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Revisiting oil-stock nexus during COVID-19 pandemic: Some preliminary results

Afees A. Salisu [a,*], Godday U. Ebuh [b], Nuruddeen Usman [b]

[a] *Centre for Econometric & Allied Research, University of Ibadan, Ibadan, Nigeria*
[b] *Monetary Policy Department, Central Bank of Nigeria, Nigeria*

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ABSTRACT

We provide some preliminary estimates about the behaviour of oil-stock nexus during COVID-19 pandemic. Consequently, we conduct distinct analyses for periods before and after the announcement of the pandemic. A panel Vector Autoregressive (pVAR) model is constructed to analyse the response of oil and stocks to shocks. A panel Logit model is also formulated to evaluate the probability of having negative oil price and stock returns between the two data samples. The pVAR analyses suggest that both oil and stock markets may experience greater initial and prolonged impacts of own and cross shocks during the pandemic than the period before it. This outcome is further corroborated by the panel Logit estimates suggesting that the probability of having negative oil and stock returns during the pandemic may be due uncertainty associated with the relevant markets.

1. Introduction

The ‘evil hand’ called COVID-19 that started in Wuhan, China in December 2019 has thrown the world into panic. According to the European Commission for Disease Control (ECDC, 2020), the pandemic virus that was first discovered in China has now spread to over 200 countries across the globe (see Appendices 1 & 2). Although opinions for now are divided, some schools of thought are of the view that this could trigger another global financial crisis while others are of the view that the effect if not quickly halted could be worse than the SARS outbreak of 2003 in China, the global financial crisis and World War Two put together. Isolating the analysis of oil-stock nexus from other variables during the pandemic is deliberate. This is apparent from the observed plummet in the stock prices of the major stock markets in the world as well as oil prices following the coronavirus outbreak. Between February and March 2020 when the virus spread much rapidly and was declared a global pandemic (See WHO, 2020), the US stock prices fell by 32 percent, the UK’s by 27.9 percent and the Italy’s by 39.3 percent. Emerging stock markets have also not been spared with the stock prices of Brazil declining by 40.5 percent, Russia’s by 24.2 percent and China’s by 10.1 percent. Globally, as shown in Fig. 2, stock markets continue to exhibit a high degree of volatility, with a cumulative loss of 12.35 per cent value between January and May 2020 and more than $9 trillion loss since the outbreak of COVID-19. Some analysts have attributed the fall in stock prices to investors’ panic, as many investors sold out of fear.[1] Similarly, the oil price market was expected to move towards balance in the second half of 2020 arising from a combination of stronger demand and the implementation of the production cuts agreed at the beginning of 2020 as well as a tailing off of non-OPEC supply growth. However, as the COVID-19 pandemic rages, oil price fell by a whopping 30%, the highest loss since after the Gulf War of 1991(Schneider & Domonoske, 2020).

* Corresponding author. Centre for Econometric & Allied Research, University of Ibadan, Ibadan, Nigeria.
E-mail addresses: adebare1@yahoo.com (A.A. Salisu), ablegod007@yahoo.com (G.U. Ebuh), nuru94@yahoo.com (N. Usman).

[1] World Economic Forum (https://www.weforum.org/agenda/2020/03/stock-market-volatility-coronavirus/).

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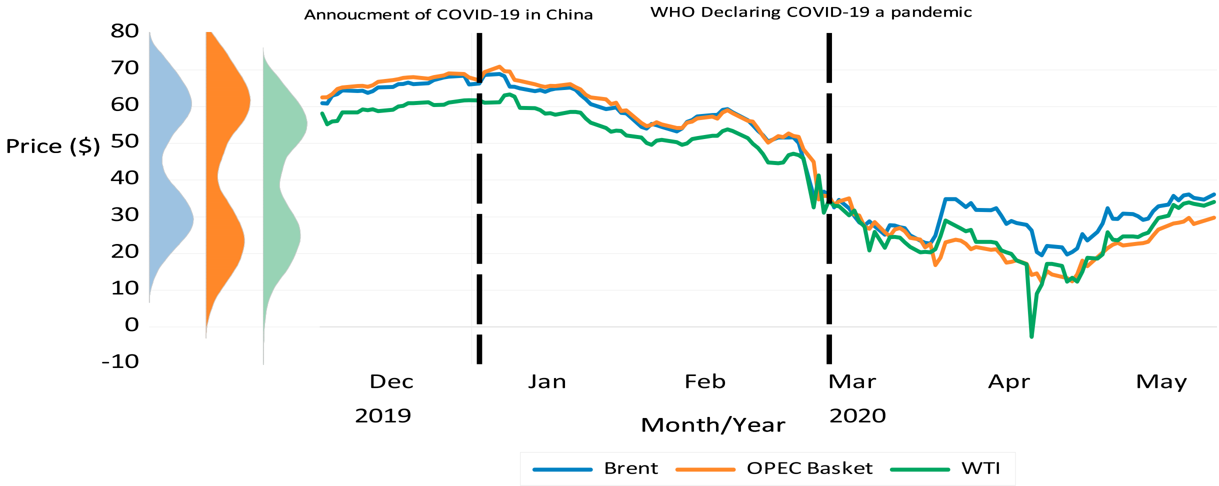


Fig. 1. Daily Oil Price December 2019–May 2020.
Source: Authors' graph.

The debate on the causality associated with oil price-stock nexus anchored on the financialization of the commodity markets predates the emergence of COVID-19 (see Wang et al., 2013; Salisu & Isah, 2017; Swaray & Salisu, 2018; and; Salisu et al., 2019). Although COVID-19 announcement and the pandemic may produce a short-term economic impact, however, this shock could adversely affect the oil price-stock nexus. This is the motivation for our study and the main objective is to examine the behaviour of oil-stock nexus during the pandemic relative to the evidence before it. It is believed that our findings will offer areas for future research as events unfold during the pandemic. Information about the behaviour of the nexus in this difficult time is important for investment and policy decisions. For instance, policy makers are confronted with the choice between containing the virus and sustaining the economy. Information about the extent of the behaviour of the two series during the pandemic will help determine how much sacrifice the relevant markets will have to endure to contain the virus. In other words, the analyses rendered in this study may help us determine how long it will take the impact of a shock due to either market will fizzle e out during the pandemic. Also, investors seeking to minimize risks and by extension maximize returns will find this information useful particularly in terms of portfolio diversification and hedging strategy.

