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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Oil price changes and stock returns: Fresh evidence from oil exporting and oil importing countries

Mohd Atif¹, Mustafa Raza Rabbani²*, Hana Bawazir³, Iqbal Thonse Hawaldar³, Daouia Chebab³, Sitara Karim⁴ and Amani AlAbbas⁵

Abstract: The study examines the vital connection between stock returns and oil price changes for oil exporting/importing countries separately. We present evidence employing granger causality, impulse response and error variance decomposition based on panel vector autoregression. The results of panel granger causality suggested that after oil price crash owing to covid-19 pandemic, the interdependence between oil and stock price changes increased. Similar results were revealed by impulse response graphs and forecast error variance decomposition. Specifically, in the period marked by the rapid outbreak of the covid-19 pandemic, causality from oil to stocks increased. Although we found that both oil exporting and oil importing countries were affected in a similar way, oil price changes had a larger impact on oil exporting countries. The findings of the present study have implications for investors and fund managers. By incorporating crude oil price in the prediction models, the accuracy of stock returns forecast can be improved.

Subjects: Equity and Trusts; Economics; Finance; Banking; Business, Management and Accounting

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PUBLIC INTEREST STATEMENT

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Oil is a major input for various industries and therefore oil prices influence almost all the sectors of the economy. Since stock markets reflect economic health, oil-stock relations are of importance for all-from general investors to policymakers. In this study, we provide evidence about oil-stock relations for oil-importing and oilexporting countries before and after the announcement of Covid-19 as pandemic. The study finds that after WHO declared Covid-19 a pandemic, the oil-stock relations changed. In the post-declaration period, the interdependence between oil price changes and stock returns increased. It implies that after covid-19 became pandemic, changes in stock prices became more sensitive to oil price changes and vice versa. In addition, post-pandemic announcement the impacts of shocks in oil/stock prices have larger impacts on one another and such impacts persist for a greater number of days. This suggests that stock price forecasts can be improved by considering the likely changes in oil prices.





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Keywords: Covid-19; panel granger causality; oil price; panel vector autoregression; stock returns

1. Introduction

The COVID-19 pandemic has created mayhem all across the globe and it has directly or indirectly affected almost every single entity living on this planet (Pattnaik et al., 2020). The first COVID-19 case was detected in China in November, 2019, it has spread across the 200 countries of the world (Hassan et al., 2020). Primarily a health emergency and declared as the "pandemic' by the World Health Organization (WHO), the COVID-19 crisis has done extensive destruction to the economies around the globe and has disrupted almost every section of the society including economic sector (Rabbani et al., 2020a). The pandemic has brought the economic downturn at the unprecedented speed and scale (Sachs et al., 2020). The economic cost brought in the pandemic is difficult to calculate and it is almost incalculable (Rabbani et al., 2021a). The world economy shrank by 4.3% in 2020 which can only be matched with the great depression and two world wars (Salisu et al., 2020). The damage done by the pandemic is beyond any number as it is expected to leave a long-lasting impact on the psychology of the investors and entrepreneurs (Hassan et al., 2021). It is likely to worsen the global economic situation due to the growing uncertainty and anxiety among the masses as it is expected that the road to recovery will be long and far (Lipshitz & Walter, 2020). It is evident from the above discussion that the impacts of COVID-19 on stock market, crude oil and foreign exchange prices are not an exception (Salisu et al., 2020). Between February and March 2020, during the peak time of COVID-19 when the virus was spreading rapidly and economic activities were at halt due to the lockdown imposed by the governments to stop the spread of the virus, the stock market and oil prices took a hit and shrank by a significant margin (Aydın & Ari, 2020). The stock market in the United States went down by 32% and the United Kingdom by 27.9% and Italy's by 29.3% (Dharani et al., 2022; Salisu et al., 2020). The pandemic has created a panic among the investors leading to the oil price crash and volatility in the financial markets (Albulescu, 2020). The market reactions were negatives during the early days of COVID cases (Naeem et al., 2022). During the first 50 to 50 days of the detection of first confirmed cases, there was more panic and uncertainty and markets showed negative reactions in respective countries (Ashraf, 2020). The market reaction to the pandemic in terms of zero interest and various stimulus packages by the governments created more panic and worries in the worldwide financial world. Still there is no economy which can be termed as the ideal in response to the COVID-19 pandemic (M. R. Rabbani et al., 2021c; Rabbani et al., 2020b, 2021b). The recovery still looks far reaching and it will take a herculean task to get back to the normal situation as the damage is huge and it is expected to leave a long-lasting impact on the social, mental, physical and financial well-being of the individuals and organizations (Karim et al., 2021, 2021; Pankaje et al., 2022; Rabbani et al., 2022; Sitara et al., 2021b).

