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COVID-19 and Energy

COVID-19 and the Oil Price – Stock Market Nexus: Evidence From Net Oil-Importing Countries

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This study focuses on the relation between stock price returns and oil price returns covering the COVID-19 period. This relation is examined for major net oil-importing Asian countries. Utilizing daily data, we fit a DCC-GARCH model. We find evidence of a positive co-movement between oil price returns and stock price returns during the COVID-19 period. This indicates that falling oil prices act as a negative signal for the stock market.

1. Introduction

Oil prices play a key role in stock market performance of oil-importing economies. A decline in oil prices reduces the cost of production and increases economic growth (Narayan et al., 2014). The effect of this is a rise in stock prices due to higher future earnings and dividends (Filis, 2010; Jones & Kaul, 1996; Sadorsky, 1999). However, the recent decline in oil prices due to the COVID-19 pandemic along with plummeting stock markets globally (see Figure 1), including in oil-importing economies, raises the question of whether the well-established negative relation between oil and stock prices holds. The COVID-19 pandemic and the consequent economic lockdowns globally have disrupted the global supply chains and reduced aggregate demand (Vidya & Prabheesh, 2020). A sharp reduction in oil consumption due to lockdowns led to a drastic decline in crude oil prices in the international market, from US$61 on January 2, 2020 to US$12 on April 28, 2020.

The oil market is volatile due to disruptions caused by COVID-19. In light of this, how oil prices are impacting stock prices of oil-importing countries is unknown. The motivation for understanding this relationship is well established in the financial economics literature; see Narayan and Sharma (2011) and the studies that have followed. We, therefore, do not discuss this. The present paper revisits a traditional oil price-stock returns hypothesis focussing on major net oil-importing countries. The need to revisit this hypothesis is imperative in light of the on-going COVID-19 pandemic.

The existing literature on oil price-stock market nexus is enormous. There is a consensus in this literature that a rise in oil prices increases stock prices in oil-exporting economies mainly due to higher revenues from oil exports (Kilian & Park, 2009). Overall, the findings are mixed in the context of oil-importing countries (see, inter alia, Kilian & Park, 2009; Narayan & Narayan, 2010; Silvapulle et al., 2017). There are some studies (Aspergis and Miller, 2009; Lescaroux & Mignon, 2008) that do not find any statistical relationship between oil prices and stock returns.

Kilian and Park (2009) found that sources of variations in oil prices affect stock prices differently. Moreover, the variations in oil price due to the supply-side shocks have less effect on stock prices as compared to demand-side shocks. Filis et al. (2011) argue that in the presence of a strong demand-side shock, stock markets of oil-importing countries could react negatively to a negative oil price shock. Narayan and Gupta (2015) also argue that negative oil shocks predict stock returns relatively better.

With this background, the decline in oil prices due to the global slowdown associated with COVID-19 necessitates an inquiry into the oil-stock dynamics from the net oil-importing country perspective. The existing studies on COVID-19 research focus on oil markets and their impact on various economic factors (E. Apergis & Apergis, 2020; Fu & Shen, 2020; Gil-Alana & Monge, 2020; Iyke, 2020a; L. Liu et al., 2020; Narayan, 2020; Qin et al., 2020)[1]. However, none of these studies investigates the oil price-stock market nexus among the major net oil-importing Asian countries during the COVID-19 period.

Our approach to examining oil price-stock market nexus is as follows. First, we select four largest Asian net oil-importing countries, namely, China, India, Japan, and South Korea[2] (hereafter, Korea) and draw a sample of daily observations for the period from January 1, 2020 to June 8, 2020. Second, we implement the DCC-GARCH model to evaluate the strength and direction of the price relation from a time-varying perspective. Our empirical findings suggest that: (1) there is a positive relationship between oil price returns and stock price returns in all countries; and (2) the strength of the relationship increased significantly during the initial months of the COVID-19 pandemic (that is, from February to March 2020).