We structure our study in such a way as to offer the following contributions to the literature on oil-stock nexus. First, we partition our analyses into two periods for pre- and post-announcement of COVID-19 pandemic and thereafter, we conduct distinct analyses for them. This becomes necessary given the trends in crude oil prices and some selected global stock indices (see Figs. 1 and 2) which depict distinct patterns between the two periods. In fact, most economies in the world including the US, UK, and EU, among others, have witnessed a shift in macroeconomic fundamentals between the Pre- and Post-COVID-19 announcement. Secondly, if the shift is significant (and it does based on our analyses, see Table 3 for the break test), accounting for the same in empirical analyses becomes inevitable to avoid biased estimates (see Devpura et al., 2019; Salisu, Adekunle, et al., 2019; Salisu, Swaray, et al., 2019). Lastly, this study may provide a lead for the monetary policy authority to evaluate the effectiveness of its policies in stabilizing the macro-economy after the COVID-19 virus crisis subsides and the need for stress testing of the resilience of the oil price-stock nexus during a pandemic.

In addition, we construct a panel Vector Autoregressive (pVAR) model to analyse the response of both oil and stock prices to own and cross-shocks. A major attraction to this model lies in its ability to accommodate short time dimension since the estimation follows the Generalized Method of Moments (GMM) procedure. Also, we formulate a panel Logit model to examine the probability of having negative stock returns in the presence of continuous decline in oil price and depreciation of exchange rate. This is particularly predicated on the fact that, understanding the extent of negative returns during crisis is critical for investment decisions, particularly where the crisis is global in nature, thus, making it difficult for investors to diversify in the short term.

Following this introduction, the rest of the paper is structured as follows: Section 2 presents a brief review of the literature; Section 3 offers some stylized facts on the state of crude oil prices and global stock indices for both periods of pre- and post-COVID announcement; Section 4 presents the research methodology; Section 5 discusses the empirical results while Section 6 provides some policy implications of findings and concluding remarks.

2. A brief review of the literature

The motivation for linking stock prices to oil price and vice versa is drawn from the work of Hamilton (1983) where the evidence suggests that movements in energy prices can be explained by macroeconomic performance of countries. Recent literature in this regard have extended this analysis to financial market and similar findings have been established (see, Arouri & Rault, 2010; Bondia et al., 2016; Narayan & Gupta, 2015; Salisu & Isah, 2017; Swaray & Salisu, 2018 and Salisu et al., 2019). From the investment standpoint, a number of studies have ascertained that oil prices can influence stock prices through their impact on future cash flows of firms and implicitly through the interest rate which is used to discount future cash flows (see for example, Hammoudeh & Li, 2005; Basher &

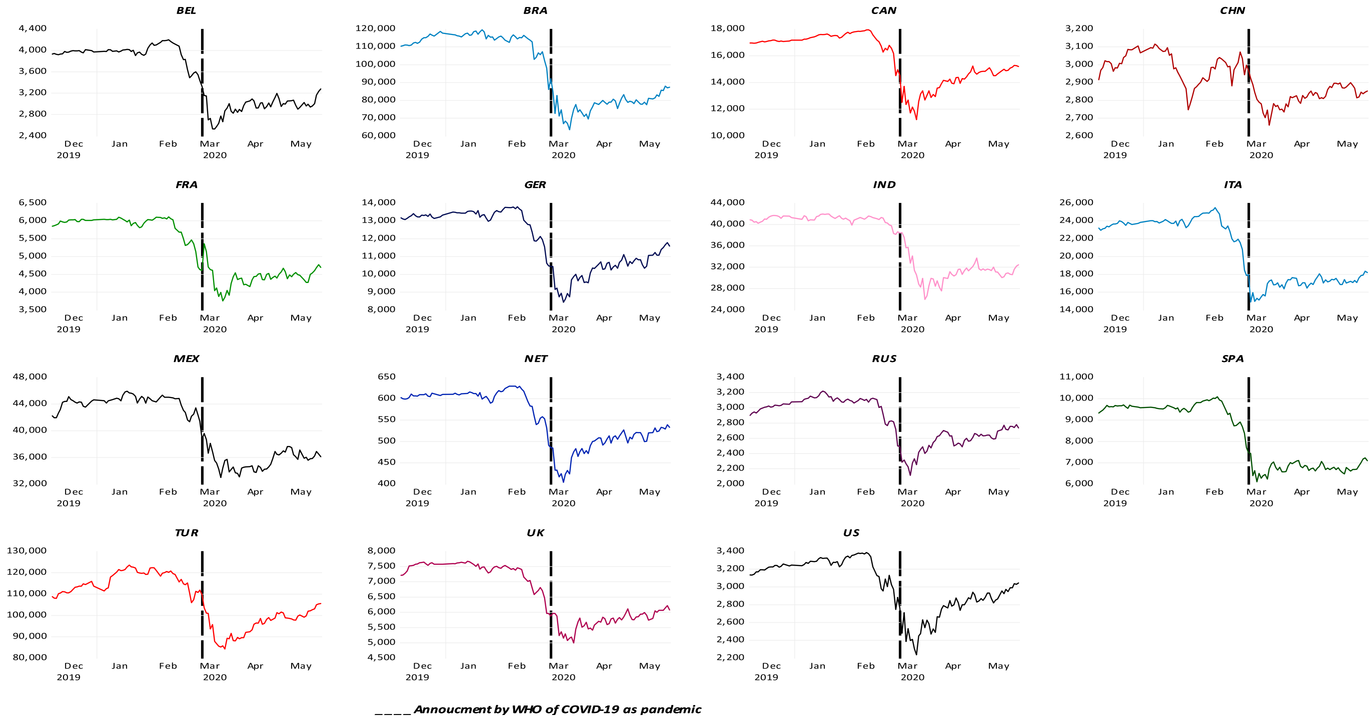


Fig. 2. Global stocks (daily) Dec 2019–May 2020.
Note: Belgium (BEL), Brazil (BRA), Canada (CAN), China (CHN), France (FRA), Germany (GER), India (IND), Italy (ITA), Mexico (MEX), Netherlands (NET), Russia (RUS), Spain (SPA), Turkey (TUR), UK and USA (US).
Source: Author's Computation

Table 1
Descriptive Statistics.

