets are affected by various shocks including oil supply and its price (Salisu & Gupta, 2021; Mokni, 2020; Liu, et al,, 2020; Papadamou, et al., 2020; Gou, et al., 2020).

The oil market has always been a strategic and important market with a significant impact on the macroeconomic and financial markets of the world economy. The importance of the oil price shock is such that Hamilton (1983) asserts, that after World War II, all economic downturns in the United States began with a rise in the price of oil (Bjørnland, 2008). Since the oil market has played a major role in shaping and organizing the economy, the nature of the relationship between the oil price shock and the stock market would be of great importance and its price has been one of the most important components of economic policy modeling for both developed and developing countries. Oil price shocks have always been targeted by economists as exogenous shocks due to their impact on various sectors of countries' economies and various studies have been conducted on the impact of oil prices on important and macroeconomic variables. Studying the stock market response to the oil price market is important because these shocks affect the stock market returns of different countries in different ways including production cost channel, cost of goods and services, effectiveness on aggregate demand in terms of oil-importing countries, and oil income channel, public and private sector investment in terms of oil-exporting countries.

The main objective of the present study is to determine the general response of the stock markets of the major oil-importing countries to the oil price shock. On the other hand, the study aims to investigate the response of the stock market index variables to shocks in the global oil production variables (oil supply shock) and the Kilian index variables (aggregate demand shock). To achieve these objectives, the study applied a model involving the stock market return, global oil price, global oil production, and Kilian index variables at the monthly level. The approach for estimating the parameters, extracting the impulse response functions, and variance decomposition of the model is performed using the Panel Vector Autoregressive (PVAR) method during the monthly interval from 2010 to 2019.

The present study differs from previous studies in several aspects. The innovation of the present research can be seen in the selection of the studied countries and the investigation of the response of the stock market of different oil importing countries to the global oil price shock.

The remaining of paper includes four more sections in which Section 2 reviews the literature, Section 3 indicates the research method used in this study, Section 4 represents empirical findings and Section 5 discusses the results and concludes, respectively.

2. Review of the Literature

Many factors affect the information and opinion formation of market participants and the stock prices of companies, some of which are internal and others are due to the situation of variables outside the domestic economy. Internal factors are related to the company's operations and decisions and include such things as earnings per share (EPC), dividend per share (DPC), price/earnings ratio (P/E), capital increases, and other factors within the company. External factors in management, on the other hand, are not related to the company and can generally be divided into two areas: 1) Political factors such as war, peace, the breakdown of political relations, and the emergence of rival political parties, and 2) Economic factors such as the period of prosperity and recession (Cong, et al., 2008). In general, the current situation of the stock market depends on the current economic situation and the knowledge of the prospects of companies. The most important factor that influences investors' decisions in the stock market is the stock price index; therefore, knowing the factors that influence stock prices is very important. In this regard, several studies have been conducted to investigate various economic factors in the stock market (Engle & Rangle, 2008; Güntner, 2014; Kang & Ratti, 2013; Kilian & Park, 2009).

On the other hand, oil as the most important energy source in the world and one of the most important factors of production has always occupied a special place in the world economy and is considered one of the important factors influencing the stock market. Since the value of stocks is equal to the sum of the discounted effects of future cash flows and these flows are affected by macroeconomic events, they can therefore be affected by oil and shock, which makes perfect sense. The stock market absorbs information about the consequences of oil shocks and reflects it in stock prices (Bjørnland, 2008). Capital market analyses indicate that since oil plays an important role in the production process of companies, it can affect the stock markets of importing countries through various channels and ultimately lead to lower economic growth and higher inflation. In other words, an increase in oil prices leads to an increase in production costs and the cost of goods and services produced, as well as a decrease in corporate profits. In addition, an increase in the price of produced goods and services changes consumer behavior and reduces aggregate demand. In the next phase, after the decrease in consumer demand, the level of production also decreases, and the unemployment rate increases; therefore, the stock market is expected to react negatively to oil shocks (Youssef & Mokni, 2019). Moreover, the impact of the oil price shock due to the uncertainty it creates for the financial markets should not be ignored, depending on whether this sudden price increase is due to demand or supply. Indeed, stock markets are expected to react positively and negatively to oil price shocks caused by increasing global demand and supply, respectively (Filis, et al., 2011; Hamilton, 2009; Kilian & Park, 2009). The study of the relationship between oil price shock as one of the macroeconomic variables and the stock market of different countries has yielded different results in different periods and using different econometric methods.

A review of the literature on the oil price shock shows that a large number of empirical studies used time series and case studies of countries in this regard (Hussin, et al., 2012; Kang et al., 2015; Akinlo, 2014). Moreover, many studies have examined the impact of an oil price shock on variables such as economic growth, inflation, unemployment, exchange rate, etc. (Cunado & Garcia, 2005; Kilian, 2008; Cologne & Manera, 2008), and relatively few studies have focused on the stock market response to this shock. Fasanya, al. (2021) studied the behavior of oil price and the stock market in GCC countries in terms of asymmetries and structural breaks using the symmetric and nonlinear ARDL estimation approach during the weekly period (2016-1992). The results show an asymmetric response of most GCC equity markets to oil prices, and the high sensitivity of global economic activity and geopolitical risks to oil prices.