The efficiency of foreign exchange market has declined during the peak COVID-19 period. Barring Swiss Franc and Canadian dollars, all other currencies were very volatile when COVID cases were increasing between March and April 2020 (Aslam et al., 2020). The intensity of interdependency between the oil price, changes in exchange rate and stock returns vary over the period and it is strictly dependent on the market factors (Yang et al., 2017).

The debate on causal relationship between the oil price movements and stock returns precedes the emergence of COVID-19 (Antonakakis et al., 2017; Bouri, 2015; Maghyereh & Awartani, 2016; Salisu et al., 2020; Wang et al., 2013). It has been more than a year since the first COVID-19 case was reported in Wuhan Province of China (Khan et al., 2021). It was initially anticipated that the adverse movement of oil prices, foreign exchange and stock indices will produce only short term economic impact (Czeczeli et al., 2020; Zimon et al., 2020). But, it is now realized that the COVID-19 is far from over and it produce the results which will be far reaching for the generations to remember (Eichenauer & Sturm, 2020; Karim et al., 2021)

We organize our paper in such a way to offer the following contributions to the existing strand of literature. First, this paper investigates how causal linkages between crude oil and stock market

change for major oil exporting and oil importing countries immediately before and after the breakout of the COVID-19 pandemic. Second, using impulse response and forecast error variance decomposition based on panel vector autoregression, we examine how shocks to oil and stock returns influence each other before and after the outbreak of the pandemic.

The remaining paper proceeds as follows: We review the relevant literature in the second part. Part three presents the description of data. Part four presents the research methodology used for the study, part five discusses the empirical findings of the study and finally in section six, we provide concluding remarks, future scope of the study and policy implications of the findings.

2. Review of literature

The research on linkage between the oil price change and its impact on stock prices started with the work of (Chen et al., 1986) and (Jones & Kaul, 1996). These are the early studies in the field of movement of oil prices as an indicator of stock price changes. After that, there is plenty of literature examining the different aspects of oil price movement and its impact on the stock market. Some of the most notable works are done by (Antonakakis et al., 2017; Basher et al., 2018; Boldanov et al., 2016; Bouri, 2015; Maghyereh & Awartani, 2016; Mokni, 2020; Shanken & Weinstein, 2006; Wang & Liu, 2016). (Sukcharoen et al., 2014) concluded that, there is a weak dependence between the oil prices and stock indices in most cases. They further concluded that this is not the in case of large oil producing and oil consuming countries such as the USA and Canada. For large oil producing and consuming countries like the USA and Canada, there exists strong dependence between the oil prices and stock indices. The same finding is obtained by the (Akoum et al., 2012). They concluded that in the GCC (Gulf Cooperation Council) countries, the majority being producers of oil, there is a lack of dependence between the oil prices and stock returns in the short run. However, in the long run they co-move together. (Degiannakis et al., 2018) did a comprehensive overview of the stock returns, oil prices and exchange rate movement. The findings suggest that the oil prices respond positively to the aggregate demand shocks and oil shock negatively affects the US dollar index. Similar findings are obtained by (Singhal et al., 2019), where they concluded that the oil prices negatively influence the exchange rate in the long run whereas in the short run no interdependency is found. The stock prices of both the groups of countries, oil exporting as well as oil importing countries react disproportionately to the changes in the oil prices (Salisu & Isah, 2017). There is bi-directional spillover between the two markets, that is, between the oil shock and stock market (Salisu & Oloko, 2015). The COVID-19 pandemic will open new doors and avenues in terms of stock returns and oil prices (Ashraf, 2020; Onali, 2020; Sharif et al., 2020).

The results of the fresh studies based on the experimental examinations suggests that prices of oil do have an impact on the stock returns (Boldanov et al., 2016; Filis et al., 2011; Memmel, 2020; Wang & Liu, 2016; Wang et al., 2013). A comprehensive table is presented below for the review of relevant literature.

As can be seen from the preceding discussion, our study differs with the previous studies in three ways. First, instead of applying the time series techniques, we have used a panel data approach to eliminate the limitations of time series and to get robust results (Salles et al., 2019). Second, we perform distinct analyses for oil exporting and oil importing countries before and after the outbreak of COVID-19. This way the results can be compared for two sets of countries. Finally, the post COVID-19 revelation period is taken up to December 2020 which is the largest so far as other studies have taken very small periods and consequently their results are questionable.

