

Impact of COVID-19 on Global Energy Markets

BY ANUPAM DUTTA, ELIE BOURI, GAZI SALAH UDDIN AND MUHAMMAD YAHYA

Anupam Dutta

is with the School of Accounting and Finance, University of Vaasa, Finland. adutta@uwasa.fi **Elie Bouri** is with USEK Business School, Holy Spirit University of Kaslik, Jounieh, Lebanon. eliebouri@usek.edu **Gazi Salah Uddin** is with the Department of Management and Engineering, Linköping University, Linköping, Sweden. gazi.salah.uddin@liu.se **Muhammad Yahya** is with the Department of Safety, Economics and Planning, University of Stavanger, Norway. muhhammad.yahya@uis.no

by examining the impact of COVID-19 on energy market returns. To this end, we use an

1. Introduction

The unprecedented time of panic and astronomical uncertainty from the COVID-19 outbreak in January-March 2020 has led to a massive sell-off in financial markets and a huge spike in market volatility levels. The COVID-19 risk factors are severely damaging global economic activities, and evidence suggests that recession is already in place¹. Notably, there has been a sharp decline in the crude oil market that is often seen as a barometer of economic activity. As shown in Fig. 1, the Brent crude price fell from over \$50 in January 2020 to \$22.58 a barrel at the end of March 2020, its lowest level since November 2002. In the interim, the price of U.S. West Texas Intermediate (WTI) also fell below

attacks, or other extreme events such as wars and natural disasters (e.g., Zhang et al., 2009; Lin and Tamvakis, 2010; Demirer and Kutan, 2010; Brandt and Gao, 2019), there is scarce evidence on the effects of rare disaster risks not related to macroeconomic, geopolitical, or war events on the energy markets.

In this paper, we extend the above line of studies and the resulting research gap

Table 1: Summary Statistics of daily returns

	January 2019-November 2019				December 2019-March 2020			
	WTI	Brent	Dubai	XLE ETF	WTI	Brent	Dubai	XLE ETF
Mean	0.083	0.102	0.053	0.011	-1.169	-1.393	-1.082	-0.821
Std. Dev.	2.183	2.122	2.113	1.204	7.057	5.402	4.657	4.743
Skewness	0.526	0.363	0.531	-0.185	-2.199	-2.061	-3.276	-1.451
Kurtosis	9.666	6.084	13.156	3.514	15.67	9.032	23.056	9.732
JB test	451.68***	99.55***	1034.18***	3.98	644.67***	191.26***	1595.26***	192.6***

Notes: This table reports summary statistics for daily returns of the three crude oil indices and the energy ETF. JB refers to the Jarque-Bera test. ***, ** and * indicate 1%, 5% and 10% levels of significant respectively.

\$20 a barrel, dropping to lowest level for 18 years. A similar pattern is witnessed in Dubai crude oil prices. Furthermore, during the February-March 2020 period, the crude oil implied volatility index (OVX) depicted in Fig.2, reached their highest level since its inception by

Table 2: Correlation matrix of daily returns

	January 2019-November 2019				December 2019-March 2020			
	WTI	Brent	Dubai	XLE ETF	WTI	Brent	Dubai	XLE ETF
WTI	1				1			
Brent	0.69*** (0.00)	1			0.63*** (0.00)	1		
Dubai	0.69*** (0.00)	0.70*** (0.00)	1		0.70*** (0.00)	0.81*** (0.00)	1	
XLE ETF	0.61*** (0.00)	0.57*** (0.00)	0.59*** (0.00)	1	0.66*** (0.00)	0.79*** (0.00)	0.78*** (0.00)	1

Notes: This table reports the pairwise Pearson correlation coefficients for daily returns on the three crude oil indices and the energy ETF. *p*-values are provided in parentheses. ***, ** and * indicate 1%, 5% and 10% levels of significant respectively.

the Chicago Board Options Exchange (CBOE). Likewise, the prices of the Energy Select Sector SPDR Fund (XLE) decreased sharply.

While the academic literature considers the response of the crude oil market to news events related to macroeconomic, OPEC announcements, terrorist

event study framework that has been a standard approach in the academic literature (e.g., Lin and Tamvakis, 2010; Demirer and Kutan, 2010; Kim et al., 2019). Specifically, we seek to answer the following questions: To what extent has the COVID-19 outbreak pushed the international crude oil prices lower? Is the negative effect of the COVID-19 outbreak on crude oil prices similar or dissimilar across the various international crude oil benchmarks (WTI, Brent, Dubai). What are the effects of the COVID-19 outbreak on the XLE index? Answering these questions is important for the sake of investors and policymakers given previous evidence that episodic events such as the 9/11 attacks and the Iraq War become the main driving factors for oil returns from 2000 to 2004 (Fan and Xu, 2011).