Alamgir and Amin (2021) studied the relationship between oil price and stock markets in South Asian countries using the NARDL method for the period 1997 to 2018. The results show a positive relationship between the world oil price and the stock market index and the asymmetric response of the stock market index to positive and negative oil price shocks. Mokni (2020) examined the time-varying effects of oil price shocks on stock market returns in oil-importing countries including China, Japan, India, South Korea, and oil-exporting countries including Russia, Norway, Venezuela, and Mexico using Structural Vector Autoregressive (SVAR) and Time-Varying Parameter Regression (TVPR) methods over the period 1999-2018. The results show that stock market returns are more responsive to demand shocks than to supply shocks. The effects of supply shocks on stock market returns are small and negative, while the effects of demand shocks on stock market returns were positive. The oil-specific demand shock has a positive effect on stock market returns in oil-exporting countries and a negative effect on oil-importing countries (except China). Algia and Abdelfatteh (2018) investigated oil price shocks and their impact on stock market returns in selected developed and emerging countries including the United States, Germany, France, Italy, Japan, Thailand, Argentina, Brazil, Tunisia, and Jordan using the SVAR method over the period 1998-2014. The results suggest that the impact of oil price changes due to financial shocks could lead to a decline in stock prices in all developed countries and one of the emerging countries (Brazil) and the oil supply shock has a small effect on the fluctuations of stock prices in developed and emerging economies.

Bouoiyour, et al. (2017) examined the stock market return response of selected importing countries (China, France, Germany, India, Japan, the UK, and the US) and exporting countries (Canada, Kuwait, Mexico, Norway, Russia, Saudi Arabia, and Venezuela) to oil price shocks using SVAR and Quantile-on-Quantile regression (QQR) approach in the period 1994-2015. The results show significant heterogeneity in the relationship between stock returns and oil prices in importing and exporting countries, and the response of large exporting countries to oil shocks on the demand side is higher than in importing countries. Bestianim, et al. (2016) studied the impact of oil price shocks on stock market volatility in G7 countries (Canada, France, Germany, Italy, Japan, and the United Kingdom) using the VAR approaches over the period from 1972 to 2015. The results show that the stock market in G7 countries does not respond to oil supply shocks; however, the oil demand-side shocks, especially the aggregate demand shock, have a significant impact on the variability of the stock market in these countries. Maboudian and Seyyed Shokri (2015) investigated the relationship between oil price and the Tehran stock market; using the SVAR method over the period from 1972 to 2015. The results indicated the oil supply shock is not statistically significant according to the impulse response functions, and the variance decomposition shows specific stock market shocks could explain 88% of the changes in the Tehran stock index, while the oil supply shock could only explain less than 1% of the changes and other shocks about 5%.

Kang et al. (2015) examined the impact of oil price shocks on the relationship between stock market returns and volatility in the U.S. stock market; using the SVAR approaches over the period from 1972 to 2015. The results show that a positive shock originating from aggregate demand and oil market-specific demand has a significant negative effect on the covariance of returns and volatility. On the other hand, a disruption in oil supply has a positive effect on the return and volatility of the U.S. stock market, while the spillover index has a large and statistically significant effect on the structural oil price shocks. Abhyankar, et al. (2013) studied the relationship between oil price shocks and the stock market in Japan; using the SVAR method over the period from 1972 to 2015. The results show that: 1) Depending on the specific causes of a higher oil price, Japanese real stock market returns respond differently to oil price shocks; 2) The response of the Japanese stock market to all crude oil price shocks could be almost completely attributed to real cash flows; and 3) the Japanese stock market responds more strongly to the unexpected global demand increase compared to the United States stock market.

Considering the previous studies and the results obtained, it can be seen that most of the studies on the stock market response to the oil price shock did not have the same results and often contradictory results were obtained. Studies by Alamgir and Amin (2021); Bashar (2006), and Sadorsky (2003) show positive relationships between the stock market return and the oil price shock, while Algia and Abdelfatteh (2018), Ono (2011), and Park and Ratti (2008) concluded the negative relationship between the stock market return and the oil price shock. The different results can be interpreted due to differences in the selected countries or the period of the models studied (short and long term). Moreover, most of the previous studies used time-series data to examine the impact of oil price shocks on the stock market, while the present study aims to focus on the response of stock market returns of major oil-importing countries to the oil price shock, oil supply shock and aggregate demand shock over the period (2010-2019) using the Panel Vector Autoregressive (PVAR) method. Accordingly, the present study seems to be innovative both in terms of the estimation approach and the group of countries studied.

3. Research Method

According to the purpose of studying the impact of oil shocks on the stock market of countries, the present study has been done with an emphasis on oil importing countries, and for this purpose, data from a panel of the top 12 oil importing countries including the United States of America, China, India, Japan, South Korea, Germany, Italy, Spain, France, Netherlands, Great Britain, and Thailand were used. The main criteria for choosing these countries is their high share in oil imports, so they accounted for 75% of the world's total oil imports in 2020. In addition, the data for the monthly period (2019-2010) were reviewed. The proposed model includes independent variables such as Global Oil Price (the variable of oil price was included in the model based on the global oil price of West Texas Intermediate (WTI) as the best representative based on comparisons in stationary variables and Granger causality), Global Oil Production (calculated based on total world oil production on a scale of millions of barrels per month), and Kilian Index (this is a proxy for real global economic activity, and is based on dry freight rates to estimate the level of global economic activity as a proxy for global oil demand). The dependent variable of the model is the Stock Market Return, which indicates the state of the stock market in the countries under study. The present research model has been illustrated in Eq. 1

$$\mathrm{Y}_{\mathrm{it}} = f(\mathrm{X}_{1\ \mathrm{it}}, \mathrm{X}_{2\ \mathrm{it}}, \mathrm{X}_{3\ \mathrm{it}})$$

$$Y_{it} = \hat{\alpha} + \widehat{\beta_1} X_{1\ it} + \widehat{\beta_2} X_{2\ it} + \widehat{\beta_3} X_{3\ it} + e_{it} \tag{1}$$

Where the variables for estimation are Y_{it}: indicating the return of the stock market, $\mathrm{X}_{1,\mathrm{it}}$: indicating global oil price based on the World Trade Index, $\mathrm{X}_{2,\mathrm{it}}$: indicating global oil supply (Total world petroleum production / million barrels per month), $\mathrm{X}_{3,\mathrm{it}}$: indicating the Kilian index, and e_{it}: indicates panel residual term.