Panel A: Oil and stock prices

Oil Price and Stock Index

Full Sample

Statistic	Oil	Belgium	Brazil	Canada	China	France	Germany	India	Italy	Mexico	Netherlands	Russia	Spain	Turkey	UK	USA
Mean	57.5	3586.9	98926.1	16133.7	2921.9	5382.3	12015.2	37558.5	21090.9	41918.0	557.5	2727.1	8838.7	101679.6	7046.7	2945.9
Std. Dev.	13.7	338.3	11751.0	1148.7	129.6	517.7	1055.5	3377.3	2256.2	3123.8	39.9	211.4	973.4	8781.5	634.1	197.7
Skewness	−1.5	−0.9	−0.7	−1.6	−0.3	−0.9	−0.8	−1.2	−0.7	−1.4	−0.9	0.3	−1.5	0.6	−1.6	−0.1
Kurtosis	3.9	3.5	3.2	6.04	3.8	3.4	3.7	3.8	2.9	3.8	4.7	2.6	3.9	3.1	4.3	3.8
Pre-COVID-19 Announcement																
Mean	63.1	3711.7	103048.9	16555.6	2942.8	5573.4	12351.1	38802.4	21907.1	43174.4	570.3	2760.0	9252.4	102727.9	7309.4	2984.8
Std. Dev.	5.3	192.9	7413.0	542.8	132.0	291.1	723.2	1772.5	1391.3	1355.2	26.3	205.1	301.3	8844.8	221.0	171.7
Skewness	−1.0	0.5	0.5	0.2	−0.5	0.0	0.1	−0.1	0.3	−0.8	0.3	0.4	−0.5	0.5	−2.1	0.5
Kurtosis	7.6	2.3	2.3	3.8	4.4	2.6	2.2	1.9	2.5	4.0	2.4	2.10	5.3	2.9	12.6	2.6
Post-COVID-19 Announcement																
Mean	29.3	2958.6	78009.1	14009.9	2822.8	4420.2	10321.7	31295.6	16977.5	35630.7	493.1	2557.3	6760.2	96280.3	5726.0	2749.2
Std. Dev.	5.0	169.7	5637.5	1034.1	58.8	278.3	803.4	2431.2	786.1	1490.8	34.2	154.7	264.5	6054.0	291.0	202.8
Skewness	−0.3	−0.6	−0.2	−0.8	−0.3	0.3	−0.6	1.0	−1.0	0.4	−1.0	−0.9	0.3	−0.3	−0.7	−0.7
Kurtosis	1.9	3.6	3.2	2.8	3.2	5.1	2.8	5.0	3.8	2.7	3.2	3.2	3.7	2.2	2.9	2.5

Panel B: Exchange rate

Full-Sample

Statistic	USD-EURO	USD-CAD	USD-YUAN	USD-REAL	USD-RUP	USD-PES	USD-RUB	USD-POUND	USD-DLiRA
Mean	0.90	1.34	6.95	4.25	71.58	19.98	66.10	0.79	5.94
Std. Dev.	0.01	0.03	0.14	0.54	2.25	1.78	4.33	0.02	0.43
Skewness	0.28	1.51	−0.50	1.55	1.07	1.78	1.63	0.68	1.16
Kurtosis	2.54	4.42	2.12	4.29	3.23	4.56	4.60	2.94	3.74
Pre-COVID-19 Announcement									
Mean	0.90	1.33	6.93	4.03	70.71	19.22	64.35	0.78	5.78
Std. Dev.	0.01	0.01	0.13	0.20	1.16	0.39	1.66	0.02	0.21
Skewness	0.18	0.23	−0.25	0.71	0.20	1.67	1.77	0.76	−0.33
Kurtosis	2.78	3.13	2.01	3.85	3.28	8.90	11.81	2.51	2.93
Post-COVID-19 Announcement									
Mean	0.92	1.41	7.07	5.36	75.99	23.81	74.91	0.81	6.78
Std. Dev.	0.01	0.02	0.04	0.28	0.75	0.81	2.52	0.02	0.22
Skewness	−0.85	0.61	−0.72	0.25	−0.20	−0.63	0.46	1.40	−0.47
Kurtosis	3.60	3.50	4.47	2.22	3.65	3.03	2.61	5.31	2.32

Note: See Table on the definition of exchange rates.
Source: Authors' Computation.

Table 2
Definition of variable proxies.

Variable	Proxy
Oil	Brent Crude
Belgium	Bel 20 index & USD-EURO
Brazil	IBOVESPA index & USD-REAL
China	Shanghai Composite Index & USD-YUAN
Canada	S&P/TSX Composite Index & USD_CAD
France	CAC 40 index & USD-EURO
Germany	DAX Index & USD-EURO
India	S&P BSE SENSEX index & USD-RUP
Italy	FTSE MIB index &USD-EURO
Mexico	S&P/BMV IPC index & USD-PES
Netherlands	AMX index & USD-EURO
Russia	IMOEX index & USD-RUB
Spain	IBEX 35 index & USD-EURO
Turkey	BIST index & USD-LiRA
UK	FTSE 100 Index & USD-POUND
USA	S&P 500 index

Source: Compiled by the authors.

Sadorsky, 2006; Henriques & Sadorsky, 2008; Narayan & Narayan, 2010; Fayyad & Daly, 2011; Basher et al., 2012; Arouri et al., 2012; and Wang et al., 2013; among others). How macroeconomic variables react based on the oil–stock relationship aids policymaking, as it helps in understanding the resilience of an economy to both internal (due to stock) and external (due oil) shocks. Hence, the behaviour of oil and stock markets particularly during the pandemic is key for policymaking and in attaining improved macroeconomic outcomes.[2]

The recent uncertainty in the global economy as a result of the COVID-19 outbreak has garnered a great deal of curiosity including the relationship amongst oil prices movements, the economy and financial markets. For instance, Albulescu (2020) and Zhang et al. (2020) contend that global financial market risks have increased substantially in response to the pandemic, with financial markets becoming highly volatile and unpredictable. In addition, Ashraf (2020) examines stock market response to the COVID-19 pandemic in 64 countries and the study finds that stock market returns decline as the number of cases increases in a country. With policy makers worried on how volatility in oil and stock markets is transmitted across the financial and real sectors of the economy, providing some preliminary estimates on the extent of behaviour between the financial and energy markets will present useful guide when making decisions.