Our main contribution to this literature is that we add to

1 Other recent studies related to COVID-19 and its impact on various economic factors include Chen et al. (2020), He et al. (2020), Iyke (2020b), D. Liu et al. (2020), Phan & Narayan (2020), Salisu & Akanni (2020), and Yue et al. (2020), among others.

2 According to the latest available data from the Central Intelligence Agency's *The World Factbook*, the four selected Asian countries are the four largest net oil-importers in Asia as well as among the top five largest net oil-importers globally.

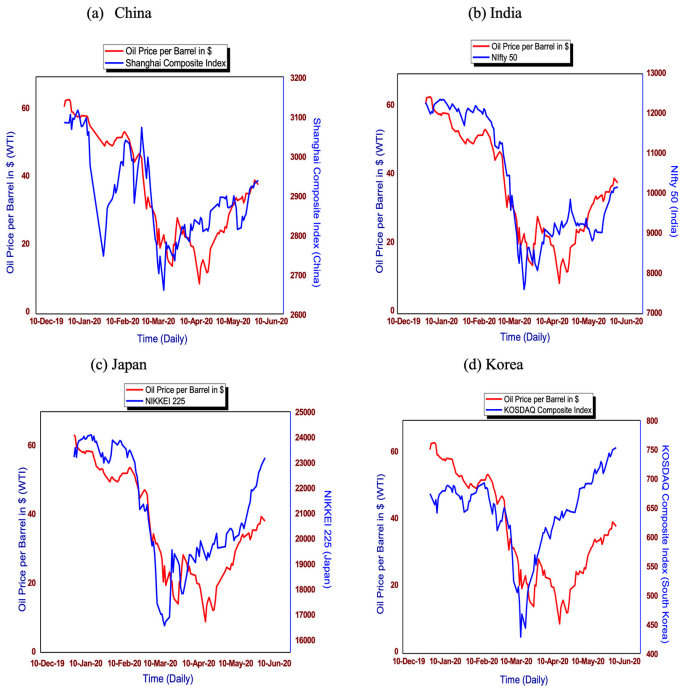

Figure 1: Trends in Oil Price and Stock Indices

The figure shows plots of WTI oil prices and stock indices of China, India, Japan, and Korea. The sample period used is from January 1, 2020 to June 8, 2020.

studies which show that oil prices predict stock market returns (Narayan et al., 2019; Narayan & Sharma, 2011; Phan et al., 2015a, 2015b). These studies use predictive regression models whereas we use a different modelling approach, namely, the DCC-GARCH model. We reach similar conclusions despite studying the market over a time when it is devastated by a global shock never experienced before.

The rest of the paper is structured as follows. Section 2 presents the data and methodology. Section 3 reports empirical results. Section 4 concludes.

2. Data and Methodology

We collect daily data on oil prices and stock market indices for the four Asian economies (China, India, Japan, and Korea). The data are for the period from January 1, 2020 to June 8, 2020[3]. The specific stock market indices used are the NIKKEI225 for Japan, the KOSDAQ Composite Index for Korea, the NIFTY50 for India, and the Shanghai Composite Index for China. For oil prices, we consider the West Texas Intermediate (WTI) spot prices and data are downloaded from the Energy Information Administration website (https://www.eia.gov/) while the stock indices data are collected from https://in.investing.com. We specify the two variables of interest, namely the WTI oil price returns and stock market price index returns:

$$rwti_t = log\left(\frac{wti}{wti_{t-1}}\right) * 100 \qquad (1)$$

$$rstock_t = log\left(\frac{stock}{stock_{t-1}}\right) * 100 \qquad (2)$$

where *rwti* is the returns on WTI oil prices and *rstock* is the returns of the respective country stock market index. We then implement the DCC-GARCH model proposed by Engle (2002) to calculate the time-varying correlation between stock price returns and oil price returns. The M dimensional multivariate GARCH (1, 1) model to determine the dynamic conditional correlation is:

$$Y_t = \emptyset_0 + \emptyset_1 Y_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim (0, H_t) \qquad (3)$$