3. Data

In this study, we use daily closing prices of the leading stock indices of 14 countries along with the daily price history of Brent crude oil. The sample period ranges from 1 January 2019 to 31 December 2020. Out of the 14 countries, 5 are net oil exporting countries and 9 are net oil importing countries. For choosing the countries for which crude oil plays a significant role. However, we drop Kuwait and Venezuela as both are not even included in "S&P Dow Jones Emerging Markets Index".

Among oil exporting countries, we include Saudi Arabia (Tadawul All Share Index), Russia (MOEX Russia Index), Canada (S&P/TSX Composite Index), Mexico (S&P/BMV IPC), and Norway (OBX Index). For oil importing countries, we consider the United States (S&P 500), the United Kingdom (FTSE), France (CAC), Germany (DAX), Spain (IBEX 35), China (Shanghai Composite), Japan (Nikkei 225), India (Nifty 50) and South Korea (Kospi). We carry out the whole series of analyses for two sub-periods. The first sub-period starts from 1 January 2019, and ends on 6 March 2020, that is, immediately before the oil price crash. The second sub-period ranges from 9 March 2020 till 31 December 2020.

Table A1 shows average, minimum, and maximum values of crude oil and stock indices. In the first period, the average price of the Brent crude oil is \$63.4 while in the second period it is around \$39.8. The stock indices of all the countries except for China, Japan, Russia, Korea, and the United States have lower averages during the second period. Stock indices of all the countries except for China hit bottom during the second time. The Chinese market hit bottom earlier as the negative impacts of COVID-19 pandemic had made their way much earlier in the country. A comparison of the maximum values in the two time periods reveals that for half of the countries, the stock indices could not get to the previous highs.

Table A2 presents descriptive statistics of daily percentage returns for the stock indices of oil exporting countries. The same Table A2 also presents the descriptive statistics for the daily percentage changes in oil prices. Panel 1 displays the summary measures for the first subperiod and Panel 2 presents the same measures for the second subperiod. Table A3 presents the similar measures for oil importing countries. An examination of Tables A2 and A3 reveals that for both sets of countries standard deviation is higher in the second period. All the countries have negative skewness during both the periods except India and Mexico in the first period and Japan in the second period. Kurtosis is also higher in the second period for all countries except China. Oil price changes also have larger variability, negative skewness, and higher kurtosis during the second period. Standard deviation measures the variability of the data, skewness measures the asymmetry of the probability distribution, Kurtosis measures how heavily the tails of a distribution differs from a normal distribution and mean of the data is the average or central value of the finite set of numbers (Alam et al., 2021; Mandel, 2012).

4. Methodology

The present study employs the Panel Vector Autoregression (PVAR) initially proposed by (Holtz-Eakin et al., 1988). Later, Love and Zicchino (2006) implemented Panel VAR in the Generalised Method of Moments (GMM) framework. A recent implementation of Panel VAR can be found in Abrigo and Love (2016) and Salisu et al. (2020). In our case, the panel VAR consists of two endogenous variables, that is, stock returns and oil price changes. Specifically, the PVAR is given as:

$$R_{it} = \sum_{j=1}^{p} \alpha_j^{(r)} C_{t-j} + \sum_{j=1}^{p} \beta_j^{(r)} R_{i,t-j} + \mu_i + \varepsilon_{it}^{(r)}$$
(1)

$$C_{t} = \sum_{j=1}^{p} \alpha_{j}^{(c)} C_{t-j} + \sum_{j=1}^{p} \beta_{j}^{(c)} R_{i,t-j} + \omega_{i} + \varepsilon_{it}^{(c)}$$
(2)

Where,

 $R_{i,t}$ is return for ith index at time t; C_t is return on crude oil at time t; α and β are parameters to be estimated; μ_i , and ω_i are country-specific effects; and, $\varepsilon_{i,t}^{(r)}$, and $\varepsilon_{i,t}^{(c)}$ are error terms.

As suggested by (Holtz-Eakin et al., 1988) we estimate Equations (1) and (2) using GMM in the framework of panel vector autoregression for efficiency gains. In addition, we estimate the PVAR equations separately for oil exporting and oil importing countries for the two time periods.

5. Results and discussion

First, we employ (Levin et al., 2002) test to determine whether the variables under consideration have a unit root. The results for stock and oil returns for the two time periods are given in Table A4 separately for oil exporting and oil importing countries. As expected, the test results reveal that both stock returns and oil returns don't have a unit root for both the time periods.

After confirming that the variables under consideration are stationary, we estimate panel VAR with 3 lags of the endogenous variables. Then, we proceed to perform panel granger causality and present the results in Table A5. Panel A of Table A5 presents the results of granger causality for oil exporting countries while Panel B presents the same results for oil importing countries. From Table A5, there is bidirectional granger causality between stock returns and oil price changes for oil exporting countries, granger causality from oil to stock in the first period is not very strong as the test statistic is only marginally significant with p-value of 0.0460.