To estimate the research model, the Panel Vector Autoregressive (PVAR) approach is used which is a combination of the Vector Autoregressive (VAR) model and the panel data. In this method, all model variables are endogenous and the number of variables entered is equated. This estimation approach attempts to explain the behavior of a variable based on the past values of that variable and a number of other variables simultaneously. Also, when the equations of this model include the intervals of the mentioned variables, we will face a system of simultaneous dynamic equations. This allows us to examine ignored individual heterogeneity as well (Ibrahim, 2019). Considering that the vector autoregressive panel data system is a suitable method for predicting systems with combined time-series and cross-sectional variables, it is sometimes used in the dynamic analysis of various random disturbances and control of variable systems (Comunale, 2022). The following vector autoregressive panel data system is considered with two variables and one lag length, as illustrated in Eq. 2 and 3.

$$y_{it} = b_{10} - b_{12}z_{it} + \gamma_{11}y_{it-1} + \gamma_{12}z_{it-1} + \varepsilon_{yit} \quad (2)$$

$$z_{it} = b_{20} - b_{21}y_{it} + \gamma_{21}y_{it-1} + \gamma_{22}z_{it-1} + \varepsilon_{zit} \quad (3)$$

The system structure in equations 2 and 3 is such that y_{it} and Z_{it} influence each other. For example, $-b_{12}$ indicates the simultaneous effect of one unit of change from z_{it} to y_{it} and γ_{21} indicates the effect of one unit of change from y_{it-1} to z_{it}. ε_{yit} and ε_{zit} are the net shocks of y_{it} and z_{it}, respectively. When b_{12} is nonzero, ε_{yit} has a simultaneous indirect effect on z_{it}, and when b_{21} is nonzero, ε_{zit} has a simultaneous indirect effect on y_{it}. Since y_{it} and z_{it} act on each other simultaneously, equations 2 and 3 are not in the shortened form, and for their transformation into a useful form of matrix algebra, Eq. 4 & 5 are introduced.

$$\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} y_{it} \\ z_{it} \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} y_{it-1} \\ z_{it-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yit} \\ \varepsilon_{zit} \end{bmatrix} \quad (4)$$

Or

$$BX_{it} = \Gamma_0 + \Gamma_1 X_{it-1} + \varepsilon_{it} \quad (5)$$

By multiplying B^{-1} in Eq. 5, the vector autoregression model in standard form is generated as Eq. 6 & 7.

$$X_{it} = A_0 + A_1 X_{it-1} + e_{it} \quad (6)$$

Where; $A_0 = B^{-1}\Gamma_0$, $A_1 = B^{-1}\Gamma_1$, $e_{it} = B^{-1}\varepsilon_{it}$ (7)

Equations 2 and 3 are called the structural Panel-VAR system or the primary equation system and Equations 6 and 7 are known as the Panel-VAR system in the structure's form. The PVAR equation system is known as the dynamic and linear system which could be estimated using the OLS technique due to the presence of the predetermined variables (Abrigo & Love, 2016). What is generally said in panel models is that there is a separate P decision unit that is numbered with an index of i from 1 to p as well as an m consecutive period that is numbered with an index of t from 1 to m.

It should be noted that in order to pay attention to the importance of the stock financial market and its effective and determining factors, including oil price fluctuations, global shocks, oil supply, and also oil demand, the selected theoretical framework and the variables examined in the measurement model of this research were inspired by the studies of Algia and Abdelfatteh (2018), Bestianim et al. (2016), and Kang et al. (2015) have been formed. The linear regression of this panel is as follows (Eq. 8):

$$Y_{it} = \alpha_i + \beta_1 X_{1it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + e_{it} \quad (8)$$

In this regression, the general system of the parameters of all units has been provided for all intervals. One of the most common forms of data organization in the above equation is based on the decision units. So, we have Eq. 9:

$$Y_i = \begin{bmatrix} Y_{i1} \\ \cdot \\ \cdot \\ y_{im} \end{bmatrix} \quad X_i = \begin{bmatrix} X_{1it} & \cdot & X_{kit} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ X_{1im} & \cdot & X_{kim} \end{bmatrix} \quad e_{it} = \begin{bmatrix} e_{i1} \\ \cdot \\ \cdot \\ e_{im} \end{bmatrix} \quad (9)$$

The data could also be expressed in the aggregated form as follows (Eq. 10):

$$Y = \begin{bmatrix} Y_1 \\ \cdot \\ \cdot \\ y_p \end{bmatrix} \quad X = \begin{bmatrix} X_1 \\ \cdot \\ \cdot \\ X_p \end{bmatrix} \quad e = \begin{bmatrix} e_1 \\ \cdot \\ \cdot \\ e_p \end{bmatrix} \quad (10)$$

where Y is a vector of n×1 order variables, X is a vector of n×k order variables, e is a vector of n×1 order error terms, which can be rewritten as follows (Eq. 11):

$$Y = [i \quad X].\begin{bmatrix} \alpha \\ \beta \end{bmatrix} + e \quad (11)$$

where i indicate a vector of n×1 order units (country), α indicates the scalar matrix showing the difference between the sections (countries) in the panel model that is assumed to be fixed over time, and $\beta = \beta_1, \beta_2, \beta_3, \ldots, \beta_k$ are the model estimation coefficients. Assuming the stability of α_i in all sections (countries), the OLS method generates efficient and adapted estimations of α, and β (Baltagi, 2005).