$$H_t = \Gamma_t \backslash R_t \, \Gamma_t \qquad (4)$$

$$\Gamma_1 = diag\left\{\sqrt{h_{11,t}}, \sqrt{h_{22,t}}, \ldots . \sqrt{h_{MM,t}}\right\}$$

$$h_{ii,t} = w_i + \beta_1 h_{ii,t-1} + \gamma_i \varepsilon^2_{i,t-1} \quad i = 1, 2 \ldots \ldots M$$

$$R_t = (diag\{Q_t\})^{-1/2} Q_t (diag\{Q_t\})^{-1/2}$$

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha u_{t-1} u'_{t-1} + \beta Q_{t-1}$$

Where, $Y_t = (Y_{1,t}, Y_{2,t} \ldots, Y_{M,t})'$ and $\varepsilon_t = (\varepsilon_{1,t}, \varepsilon_{2,t} \ldots, \varepsilon_{M,t})$ are the $M \times 1$ vectors. H_t is the conditional covariance matrix of the random vector ε_t and $u_t = \left(\frac{\varepsilon_{1,t}}{\sqrt{h_{11,t}}}, \frac{\varepsilon_{2,t}}{\sqrt{h_{22,t}}} \ldots \ldots \frac{\varepsilon_{l,t}}{\sqrt{h_{MM,t}}}\right)'$ is a vector that contains the standardized values of ε_t. R_t is

3 We treat the observation for April 20, 2020 as an outlier since it was the first time in history that oil prices recorded negative prices (US$ -36.98). Hence, we exclude it from our empirical analysis.

Table 1: Descriptive Statistics and DCC-GARCH results

Panel A: Descriptive Statistics	Mean	Standard Deviation	Skewness
R_WTI	-0.440	12.423	-1.302
R_CHINA	-0.048	1.462	-1.819
R_INDIA	-0.174	2.770	-1.186
R_JAPAN	-0.001	2.137	0.268
R_KOREA	0.101	2.748	-0.812

Panel B: DCC GARCH Pairs/Time	FEB	MAR	APR	MAY
R_CHINA - R_WTI	0.002	0.082	0.083	0.091
R_INDIA- R_WTI	0.031	0.112	0.112	0.112
R_JAPAN - R_WTI	0.008	0.073	0.081	0.081
R_KOREA - R_WTI	0.013	0.081	0.072	0.071

This table reports selected descriptive statistics of oil price returns and stock price returns (Panel A) and DCC-GARCH results (Panel B). The values given in the panel B are the time-varying correlation between oil price returns and stock price returns. The sample period used is from January 1, 2020 to June 8, 2020. Where, R and WTI stand for Returns and West Texas Intermediate Oil Prices, respectively.

the time varying correlation matrix and Q_t is the positive definite symmetric matrix. $\overline{Q}$ represents the unconditional variance matrix of u_t; α and β are scalars; $\alpha \geq 0,\ \beta \geq 0$ and $\alpha + \beta < 1$, for the positive definiteness of a conditional correlation matrix. The time varying elements of $Y_t, \rho_{ij,t}$ are as follows:

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t},\ q_{jj,t}}} \qquad (5)$$

where $q_{ij,t}$ is the $i - j^{th}$ element of Q_t.

3. Empirical Findings

Table 1 (Panel A) reports descriptive statistics for oil price returns and stock price returns[4]. The standard deviation reveals that oil price returns are more volatile compared to stock price returns. Table 1 (Panel B) reports the month-wise DCC results between oil price returns and stock price returns for all four countries[5]. It is interesting to note that while the correlation coefficients are small for all countries, the correlations are positive. Noteworthy is the finding that there is a marked increase in correlation over the months February to March for all countries, indicating that the COVID-19 pandemic strengthened the oil price-stock market relation.