3. Some stylized facts

The global outbreak of the coronavirus has caused upheaval in stock markets and disrupted supply chains around the world. The outbreak of the virus is the world's most pressing uncertainty in 2020 as the increased uncertainty has led to lower valuations and increased volatility in financial markets. With the exception of oil price, our analyses here cover fifteen countries that are worse hit by the COVID-19 pandemic in terms of deaths as reported by the WHO. They are arranged in alphabetical as follows: Belgium (BEL), Brazil (BRA), Canada (CAN), China (CHN), France (FRA), Germany (GER), India (IND), Italy (ITA), Mexico (MEX), Netherlands (NET), Russia (RUS), Spain (SPA), Turkey (TUR), UK and USA (US).

Oil prices as shown in Fig. 1, have continued to tumble, two months after the announcement of the first case of the coronavirus was announced in December 2019, oil prices fell spectacularly by 30 per cent. This was the largest slump since in oil prices since the Gulf war as increased cases outside China spurred investor fears that the rapidly spreading outbreak could slow the global economy and a price war between Russia and Saudi Arabia led to the collapse of oil prices. The downward trend continued amidst the World Health Organization (WHO) declaring a public outbreak, softening oil demand globally, particularly for transportation fuel as airlines cut flights and tourist cancel business trips and holidays. However, as of April the oil price started recovering, as lockdowns were gradually being eased and an agreement by several oil producing countries (OPEC+) to cut production. Unquestionably, information from movements in oil prices and the cases of the COVID-19 outbreak are drivers in the movement of global stock markets. As depicted in Fig. 2, stock markets globally continue to exhibit a high degree of volatility, with stock markets experiencing a fall of 12.35 per cent since the start of January 2020 to May 2020 and more than $9 trillion has been wiped off global stocks since the announcement by the WHO.

The Pre-COVID-19 pandemic period ranges from the 4th January 2019 to 10th March 2020 (i.e. period before COVID-19 was declared to be pandemic) while the Post-COVID-19 period ranges from 11th March 2020 to 29th May 2020. The start date for the former was informed by the available data for all the countries considered. The Post-COVID-19 period is defined in this manner as it captures when the World Health Organisation (WHO) declared the COVID-19 outbreak a pandemic and the effect of the COVID-19 on macroeconomic fundamentals in the world especially on crude oil and global stock prices is more pronounced. Inferring from Table 1, all categories of oil and stock prices recorded lower mean values during the Post COVID-19 Announcement period than during the Pre- COVID-19 Announcement period. In other words, oil prices and stock prices were higher during the Pre-COVID-19 announcement period than the Post-COVID-19 Announcement period. The series seem to exhibit more asymmetry during the period of pre-COVID-19 than the post-COVID-19. In the Pre-COVID-19 period, oil, Canada,

[2] A succinct review of the link between oil and stock is well documented Smyth and Narayan (2018) and Salisu, Swaray, et al. (2019).

Table 3
Panel Granger Causality and Break tests.

	Pre-Announcement			Post-Announcement		
	Chi-Sq	DF	Prob.	Chi-Sq	DF	Prob.
Roil						
rexr	37.6539***	1	0.0000	2.4549	1	0.1172
rstock	0.2675	1	0.6050	4.2375**	1	0.0395
ALL	37.6600***	2	0.0000	6.8301**	2	0.0329
Rexr						
roil	1.8673	1	0.1718	0.00043	1	0.9477
rstock	1.5	1	0.8042	1.7532	1	0.1855
ALL	4.963	2	0.3287	1.7706	2	0.4126
Rstock						
roil	114.945***	1	0.0000	0.5190	1	0.4713
Rexr	0.4976	1	0.4806	5.7308**	1	0.0167
ALL	116.239***	2	0.0000	6.1707**	2	0.0457
Break Test						
Chi-square	7.12**					
Prob.	0.0681					

Note: All the variables are expressed in their returns form. DF denotes degrees of freedom and it equals the optimal lag length which is automatically determined using the Schwarz Information Criterion (SIC).

china, Mexico, Spain and United Kingdom stock prices exhibit fat tail while the other series were leptokurtic. However, during the Post-COVID period, Oil prices, Germany, Mexico, turkey, UK and USA stock prices were leptokurtic while all the remaining stock prices approximately exhibited fat tail. Following the oil price and stock index descriptive statistics, is the exchange rate descriptive statistics for the various subsamples. However, in the USD exchange rates of the countries under consideration, all categories of exchange rates prices recorded higher mean values during the Post COVID-19 Announcement period than during the Pre- COVID-19 Announcement period. The Post-COVID-19 Announcement period is characterised by a strong dollar appreciation and a depreciation of global currencies vis-à-vis the dollar. These notable distinctions in the behaviour of crude oil, exchange rate and global stock prices over the two sub-samples constitute a major motivation for doing same in the empirical analyses.

4. Methodology and data

The empirical model constructed here hinges on the possible interconnectedness across asset classes during crisis. This argument is well documented in Diebold and Yilmaz (2012). During crises, for example, the financial market volatility generally increases sharply and spills over across markets (Diebold & Yilmaz, 2012). Thus, analysing the probable shock spillovers since the emergence of COVID-19 will serve as "early warning signs'' as regards the severity or otherwise of the consequences of the crisis. This information is particularly useful to investors who are more concerned about maximizing their returns even in the presence of risks. If consistently updated, the analysis can also be used to track the progress made in curbing the widespread of the virus. It is hypothesized that the announcement of the COVID-19 will have greater spill over effects on both commodity and financial markets and the response of the relevant agencies to the COVID-19 epidemic determines the behaviour of these spillovers in the long run.

In setting up the methodology, we construct a panel Vector Autoregressive (pVAR) model with a vector of three endogenous variables as $X_t^{'} = [p_t e_t s_t]^{'}$ where p_t, e_t, and s_t are the returns series for oil price, exchange rate and stock price. Defining the series this way helps to circumvent the problem of unit root. As noted by Blundell and Bond (1998) in the univariate case, the GMM estimators suffer from the weak instruments problem when the variable being modelled is near unit root (Abrigo & Love, 2016).