4. Empirical Results

The main objective of the study was to investigate the response of Stock Market Returns of major oil-importing countries to the Oil Price Shock, Oil Supply Shock, and Aggregate Demand Shock over the period

2010-2019; using the Panel Vector Autoregressive (PVAR) method.

Table 1 shows the type of variables of the research model, measurement scale, and source of information collection related to each variable.

Figure 1 shows the situation of the twelve countries studied and their share of total oil imports in 2020. The United States has the largest share (nearly 18%) and Thailand has the lowest share (nearly 2%) of the oil imports in 2020.

Table 1. Introduction of Research Model's Variables

Variables	Unit of Measurement	Source of Data
Return of Stock Market	Closed price stock market index	www.investing.com
Global Oil Price (West Texas Intermediate)	Price per barrel in dollars	www.opec.org
Global Oil Supply (Total world petroleum production)	million barrels per month	www.eia.gov
Kilian Index	no unit	www.sites.google.com/site/lkilian2019

Source: Compiled by Authors

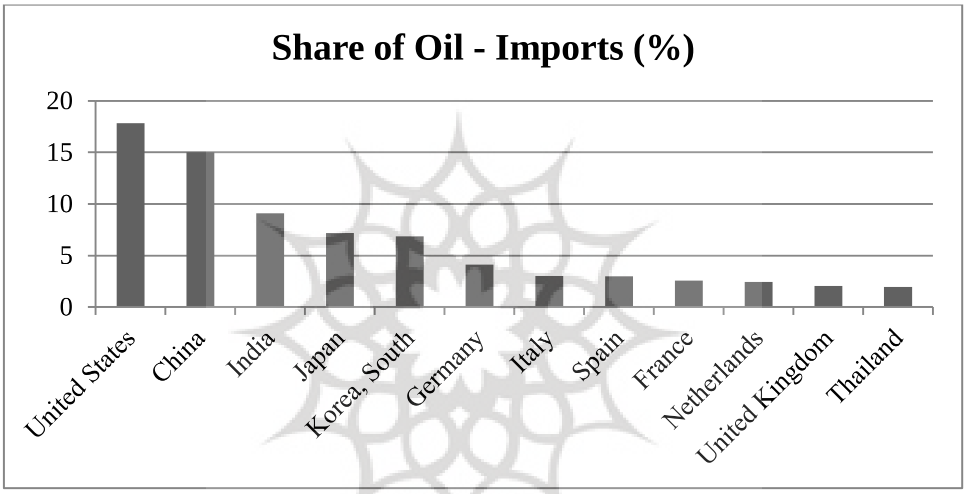

Figure 1. The Share of 12 Major Oil Importing Countries in the Total Imported Oil (2020)
Source: www.indexmundi.com

To analyze the stationary of the variables data, two approaches LLC and Fisher are used and the results are shown in Table 2. The stationary of the data is assessed by the LLC method using the statistically adjusted t* as well as the calculated probability value, and by the Fisher method (Dickey-Fuller and Phillips-Perron) using the P_M statistic and its probability value. Based on the values in Table 2, all research variables reject the null hypothesis of non-stationary data and confirm the stationary of the variables in the form given, based on the calculated probability value.

Table 2. Results of Levin-Lin-Chu (LLC) and Fisher Stationary Test

Variable	LLC test	Fisher (Dickey-Fuller) test	Fisher (Phillips-Perron) test	Conclusion
Stock Market Returns	-11.5590 (0.0000)	56.0830 (0.0000)	119.9565 (0.0000)	Stationary level
Oil Price (first differentiation)	-14.7863 (0.0000)	54.8822 (0.0000)	86.4979 (0.0000)	Non-Stationary level Stationary with one time differentiation
World Oil Production	-1.7039 (0.0442)	2.8658 (0.0021)	5.1286 (0.0000)	Stationary level
Kilian Index	-5.6801 (0.0000)	9.9604 (0.0000)	7.5289 (0.0000)	Stationary level

Note: Values in parentheses are the estimated coefficient probability values
Source: Authors

To determine the optimal lag length of the estimation model, considering the nature of the data and the significance of the coefficients in the different lags, a maximum of two lags for the explanatory variables (Table 3). According to the Bayesian, Akaike, and Quinn statistics listed in the optimal lag determination section, among the two selected lags entered manually, the estimated technique selected lag two as the optimal lag based on the negative values of the three statistics. The remaining steps of the estimation of the PVAR approach are performed considering the selected optimal lag 2.

Table 3. Determination of the Optimum Lag Length in the PVAR Approach

Lag determination statistic	Lag 1	Lag 2
MBIC[1]	28.01132	-21.48502*
MAIC[2]	193.6515	61.33505*
MQIC[3]	131.5217	30.27017*

* Indicates the optimality of data statistic value in the relevant lag
[1] Modified Bayesian Information Criterion, [2] Modified Akaike Information Criterions
[3] Modified Quinn Information Criterion
Source: Authors

After stationary analysis and determination of the optimal lag length, the model is evaluated to estimate the short-term effects and their directions, though the significance and interpretation of the coefficients and their direction are not among the objectives of the present study, one may prefer to observe the significance in part or all of the coefficients in the corresponding estimate (Abrigo & Love, 2016). The results of the model coefficients estimation have been provided in Table 4.