To gain deeper insights about the impacts of oil and stock returns on one another, we proceed to analyse impulse response function (IRF) and forecast error variance decomposition (FEVD) based on panel vector autoregression of Equations (1) and (2). Figure 1 shows the IRF graphs for oil exporting countries for the first time period and Figure 2 shows the IRF graphs for the second time period. The top-right graph in Figure 1 titled "rstock: roil" presents the response of oil returns to a unit shock to stock returns. This graph shows that a unit shock to stock returns has an oscillating impact on oil returns with a positive impact on oil returns in the first step which becomes negative in the second step



Figure 1. Impulse response graphs for first time period for oil exporting countries. Source. Authors. Figure 2. Impulse response graphs for second time period for oil exporting countries. Source. Authors.











and so on. The bottom left panel of Figure 1 presents the response of stock returns to a unit shock to oil returns. This graph reveals that a unit shock to oil return has a positive impact on stock returns for three steps and then the impact dies out. Examination of Figure 2 (IRF for oil exporting countries for a second time) reveals that a unit shock to stock returns initially has a negative impact which becomes positive on the next day and then dies out. The bottom left graph in Figure 2 shows that a unit shock to oil returns initially has a large positive contemporaneous impact on stock returns and then for next 2 steps the effect is negligible and again in the third period the effect is substantially large and positive. Thus, Figures 1 and 2 suggest that the impact of oil price changes is larger in the second period.

Figures 3 and 4 present the IRF for oil importing countries for the two time periods. An examination of the figures reveals that in the first time period shocks to stock returns have a positive impact on oil returns while in the second time period these effects are oscillating and larger. Similarly, the shocks to oil returns have a larger impact on stock returns in the second period.

In Table A6, we present the forecast error variance decomposition (FEVD) for oil exporting and oil importing countries and for the two time periods. We present 1-step, 5-step and 10-step estimates of FEVD. Table A6 reveals that stock returns explain only a very small portion of forecast error variance for oil returns in both the periods for both sets of countries. On the other hand, during the second time period, oil returns explain a larger proportion of forecast error variance of stock returns. In addition, the table reveals that for oil exporting countries 21.02% of error variance is explained by oil returns. While for oil importing countries the same figure stands at 15.88%.

6. Conclusion

Oil is a major input for various industries and therefore oil prices influence almost all the sectors of the economy. The study provides evidence about oil-stock relations for oil-importing and oil-exporting countries before and after the announcement of Covid-19 as pandemic. The study finds that after the World Health Organization (WHO) declared Covid-19 a pandemic, the oil-stock relations changed. In the post-declaration period, the interdependence between oil price

changes and stock returns increased. It implies that after covid-19 became pandemic, changes in stock prices became more sensitive to oil price changes and vice versa. In addition, post-pandemic announcements the impacts of shocks in oil/stock prices have larger impacts on one another and such impacts persist for a greater number of days. This suggests that stock price forecasts can be improved by considering the likely changes in oil prices.

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Appendices

Table A1. Average levels of stock price and crude oil							
	First I	Period		Second	l Period		
Name of the variable	mean	min	max	mean	min	max	
Crude	63.4	45.3	74.6	39.8	19.33	52.26	214
Canada	16,486	14,213	17,944	15,732	11,228	17,653	
China	2929	2464	3271	3149	2660	3452	
France	5532	4611	6111	4893	3755	5612	
Germany	12,294	10,417	13,789	12,142	8442	13,790	
India	11,524	10,604	12,362	10,933	7610	13,982	
Japan	21,936	19,562	24,084	22,576	16,553	27,568	
Korea	2117	1910	2267	2234	1458	2873	
Mexico	43,209	38,574	45,903	37,957	32,964	44,694	
Norway	984	885	1054	902	687	1048	
Russia	2747	2369	3220	2833	2113	3289	
Saudi Arabia	8377	7349	9362	7639	5960	8760	
Spain	9240	8376	10,084	7185	6107	8323	
UK	7293	6463	7687	6032	4994	6603	
US	2967	2448	3386	3212	2237	3735	

Source. Authors' computation.