The pVAR model allows for short time dimension, thus, making it possible to render some preliminary analyses on the announcement effects of COVID-19. A typical pVAR model can be represented by the following system of linear equations[3]

$$\begin{aligned} &Y_{it} = Y_{it-1}A_1 + Y_{it-2}A_2 + \dots + Y_{it-p}A_p + X_{it}B + u_i + e_{it} \\ &i \in \{1,2,\dots,N\}, \quad t \in \{1,2,\dots,T_i\}, \\ &E(e_{it}) = 0, E\left(e_{it}^{'}e_{it}\right) = \Sigma, E\left(e_{it}^{'}e_{is}\right) = 0 \; \forall \, t > s \end{aligned} \tag{1}$$

where Y_{it} is a $(1 \times k)$ vector of dependent variables, X_{it} is a $(1 \times l)$vector of exogenous covariates, u_i and e_{it} are vectors of $(1 \times k)$ dependent variables-specific panel fixed-effects and idiosyncratic errors, respectively. The $(k \times k)$ matrices $A_1, A_2, \dots, A_{p-1}, A_p$ and the $(l \times k)$ matrix B are parameters to be estimated. We employ the GMM estimator and fit the model as a system of equations. Holtz-Eakin et al. (1988) note that the joint estimation of the system of equations may result in efficiency gains. It also makes cross-equation hypothesis testing straightforward (Abrigo & Love, 2016).

Daily data on oil prices and stock prices and exchange rate of Belgium, Brazil, Canada, China, France, Germany, India, Italy, Mexico,

[3] See Abrigo and Love (2016) for computational details on panel VAR modelling and estimation issues.

Netherlands, Russia, Spain, Turkey, UK and USA. was used for the analyses. Data was sourced from Bloomberg. As previously noted, we perform distinct analyses for the pre- and post-announcement of COVID-19 pandemic (see Table 2 for the definition of proxies for the relevant variables). Thus, the Pre-COVID-19 pandemic period covers the period of 4th January 2019 to 10th March 2020 (i.e. period before COVID-19 was declared to be pandemic) while the Post-COVID-19 period ranges from 11th March 2020 to 29th May 2020.

5. Results and discussion

We begin the analyses by examining the causality among the variables of interest – oil price, exchange rate and stock returns. The test is distinctly conducted for the pre- and post-COVID-19 announcement. The results are presented in Table 3. The results show a unidirectional causality from oil price returns to stock returns in the pre-announcement period while causality between crude oil price and stock returns is bi-directionally related post-announcement period.[4] This shift between the two periods is quite understandable. The continued slowdown in the level of economic activities after the pronouncement of COVID-19 has affected both the demand for crude oil and increased uncertainties in financial markets including the stock markets. Theoretically, the relationship between oil price returns and stock returns hinges on the cash flow hypothesis. The underlying intuition rests on the presumption that oil is a crucial input in most firms' production and therefore their expected cash flows can be affected by oil price leading to changes in costs, earnings and dividends and hence stock prices (see Basher et al., 2012; Rafailidis & Katrakilidis, 2014; Salisu & Isah, 2017; Salisu, Swaray, et al., 2019; Smyth & Narayan, 2018).

From the foregoing, we construct a panel VAR model where oil price comes first, and stock returns comes last while exchange rate is an intervening variable that moderates the relationship between the two variables. This ordering is valid for both pre- and post-COVID announcement periods since oil price is dominant for the two periods. We are poised to provide some preliminary empirical results as regards the response of these variables to own and cross shocks before and after COVID-19 announcement. This is believed will provide insights that can be used to gauge the immediate/short run reaction to the pandemic. For a more realistic analysis for the post-COVID-19 announcement, we limit the period to when it was pronounced to be pandemic by the World Health Organization where the panic among economic agents (consumers, producers and governments) had become evident across the globe. Since panel VAR can accommodate short period, the short period for the post-COVID-19 announcement is not a concern here if its associated risks/uncertainties are captured in the relevant series over the period under consideration. To further justify the partitioning into two subsamples – pre- and post-pandemic announcement, we test for the significance of COVID-19 pandemic announcement using a break point test to establish whether the sudden change in the oil and stock markets is statistically significant. We test for the significance of exogenous time dummy variable in the pVAR estimates using Wald test and the result is summarised in the lower pane of Table 3. The statistical significance of the test indicates that the sudden change in the behaviour of the two markets due to COVID-19 pandemic announcement is statistically significant and therefore the distinct analysis for the two periods is justified.

The impulse response function is used to analyse both own shocks and cross shocks for oil price and stock returns. The results of own shocks due to oil and stock returns are presented in Figs. 3 and 4 respectively while Figs. 5 and 6 are for cross shocks in the same order. As hypothesized, both Figs. 3 and 4 suggest a larger initial impact of own shocks after the post-COVID-19 announcement with a greater impact on the crude oil market than the stock market. A similar trend is observed for the cross-shocks (see Figs. 5 and 6). The implication of these findings is that investors in oil and stock markets during the COVID-19 pandemic may witness greater initial impacts than normal (before the pandemic). The stability of the pVAR models is not in doubt as all the eigenvalues lie inside the unit circle (see Fig. 7). Thus, the PVAR satisfies the stability condition.

5.1. Additional results

We also provide additional results using the panel Logit regressions where both the stock and oil return series are dichotomized. In this case, we assign 1 to negative stock returns and zero otherwise, ditto for oil returns. The idea here is to predict the probability of having negative stock returns given a 1% decline in oil price and a 1% depreciation in exchange rate. In the same vein, we consider the probability of having negative oil price returns given a 1% decline in stock price and a 1% depreciation in exchange rate. The Chi-square for the Hausman test is not statistically significant, hence, the choice of the Random effect estimator. The results are summarised in Table 4 for both stock and oil return dummies as the dependent variables respectively. As depicted in Table 4, a 1% decline in crude oil price returns increases the probability of having negative stock returns before the COVID-19 pandemic announcement. In the same vein, the results show that decline in stock returns increases the probability of having a negative oil price returns before the announcement of COVID-19 as a global pandemic. The fact that the response of negative oil and stock returns is insignificant relative to the mentioned predictors during the pandemic suggests that these series are driven more by uncertainty (shocks) as observed from the impulse responses for the post-announcement period. This finding is also in line with the works of Albulescu (2020) and Zhang et al. (2020) both of which establish that global financial market risks have increased substantially in response to the pandemic, with financial markets becoming highly volatile and unpredictable. The additional results obtained using real exchange rate indicate contrasting evidence between the two periods. We find the relationship to be significant and positive for the pre-announcement period while it is negative and insignificant for the post-announcement period. This further validates the need to conduct distinct analyses for the two periods given their contrasting evidence.