Table 4. Results of PVAR Estimation of Stock Market Returns in Selected Countries

Explanatory variables of the model	Lag 1	Lag 2
Stock market returns	-0.0076549 (0.824)	-0.0664319 (0.031)
Oil price (first-time differentiation)	0.0045318 (0.874)	-0.803762 (0.001)
World oil production	-1.098447 (0.0000)	1.122264 (0.0000)
Kilian index	-0.0063456 (0.284)	0.132568 (0.022)

Note: Values in parentheses are the estimated coefficient probability values
Source: Authors

According to the results in Table 4, the model coefficients (except for world oil production) are not significant at the first lag and 95% confidence interval. However, the significance of all coefficients in the second difference level is confirmed. The non-significance of the first difference level of the variables casts doubt on the direction of causality from the independent variables to the dependent variable; therefore, the Granger causality test is used to examine the causal relationships between the variables. Given the objective of the present study (i.e. to examine the response of stock market returns of major oil-importing countries to the oil price shock), the presence of bilateral causality between the oil price variable and stock market returns would confirm the correctness of the estimation approach, and the remaining modeling steps would be performed to extract the IRF functions. The results of the Granger causality test are summarized in Table 5.

Given the results of Table 5 and the calculated probability value (=0.003), from the oil price variable to the stock market return variable and the estimated probability value of 0.030 from the stock market return variable to the oil price variable, the two-way Granger causality relationship between these two variables is confirmed. The Granger causality test also indicates a two-way causal relationship between them (except for the Kilian variable, which has a one-way relationship with the stock return index).

Table 5. Granger Causality Test

Dependent/independent variable	chi2 Statistic	Probability value
Stock market returns / first-order differentiation of oil price	11.420	0.003
Stock market returns / World oil production	25.430	0.000
Stock Market Returns / Kilian Index	7.607	0.022
Stock Market Returns / Total	46.179	0.000
First-order differentiation of oil price / stock market returns	6.987	0.030
World oil production/ stock market returns	7.369	0.025
Kilian index / stock market returns	0.852	0.653

Source: Authors

Confirming the correctness of the variables of the model, the stability of the model and PVAR estimates are determined by calculating the absolute eigenvalues of the companion matrix and comparing them with the value of criterion 1. The result of the test shows that the absolute values of the calculated eigenvalues are within a single radial circle, indicating the stability of the estimated model (Fig. 2).

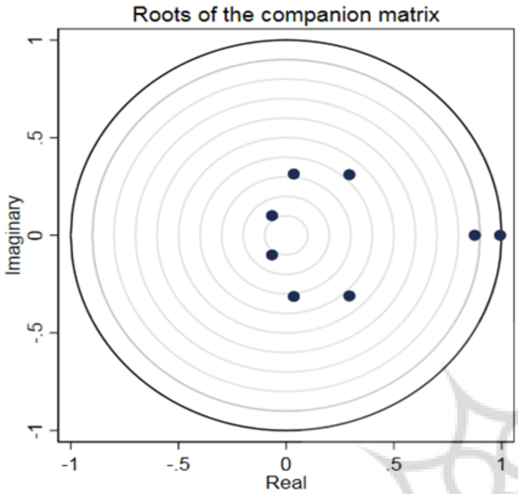

Figure 2. Model Stability Test
Source: Authors

Further, the impulse response functions (IRF) are extracted, which examine how the relevant variable (stock returns) responds to the shock emanating from each of the independent variables in the model including oil price, world oil production, and Kilian index. Diagrams in Figure 3, show that the stock market response to a shock in world oil production (oil supply shock) is negative for one period, but then becomes positive by the third period and eventually returns to the normal trend. In other words, when the oil supply shock is positive, the oil supply increases in that period, and the oil price decreases. The negative reaction of the stock market could be interpreted through the effective channel of investors' expectations.

Given the high stock prices of industries and companies based on current oil prices, small and large investors believe that the market return will decrease in the first period. In addition, the reason for the positive response of the stock return variable may be the low production costs and lower prime costs of goods and services, which increases the motivation of enterprises to earn more profits and increase the real return of the stock market permanently. Moreover, when there is a shock to aggregate demand (Kilian index variable), the stock market return response is negative for one period, but then becomes positive and does not return to normal until period 3.

In other words, when the Kilian index shock, which measures real global economic activity, is positive, oil demand increases and so does the price of oil in that period. Thus, the negative stock market variable response could be lower expected economic growth, higher production costs, higher prime costs for goods and services, and higher risk exposures such as insurance risk, resulting in lower aggregate demand. As stated before, the positive response of the stock market return variable could be due to smaller and larger public and private investors deploying their capital to enter a market with attractive prices. Since the Kilian index reflects the level of global economic activity, and most of this activity results from increased production in the developed and industrialized countries studied here, the increased return could also be justified (Aydogan & Berk, 2015).

Since the oil price shock is considered the most important shock in this study and the stock market reaction of the major oil-importing countries was estimated on this basis, a separate chart on this shock is shown in Fig. 4. According to the diagram in Fig. 4, the response of the selected oil-importing country's stock markets to the oil price shock is positive for the first period, while it was expected that the stock markets of oil-importing countries would react negatively to an oil price shock from the beginning. This can be described by the impact channel of the increase in expected inflation in a short period. With the increase in oil prices in the first days and months, investors overestimate stock prices due to their inflation expectations, which cause the stock prices and returns of these countries to increase for a while (European Central Bank, 2004). After this period, the return of the stock market reacts negatively and decreases due to the oil price shock, which can be described by the effective channels of lower expected economic growth, expected higher production costs in the next period, increased prime costs of goods and services, increased risk exposure, and lower aggregate demand. In other words, with the positive oil price shock, production costs and corporate risk increase, leading to a decline in aggregate demand, and the return on the stock market in the countries studied becomes negative until about the third period. From periods 3 to 5, the return on the stock markets of these countries becomes positive again, which could be due to smaller and larger public and private investors deploying their capital to enter a market with low prices.