For comparison purposes, three different oil markets are considered in our empirical analysis: WTI, Brent and Dubai. Due to global economic integration, news events travel and transmit quickly from one financial market to another. Hence, taking diverse markets into consideration would help understand whether COVID-19 impacts crude oil markets globally or locally.

Table 3: Cumulative abnormal returns (CARs) following COVID-19 events

Markets\Event windows	2-day CAR	3-day CAR	4-day CAR	5-day CAR	6-day CAR
Panel A: Event 1					
WTI	-0.069** (0.029)	-0.075*** (0.026)	-0.089*** (0.022)	-0.110*** (0.019)	-0.112*** (0.019)
Brent	-0.028*** (0.001)	-0.031*** (0.006)	-0.021* (0.011)	-0.054*** (0.016)	-0.042** (0.017)
Dubai	-0.066*** (0.024)	-0.071*** (0.023)	-0.079*** (0.021)	-0.098*** (0.018)	-0.104*** (0.017)
XLE	-0.025** (0.009)	-0.021* (0.012)	-0.030*** (0.010)	-0.033*** (0.009)	-0.036*** (0.008)
Panel B: Event 2					
WTI	-0.030*** (0.008)	-0.035*** (0.009)	-0.065*** (0.009)	-0.040** (0.019)	-0.035* (0.018)
Brent	-0.019 (0.022)	-0.082** (0.034)	-0.079** (0.032)	-0.047 (0.036)	-0.045 (0.032)
Dubai	-0.042*** (0.011)	-0.091*** (0.018)	-0.099*** (0.019)	-0.058* (0.033)	-0.063** (0.030)
XLE	-0.037 (0.028)	-0.057*** (0.019)	-0.060*** (0.018)	-0.030 (0.026)	-0.013 (0.023)
Panel C: Event 3					
WTI	-0.054*** (0.003)	-0.038 (0.025)	-0.116*** (0.038)	-0.162*** (0.034)	-0.427*** (0.099)
Brent	-0.150*** (0.051)	-0.118 (0.072)	-0.267*** (0.080)	-0.274*** (0.074)	-0.485*** (0.092)
Dubai	-0.096*** (0.014)	-0.035 (0.064)	-0.128* (0.066)	-0.142** (0.058)	-0.214*** (0.055)
XLE	-0.147*** (0.056)	-0.038 (0.112)	-0.164 (0.107)	-0.137 (0.099)	-0.272*** (0.098)

Notes: This table reports the cumulative abnormal returns (CARs) for international crude oil markets following several events linked to COVID-19. These events take place on (1) January 7, 2020: Chinese government confirms that they have identified a novel coronavirus; (2) January 30, 2020: WHO declares this new virus to be a "Public Health Emergency of International Concern"; and (3) March 11, 2020: WHO announces COVID-19 to be a Pandemic. To measure the CARs following these events, we consider 5 different event windows including (0,+1), (0,+2), (0,+3), (0,+4) and (0,+5). Standard errors are provided in parentheses. ***, ** and * indicate 1%, 5% and 10% levels of significant respectively.

Employing a standard event study method, our findings suggest that the new contagious disease, which has spread globally during the last few months, has substantial negative effects on international crude oil markets. While the negative effect is consistent across the three international crude oil prices used, its magnitude exhibits some differences. The effect is also significantly negative for the energy ETF, but is generally weaker, suggesting some heterogeneity in the negative response of the energy markets to the

COVID-19 outbreak.

In the rest of the paper, we first provide an overview of materials and methods in section 2. Section 3 provides the empirical findings and section 4 concludes the study.

2. Materials and methods

We investigate the effect of three events related to COVID-19 on crude oil returns and energy ETF returns. The events take place on (1) January 7, 2020: Chinese

government confirms that they have identified a novel coronavirus; (2) January 30, 2020: WHO declares this new virus to be a “Public Health Emergency of International Concern”; and (3) March 11, 2020: WHO announces COVID-19 to be a pandemic. Accordingly, we choose a sample period covering the aforesaid periods, which makes our sample period to span December 1, 2019 - March 31, 2020.