[4] For robustness purposes, we considered alternative lags and we re-conducted the causality test for both pre- and post-announcement periods. The results are summarised in the Appendix (see Appendix 3) and they show that the conclusion remains the same regardless of the lag length.

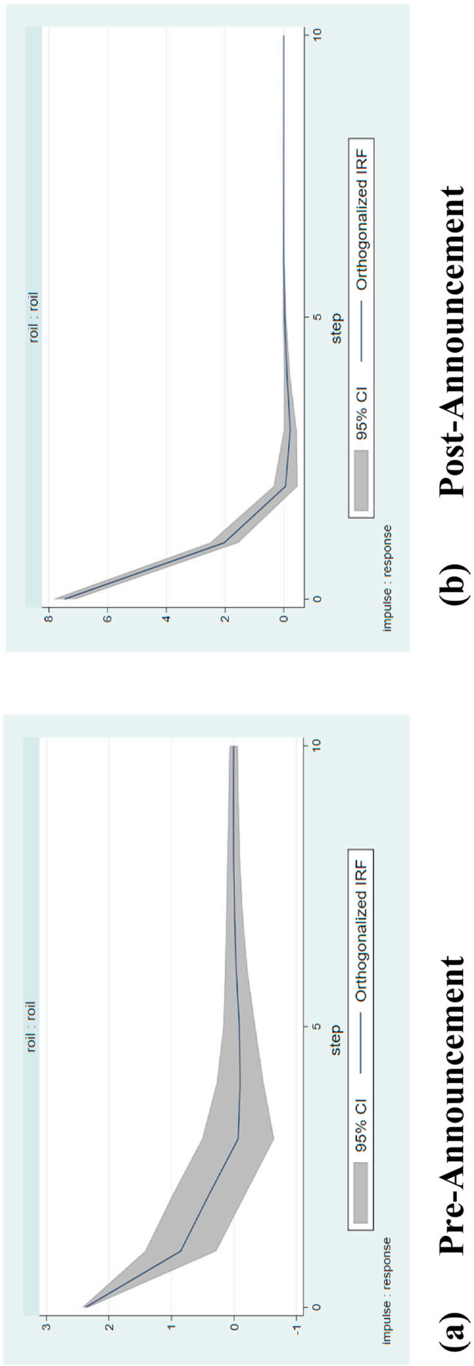
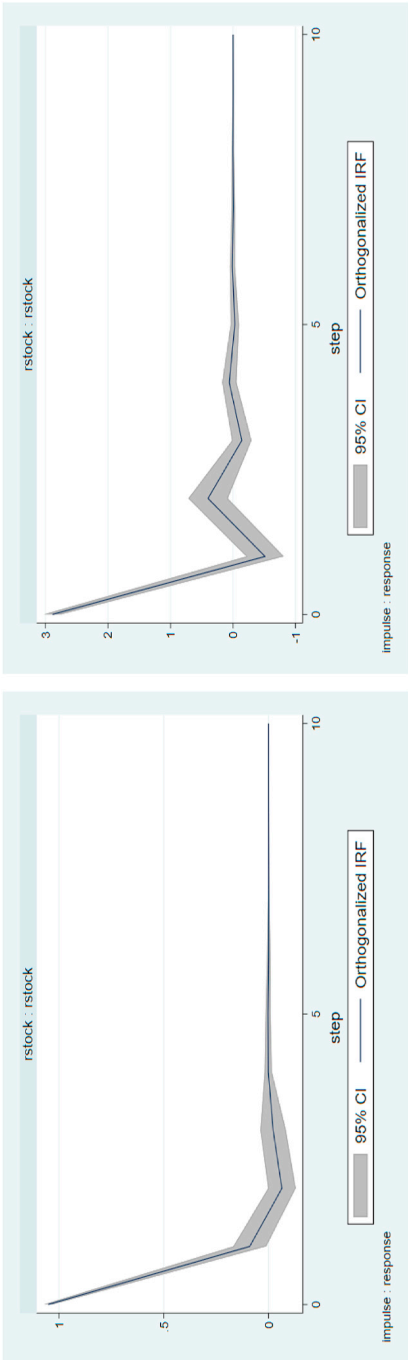


Fig. 3. Response of oil price returns to own shock.



(a) Pre-Announcement

(b) Post-Announcement

Fig. 4. Response of stock returns to own shock.

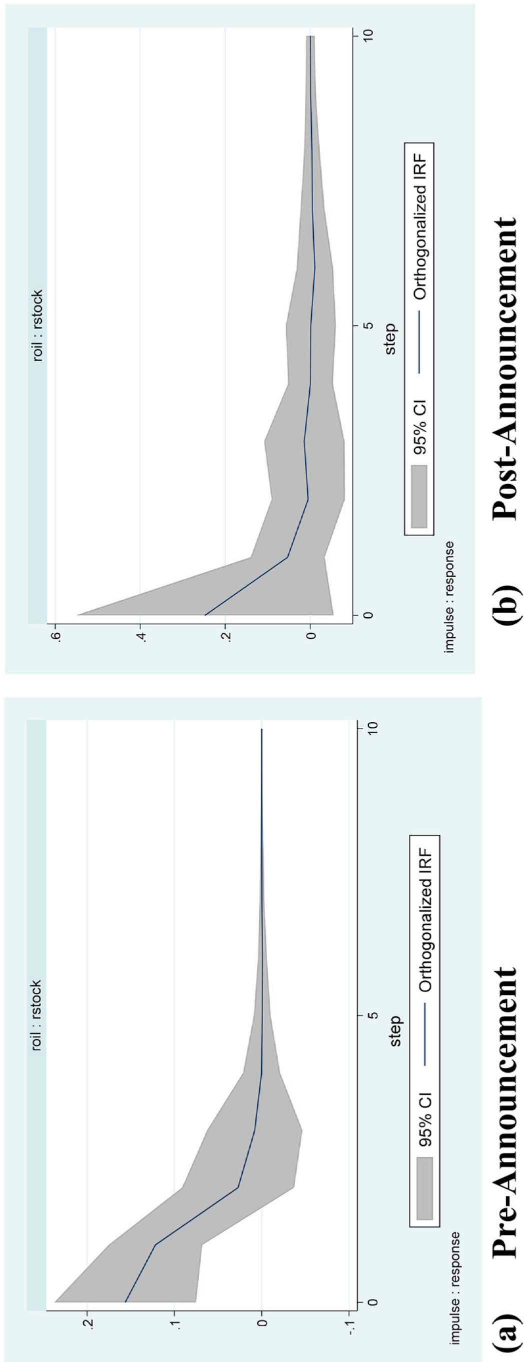


Fig. 5. Response of stock returns to shocks due to oil price returns.