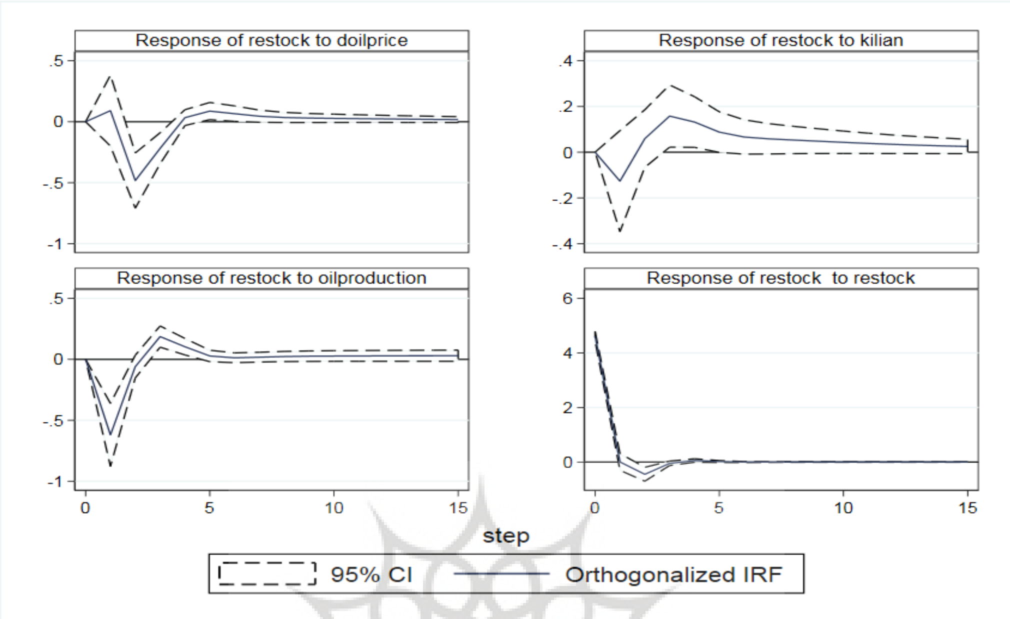

Figure 3. Impulse Response Functions (IRF) of Variables in Model Estimation
Source: Authors

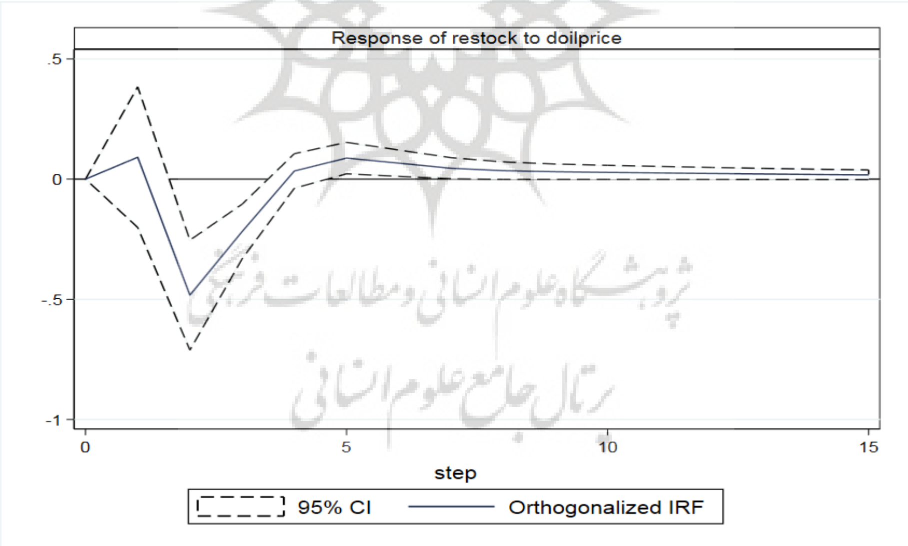

Figure 4. IRF Functions of Stock Market Return to Oil Price Shock
Source: Authors

In a few cases, technological adaptation or switching to other energy resources instead of oil could also play a role. It should be noted that in this phase, industries and companies that are less dependent on oil and whose stock returns have declined in previous periods due to the prevailing atmosphere of rising oil prices become more prominent. In the final phase (i.e. from the 5th period onwards), the effect of the oil price shock has faded and the market returns to its normal trend.

The variance decomposition (VDC) results in Table 6, illustrates the contribution of each variable to the shock that occurs in the stock market response.

Table 6. Variance Decomposition Analysis of the Research Model

Response variable and forecast horizon (stock market returns)	Stock market return variable	Oil price variable (one differentiation)	World oil production variable	Kilian index variable
Period 0	0	0	0	0
Period 1	1	0	0	0
Period 2	0.9811	0.0003	0.0176	0.0007
Period 3	0.9707	0.0108	0.0175	0.0008
Period 4	0.9660	0.0129	0.0189	0.0020
Period 5	0.9647	0.0130	0.0194	00.0027
Period 6	0.9640	0.0133	0.0194	0.0031
Period 7	0.9636	0.0135	0.0194	0.0033
Period 8	0.9634	0.0136	0.0194	0.0034
Period 9	0.9632	0.0136	0.0194	0.0036
Period 10	0.9630	0.0137	0.0195	0.0037
Period 11	0.9629	0.0137	0.0195	0.0037
Period 12	0.9627	0.0137	0.0195	0.0038
Period 13	0.9626	0.0138	0.0196	0.0039
Period 14	0.9626	0.0138	0.0196	0.0039
Period 15	0.9624	0.0138	0.0196	0.0039

Source: Authors

According to Table 6, the other stock-specific shock explains 100% of the changes in stock market returns in the short run and 96% in the long run, the oil price shock explains 0% in the short run and 1.3% in the long run, the oil supply shock explains 0% in the short run and 1.9% in the long run, and the aggregate demand shock explains 0% in the short run and 0.39% in the long run. It seems that the structure of the stock market of the selected countries has been programmed to be marginally affected by shocks in variables such as oil price, oil supply, and Kilian index and they have hedged against these shocks (Fayyad & Daly, 2010). These economies have carefully analyzed the outcomes of previous oil shocks and made their equity markets relatively insensitive to a strategic asset.