In line with Chen and Siems (2004), we employ a standard event study method² in which the abnormal returns are computed as follows:

$$AR_{it} = R_{it} - \bar{R}_j \quad (1)$$

where AR_{it} refers to the abnormal (or excess) return for oil (energy ETF) index i at time t , R_{it} denotes the actual observed rate of return for oil (energy ETF) index i at time t , and \bar{R}_j indicates the mean of oil (energy ETF) index i 's daily returns in the (-30, -11) estimation period. We calculate \bar{R}_j as follows:

$$\bar{R}_j = 1/20 \sum_{t=-30, \dots, -11} R_{it} \quad (2)$$

Within this framework, $t = 0$ indicates the event date. The mean adjusted returns model is estimated over 20 days, from $t = -30$ to $t = -11$ relative to the event date. Several event windows have been used to capture the impact of COVID-19 outbreak on oil (energy ETF) returns. They include (0,+1), (0,+2), (0,+3), (0,+4) and (0,+5). For each of these event windows, we calculate the cumulative average abnormal returns (CARs). We compute the statistical significance of the event period abnormal returns using the test statistics proposed by Brown and Warner (1985).

While the choice of the event window may appear somewhat arbitrary, it is chosen with the aim of capturing the effects of COVID-19 events and keep them separate from the effects of other potential events. Furthermore, crude oil prices are efficient and absorb information quickly, hence need a relatively short event window³.

3. Empirical findings

Table 1 provides several summary statistics for daily returns, while considering two sample periods. As expected, higher negative returns and higher volatilities are observed over the sample period December 1, 2019 - March 31, 2020 compared to the period January 1, 2019 - November 30, 2019. Table 2 also shows higher correlation values across the three international oil markets during the period December 1, 2019 - March 31, 2020, which reflects the COVID-19 risk factor underlying the oil markets.

Table 3 exhibits the results of the event study analysis (Panel A, Panel B, and Panel C show the results for event (1), event (2) and event (3), respectively). The results suggest that the COVID-19 outbreak has a strong negative effect on international crude oil returns, given all the cumulative abnormal returns have a minus sign. These results indicate a downturn in international crude oil markets following the coronavirus disease.

Note that among the events considered, the last event related to the WHO's declaration that COVID-19 is pandemic has higher impacts on crude oil returns than the remaining events. For example, the magnitude of 6-day CARs for Brent market amounts to 4.2%, 4.5% and 48.5% for event 1, event 2 and event 3, respectively. For other crude oil markets, we find similar negative effect, but its magnitude is dissimilar. Notably, Table 1 reveals that of the three oil markets, WTI is more influenced by this new virus compared to Brent and Dubai. Almost all the CARs based on WTI index are statistically significant at conventional levels. Furthermore, the magnitude of these CARs is also higher than that of Brent and Dubai in most of the cases.

Moving to the energy ETF, our analysis shows that all the events studied have experienced negative CARs. However, this effect is generally weaker compared to the oil markets, suggesting some sort of heterogeneity in the negative response of the energy markets to the COVID-19 outbreak. Moreover, like the crude oil markets, the event announcing COVID-19 to be a pandemic has more influence on the XLE index returns than the remaining events.

These results are quite different when compared to important economic and war events. In fact, the magnitude of the effect of the COVID-19 is much stronger than that reported for the case of terror attacks (Orbaneja et al., 2018), FOMC announcements (Demirer and Kutan, 2010), or the global financial crisis (Ji and Guo 2015).

To sum up, there is a significant drop in global crude oil prices following the events linked to COVID-19 and this impact is the highest when this novel coronavirus disease is declared to be a pandemic. We find that the informational content of a COVID-19 outbreak is large enough to influence investors' perceptions. Accordingly, with the advent and amplification of the COVID-19 outbreak, future demand of crude oil is in doubt and traders add a huge uncertainty or “recession premium” to the prices.

4. Conclusions

We provide strong evidence that the COVID-19 outbreak exerts substantial negative effects on energy markets. More specifically, international crude oil markets are negatively influenced by this novel virus as reflected by the sharp negative downturn in energy markets following this global pandemic. Given the importance of growing pandemic of COVID-19, our findings have important implications for policymakers and investors holding assets in international energy markets. In order to maintain the stability in the energy market, it is important for global stakeholders (U.S., Russia, OPEC and etc.) to maintain the collaboration in order to minimize the geo-political uncertainty. Given that the value of an option is an increasing function of the volatility of the underlying asset, future studies can investigate if an option's prices are sensitive to the

COVID-19 crisis.

Footnotes

1 In the U.S., estimates from St. Louis Fed indicates that the COVID-19 economic freeze could cost around 47 million jobs and skyrocket the unemployment rate to 32% (<https://www.cnbc.com/2020/03/30/coronavirus-job-losses-could-total-47-million-unemployment-rate-of-32percent-fed-says.html>).

2 Notably, the event study methodology was first introduced by Fama et al. (1969). It has been applied to the crude oil markets (e.g., Lin and Tamvakis, 2010; Demirer and Kutan, 2010).

3 For example, Wirl and Kujundzic (2004) use around two trading weeks before and after the events. Demirer and Kutan (2010) apply a 10 and 20 days before and after the events.

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