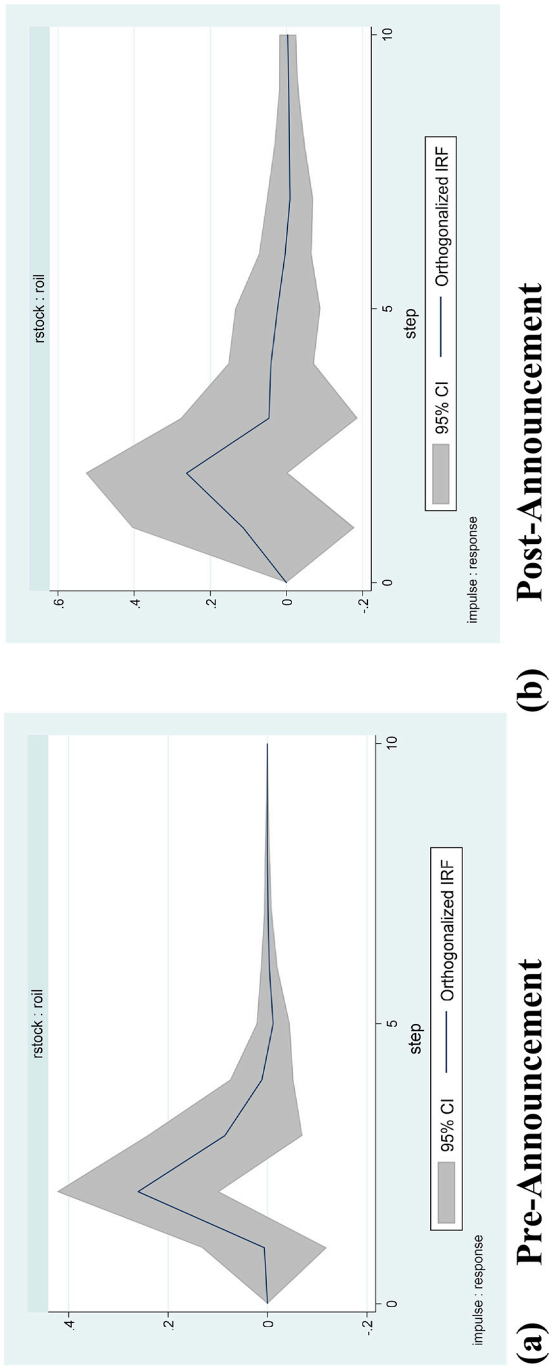


Fig. 6. Response of oil price returns to shocks due to stock returns.

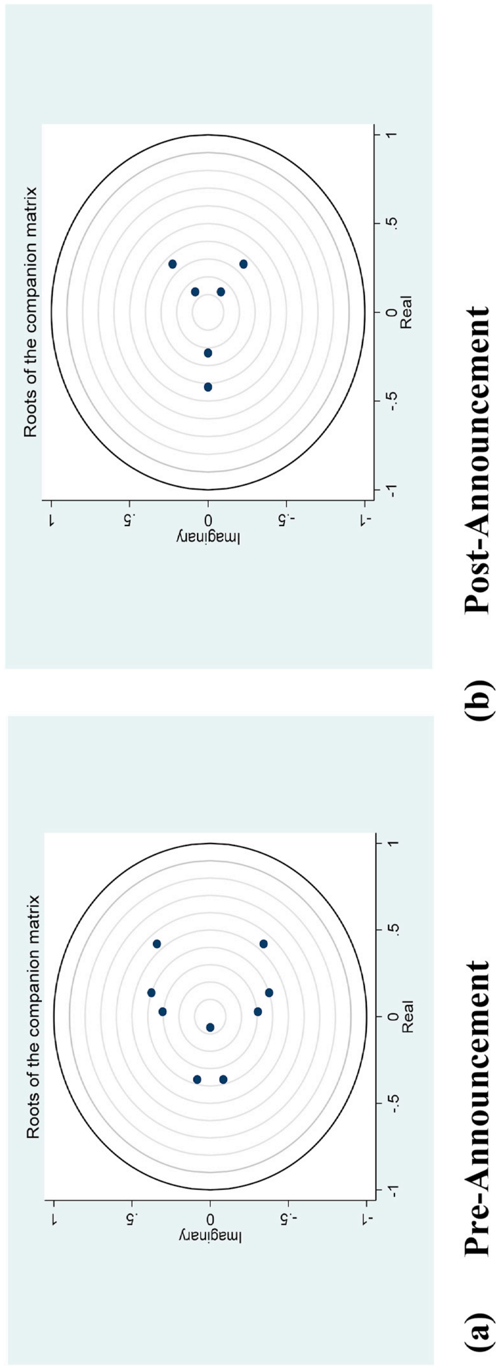


Fig. 7. Stability of the Panel VAR model.

Table 4
Panel Logit regressions using continuous regressors.

Dependent Variable	Stock dummy		Oil dummy	
Variable	Pre	Post	Pre	Post
rexr	0.1841***	0.0309	0.0996	0.1215*
	(0.0634)	(0.0698)	(0.0629)	(0.0710)
roil	−0.0479***	0.0006		
	(0.0132)	(0.0094)		
rstock			−0.0878***	−0.0249
			(0.0297)	(0.0220)
Observations	3948	770	3948	770
Number of countryid	14	14	14	14
LR test -Chi2	22.43	0.20	12.36	4.08
Chi2 Prob	0.0000	0.9051	0.0021	0.1298
Hausman test- Chi2	0.49	1.76	0.03	0.05
Chi2 Prob	0.7832	0.4142	0.9834	0.9751

Note: rexr and roil are return series for exchange rate and oil price respectively. Also, the dependent variables, stock and oil dummy, both denote dummy variables for negative stock and oil price returns respectively where 1 is assigned to negative stock/oil returns and zero otherwise; ***, ** and * respectively denote statistical significance at 1%, 5% and 10% levels.