5. Conclusion

The stock market, as one of the most important components of the financial market, plays an important role in channeling smaller financial resources into the productive sector. Since, the stock market is under the influence of various shocks, of which the oil price shock is one of the most influential variables; therefore, the present study aimed to investigate the response of the stock index of 12 major oil-importing countries to the oil price shock using the PVAR approach over the period 2010 to 2019 using monthly data. The proposed model included the variables of stock market return, oil price (West Texas Intermediate), global oil supply (world oil production), and Kilian index (which represents aggregate demand).

The results showed Granger causality between all independent variables and the stock market return variable, and the stability of the estimated model was confirmed. Moreover, using IRF functions and variance decomposition analysis, that is concluded that the overall response of the stock market variables to a variable oil price shock (oil price shock) or world oil production (oil supply shock) is negative. The stock market response to the Kilian variable (aggregate demand shock) was also positive, which was expected and consistent with the previous results. The variance decomposition analysis showed that the stock market shock, oil supply shock, oil price shock, and aggregate demand shock had the largest effects on stock market returns.

Based on the findings of this study, it can be recommended that better portfolio management could be used in the investment process in the stock markets of the countries studied (which include a wide range of individuals, companies, private and public organizations) during periods of oil price shocks to avoid losses as much as possible. In this context, investors and portfolio managers could hold on to their gains for up to a month after the oil price spike. After that, stock market returns decline. Even with a positive shock from the increase in aggregate demand (Kilian index) and the positive shock from oil supply, despite the decline in returns in the first month, the market will have a positive return in subsequent periods, and investments will be profitable. According to the obtained results, it is recommended that when there is an oil price shock, investors and portfolio managers can earn profit until the first month after the oil price increase, and after the mentioned period until the end of the third month, the stock market will face a drop in returns. Also, from the third month to the fifth month, the response of the stock market is again positive and the possibility of profitability is provided. Finally, the variance decomposition analysis of the countries shows that these countries have hedged against the shocks caused by the oil price and that the oil price plays a minor role in explaining the dispersion of their stock returns.

In summary, the reason for the low impact of the generally developed countries on the shocks from the oil variable depends on several factors, the most important of which are: 1) Promoting biofuels and using alternative fuels such as diesel fuel and bioethanol to use less oil and its derivatives, especially in the transportation industry, 2) Using biodiesel as an important alternative to diesel in developed countries, 3) Increasing energy efficiency with a combination of strong standards of fuel efficiency using advanced technologies, 4) Investing to explore new sources Oil, attracting active investors and using advanced technology to produce domestic oil, and 5) More attention of governments to liberalization and reflection of financial markets that lead to optimal allocation of savings, increase the diversification of investment risk, faster economic growth and reduction Are business cycles.

References

1. Abhyankar, A., Xub, B., & Wang, J. (2013). Oil price shocks and the stock market: Evidence from Japan. *The Energy Journal*, 34(2), 199-222.
2. Abrigo, M., & Love, I. (2016). Estimation of panel vector autoregression in Stata. *The Stata Journal*, 16(3), 778–804.
3. Akinlo, O. O. (2014). Oil price and stock market: Empirical evidence from Nigeria. *European Journal of Sustainable Development*, 3(2), 33-40.
4. Alamgir, F., & Amin, S. B. (2021). The nexus between oil price and stock market: Evidence from South Asia. *Energy Reports*, 7(1), 693-703.
5. Algia, H., & Abdelfatteh, B. (2018). The oil price shocks and their effect on the stock market return: A structural VAR model. *Journal of Economics and Economic Education Research*, 19(3), 1-23.
6. Aydogan, B., & Berk, I. (2015). Crude oil price shocks and stock market returns evidence from turkish stock market under global liquidity conditions. *International Journal of Energy Economics and Policy*, 5(1), 54-68.
7. Baltagi, B. H. (2005). *Econometric analysis of panel data*. Third Edition. UK: Wiley Publishers.
8. Bashar, A. Z. (2006). Wild oil prices, but brave stock markets! The case of GCC stock markets. *International Journal of Operational Research*, 6(2), 145–162.
9. Bashar, S. A., Haug, A., & Sadorsky, P. (2016). The impact of oil shocks on exchange rates: A Markov-switching approach. *Journal of Energy Economics*, 54(2), 11- 23.
10. Bergmann, P. (2019). Oil price shocks and GDP growth: Do energy shares amplify causal effects?. *Journal of Energy Economics*, 80(4), 1010-1040.
11. Bestianim, A., Conti, F., & Manera, M. (2016). The impacts of oil prices shock on stock market volatility: Evidence from the G7 countries. *Journal of Energy Policy*, 98(11), 160-169.
12. Bjørnland, H. (2008). Oil price shocks and stock market booms in an oil exporting country. *The Journal of Political Economy*, 56(2), 232-254.
13. Bouoiyour, J., Selmi, R., Shahzad, J., & Shahbaz, M. (2017). Response of stock returns to oil price shocks: Evidence from oil importing and exporting countries. *Journal of Economic Integration*, 32(4), 913-936.
14. Cologne, A. & Manera, M. (2008). Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G7 countries. *Journal of Energy Economics*, 30(3), 856-888.
15. Comunale, M. (2022). A panel VAR analysis of macro-financial imbalances in the EU. *Journal of International Money and Finance*, 121(2), 102511.
16. Cong, R., Wei, Y., Jiao, J., & Fan, Y. (2008). Relationships between oil price shocks and stock market: An empirical analysis from China. *Journal of Energy Policy*, 36(9), 3544-3553.
17. Cunado, J., & Garcia, F. (2005). Oil prices, economic activity, and inflation: Evidence for some Asian countries. *Quarterly Review of Economics and Finance*, 45(1), 65-83.
18. Engle, R., & Rangle, J. (2008). The spline-GARCH model for low-frequency volatility and its global macroeconomic causes. *Review of Financial Studies*, 21(3), 1187-1222.
19. European Central Bank (2004). *How do stock markets react to changes in oil prices?* Monthly Bulletin, Report Versions; 44-45.
20. Fasanya, I. O., Oyewole, O. J., Adekoya, O. B., & Badaru, F. O. (2021). Oil price and

stock market behavior in GCC countries: Do asymmetries and structural breaks matter?. *Journal of Energy Strategy Reviews*, 36(4), 100682.