Magnitude-wise, we see that amongst all countries, China experienced the highest rise in correlation, from 0.002 in February to 0.082 in March. Similarly, during the April-May period, the correlation between stock price returns and oil price returns remains same as it was in February for all countries except Korea. It can also be observed that India exhibits the highest correlation of 0.11 during the March-May window. Finally, the positive sign of the correlation during the study period implies that news related to the oil price decline during the COVID-19 pandemic is perceived by stock markets as a negative demand shock.

From Figure 2, we observe a similar pattern: that is, an increase in time-varying correlations for all countries. Figure 2(a) shows that the time-varying correlation of China's stock price returns with the oil price returns is increasing until about mid-March; there is then a slight fall in April, followed by a rise in May. This indicates higher co-movement of China's stock price returns with oil price returns. From Figure 2(b), India's stock price returns exhibit an increase in correlation until about mid-March and remains mostly constant during the post-March period. Figure 2(c) shows that Japan's correlation is increasing until about mid-March and remains mainly constant during the post-March period. During this time, the coefficients are positive but small, indicating a weak correlation with oil price returns. From Figure 2(d), Korea's correlation is increasing until about mid-March. It remains positive but small thereafter. Overall, stock price returns exhibit a positive co-movement with oil price returns despite falling after mid-March for all the economies except Japan. Specifically, Japan witnessed a positive co-movement between stock price returns and oil price returns and the decline in the correlation was limited.

Our results are in line with the arguments made in Filis et al. (2011) that an oil price shock can lead to a decline in

4 We find that both oil price returns and stock price returns are stationary at levels. For brevity, unit root results are not reported, but are available upon request.

5 The time-varying correlation is calculated using the DCC-GARCH model implemented on a rolling window technique. Due to the rolling window procedure, most of the data from January are submerged during the estimation procedure; therefore, the DCC-GARCH results are presented from February to June 2020.

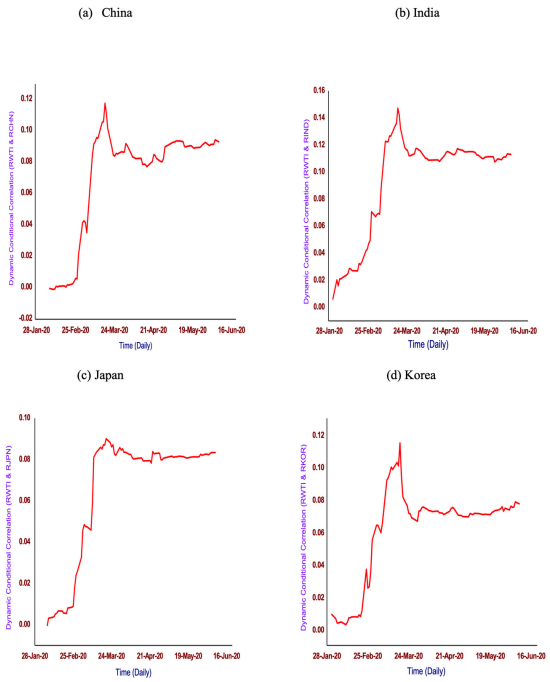

Figure 2: Dynamic Conditional Correlation (Stock Returns with Oil Returns)

The figure shows the results of dynamic conditional correlation between oil returns and stock returns. The results are calculated using the DCC-GARCH model. The sample period used is from January 1, 2020 to June 8, 2020.

the stock market in an oil-importing country in the presence of high uncertainty in financial markets.

4. Conclusion

This paper examines the strength and direction of the relation between oil price returns and stock price returns for four major net oil-importing Asian countries. Using the DCC-GARCH model fitted to daily price data, we find that the COVID-19 pandemic strengthened the relationship between oil prices and stock prices in all four countries, particularly during March. While we find that the correlations between the two price returns are small, the values are positive. Hence, this positive co-movement may reduce the scope for portfolio diversification as the uncertainty associated with COVID-19 may damage economic performance in light of falling oil prices, which acts as a signal of future demand contraction and associated weak economic prospects. Future studies should explore portfolio diversification issues in depth.

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