Table A2. Descriptive statistics for oil exporting countries and crude oil							
Name of the variable	min	median	mean	max	sd	skewness	kurtosis
crude	-9.918	0.108	-0.056	13.639	2.041	0.132	8.219
Saudi	-5.695	0.000	-0.014	3.833	0.983	-0.763	5.360
Russia	-4.588	0.047	0.045	2.395	0.826	-1.158	5.125
Mexico	-2.679	-0.030	-0.002	2.423	0.879	0.058	0.731
Norway	-4.888	0.026	-0.006	3.024	0.954	-1.063	4.760
Canada	-2.756	0.068	0.039	2.144	0.556	-1.039	4.617
Second Period							
crude	-27.976	0.208	0.063	19.077	4.734	-1.491	11.804
Saudi	-16.755	0.000	0.075	6.831	1.761	-4.509	40.862
Russia	-8.646	0.132	0.089	7.435	1.676	-0.854	8.604
Mexico	-6.638	0.000	0.036	4.744	1.602	-0.531	2.168
Norway	-9.832	0.047	0.079	5.842	1.805	-1.533	7.702
Canada	-13.176	0.195	0.038	11.294	2.241	-1.365	13.520

Source. Authors' computation.

Table A3. Descriptive statistics for stock index returns of oil importing countries							
Name of the variable	min	median	mean	max	sd	skewness	kurtosis
France	-4.229	0.108	0.027	2.688	0.942	-1.268	3.848
Germany	-4.089	0.099	0.029	3.314	0.975	-0.904	2.959
Spain	-4.159	0.008	-0.006	2.485	0.899	-1.063	3.092
Korea	-3.952	0.027	0.000	2.837	0.895	-0.738	2.267
India	-3.780	0.000	0.002	5.182	0.883	0.568	5.194
Japan	-3.738	0.021	0.012	2.578	0.928	-0.448	1.921
China	-8.039	0.002	0.064	5.450	1.203	-1.132	9.470
US	-4.517	0.085	0.055	4.501	0.951	-0.566	5.758
UK	-3.689	0.048	-0.013	2.227	0.846	-1.100	3.610
Second Perio	d						
France	-13.098	0.028	0.040	8.056	2.157	-1.154	8.221
Germany	-13.055	0.000	0.081	10.414	2.179	-0.910	8.611
Spain	-15.151	0.039	-0.013	8.225	2.266	-1.362	10.626
Korea	-8.767	0.231	0.160	8.251	1.801	-0.291	5.812
India	-13.904	0.271	0.113	8.400	2.103	-1.806	11.974
Japan	-6.274	0.000	0.131	7.731	1.620	0.246	4.924
China	-4.603	0.000	0.055	5.554	1.162	-0.008	3.611
US	-12.765	0.255	0.106	8.968	2.252	-0.960	8.850
UK	-11.512	0.055	0.007	8.667	1.929	-1.050	8.053

Source. Authors' computation.

Table A4. Results of panel unit root test							
	Variable	test-stat	p.value				
Panel A: Brent Crude Oil							
Period 1	roil	-22.51	0.0000				
Period 2	roil	-24.98	0.0000				
Panel B: Oil Exporting Cour	ntries						
Period 1	rstock	-24.34	0.0000				
Period 2	rstock	-25.68	0.0000				
Panel C: Oil Importing Countries							
Period 1	rstock	-24.34	0.0000				
Period 2	rstock	-25.68	0.0000				

Source. Authors' computation.

Table A5. Results of granger-causality							
Oil Exporting countries							
Causality	Stat	df	p.value				
stock to oil	15.383	3	0.0020				
oil to stock	8.024	3	0.0460				
stock to oil	15.343	3	0.0020				
oil to stock	18.274	3	0.0000				
Oil Importing countries							
Causality	Stat	df	p.value				
stock to oil	33.415	3	0.0000				
oil to stock	14.796	3	0.0020				
stock to oil	22.554	3	0.0000				
oil to stock	49.977	3	0.0000				

Source. Authors' computation.

Table A6. Forecast error variance decomposition							
		First	Period	Second	Period		
		Impulse					
Response	Step	Oil	stock	Oil	stock		
Oil	1	1	0	1	0		
	5	0.9879	0.0121	0.9779	0.0221		
	10	0.9879	0.0121	0.9779	0.0221		
Stock	1	0.0716	0.9284	0.1719	0.8281		
	5	0.0813	0.9187	0.2096	0.7904		
	10	0.0813	0.9187	0.2102	0.7898		
Oil Importing Cou	Intries						
	Step	Oil	stock	Oil	stock		
Oil	1	1	0	1	0		
	5	0.9828	0.0172	0.9837	0.0163		
	10	0.9828	0.0172	0.9836	0.0164		
Stock	1	0.0683	0.9317	0.0853	0.9147		
	5	0.0764	0.9236	0.1571	0.8429		
	10	0.0764	0.9236	0.1588	0.8412		

Source. Authors' computation.



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