21. Fayyad, A., & Daly, K. (2010). The impact of oil price shocks on stock market returns: comparing GCC countries with the UK and USA. *Emerging Markets Review*, 12(1), 61-78.
22. Filis, G., Degiannakis, S., & Floros, C. (2011). Dynamic correlation between stock market and oil prices: The case of oil-importing and oil exporting countries. *International Review of Financial Analysis*, 20(3), 152–164.
23. Gokmenoglu, K., & Fazlollahi, N. (2015). The interactions among gold, oil, and stock market: Evidence from S&P500. *Procedia Economics and Finance*, 25(7), 478–488.
24. Gou, M., Kuai, Y., & Liu, X. (2020). Stock market response to environmental policies: Evidence from heavily polluting firms in China. *Journal of Economic Modeling*, 86(3), 306-316.
25. Guillamont, P. (2010). Assessing the economic vulnerability of small island developing states and least developed countries. *Journal of Development Studies*, 46(5), 1-38.
26. Güntner, J. H. (2014). How do international stock markets respond to oil demand and supply shocks?. *Journal of Macroeconomic Dynamics*, 18(8), 1657- 1682.
27. Hamilton, J. D. (1983). Oil and the macroeconomy since World War II. *Journal of Political Economy*, 91(2), 228-248.
28. Hamilton, J. D. (2009). Understanding crude oil prices. *Energy Journal*, 30(2), 179–206.
29. Hussin, M. Y. M., Muhammad, F., Hussin, M. A., & Razak, A. A. (2012). The relationship between oil price, exchange rate and Islamic stock market in Malaysia. *Research Journal of Finance and Accounting*, 3(5), 83-92.
30. Ibrahim, M. H. (2019). Oil and macro-financial linkages: Evidence from the GCC countries. *The Quarterly Review of Economics and Finance*, 72(2), 1–13.
31. Kang, W., & Ratti, R. A. (2013). Oil shocks, policy uncertainty and stock market returns. *Journal of International Financial Markets Institutions and Money*, 26(1), 305-318.
32. Kang, W., Ratti, R. A., & Yoon, K. H. (2015). The impact of oil price shocks on the stock market return and volatility relationship. *Journal of International Financial Markets, Institutions & Money*, 34(1), 41–54.
33. Kilian, L. (2008). Exogenous oil supply shocks: How big are they and how much do they matter for the US Economy?. *Review of Economics and Statistics*, 90(2), 216-240.
34. Kilian, L., & Park, C. (2009). The impact of oil price shocks on the US stock market. *International Economic Review*, 50(4), 1267-1287.
35. Liu, M., Choo, W. C., & Lee, C. C. (2020). The response of the stock market to the announcement of global pandemic. *Emerging Markets Finance and Trade*, 56(15), 3562–3577.
36. Maboudian, E., & Seyyed Shokri, K. (2015). Reinvestigation of oil price-stock market nexus in Iran: A SVAR approach. *Journal of Iranian Economic Review*, 19(1), 81-90.
37. Mokni, K. (2020). Time-varying effect of oil price shocks on stock market returns: Evidence from oil- importing and oil-exporting countries. *Journal of Energy Reports*, 6, 605–615.
38. Ono, S. (2011). Oil price shocks and stock markets in BRICs. *The European Journal of Comparative Economics*, 8(1), 29-45.
39. Ordóñez, J., Monfort, M., & Cuestas, J. (2019). Oil prices, unemployment and the financial crisis in oil-importing countries: The case of Spain. *Energy*, 181(16), 625-634.
40. Papadamou, S., Fassas, A., Kenourgios, D., & Dimitriou, D. (2020). *Direct and indirect effects of COVID-19 pandemic on implied stock market volatility: Evidence from panel data analysis*. MPRA Paper 100020, University Library of Munich, Germany.
41. Park, J., & Ratti, R. A. (2008). Oil price shocks and stock markets in the US and 13 European countries. *Journal of Energy Economics*, 30(5), 2587-2608.
42. Sadorsky, P. (2003). The macroeconomic determinants of technology stock price volatility. *Review of Financial Economics*, 12(2), 191-205.
43. Salisu, A., & Gupta, R. (2021). Oil shocks and stock market volatility of the BRICS: A GARCH-MIDAS approach. *Global Finance Journal*, 48(2), 1-9.
44. Subing, H. J., & Kusumah, R. W. (2017).

An empirical analysis of internal and external factors of stock pricing: Evidence from Indonesia. *Problems and Perspectives in Management*, 15(4), 178-187.

45. Wu, J., Hou, H., & Cheng, S. (2010). The dynamic impacts of financial institutions on economic growth: Evidence from the European union. *Journal of Macroeconomics*, 32(3), 879–891.

46. Youssef, M. & Mokni, K. (2019). Do crude oil prices drive the relationship between stock markets of oil-importing and oil-exporting countries? *Economies*, 7(70), 1-22.