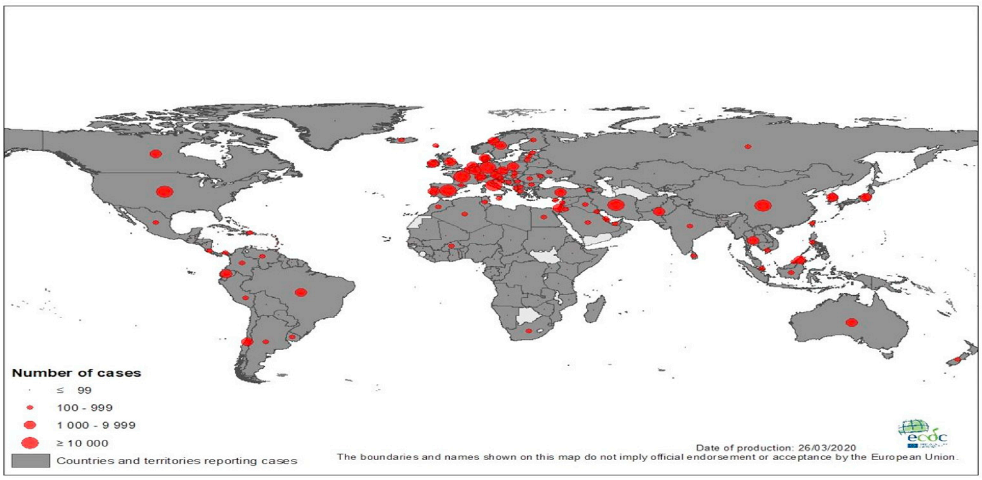
6. Conclusion

This study provides some preliminary results on the behaviour of oil-stock nexus during the pandemic. Due to data limitation, we construct a panel VAR model that allows for short time series dimension while pooling stock price data from some of the countries (cross-sections) that seem to have been worse hit by COVID-19. We model own shocks and cross shocks for oil price and stock prices and find the impact of shocks during the post-announcement of COVID-19 to be more pronounced for oil and stocks albeit with a larger impact for the former. In addition, a panel Logit model is employed where the probability of having negative oil and stock returns during the pandemic is evaluated. While the probability of having negative oil and stock returns seems to be higher during the pre-announcement period than the period after; it does appear that the recorded negative returns in the latter period may be driven by panic/uncertainty in their respective markets as shown in the impulse response functions. Thus, policy recommendation from the study revolves around the need for policymakers, globally to reduce uncertainties in financial markets. This could be achieved by reducing policy inconsistencies and enhanced monetary and fiscal policy coordination that would guarantee effective implementation of policy decisions that would reduce the impact of the pandemic on the global economy. Given the length of the COVID-19 outbreak is unknown and the increasing spread to more countries around the world, there is need for future studies to update these preliminary estimates as events unfold.

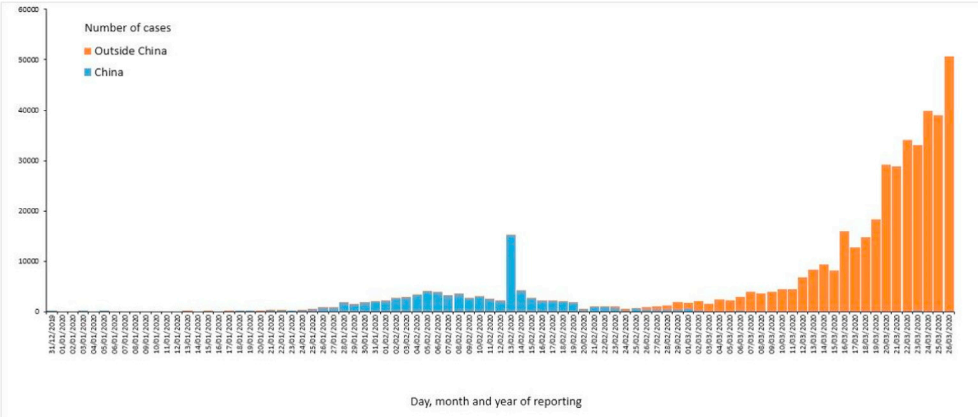
CRediT authorship contribution statement

Afees A. Salisu: Conceptualization, Methodology, Data curation, Formal analysis, Validation. **Godday U. Ebuh:** Conceptualization, Data curation, Validation. **Nuruddeen Usman:** Data curation, Writing - review & editing, Validation.

Appendix 1. Geographic distribution of COVID-19 as at 26/3/2020Source: European Centre for Disease Prevention and Control



Appendix 2. COVID-19 Worldwide case distribution as at 26/3/2020Source: European Centre for Disease Prevention and Control



Appendix 3. Alternative scenarios

Panel Granger Causality test with varying lag lengths

	Pre-Announcement			Post-Announcement		
	Chi-Sq [2]	Chi-Sq [3]	Chi-Sq [4]	Chi-Sq [2]	Chi-Sq [3]	Chi-Sq [4]
roil						
rexr	67.7752***	73.1389***	81.0331***	8.4924**	8.5128**	8.4352*
rstock	0.4129	0.2703	7.4799	2.2586	0.7030	1.4171
ALL	37.6600***	73.4269***	93.7773***	10.8445**	9.2825	9.8405
rexr						
roil	8.3217**	7.0198*	5.5027	5.4593*	6.2870*	2.6380
rstock	4.7202*	10.2589**	18.1325***	3.2973	4.7141	15.1575***
ALL	14.4635***	18.436***	25.1213***	9.1999*	10.7103*	19.1446**
rstock						
roil	118.613***	114.311***	111.301***	0.7931	6.6172*	2.1617
rexr	9.8807***	27.318***	30.799***	4.4486	7.5528*	9.2760*
ALL	137.516***	162.413***	164.441***	5.5965	14.3789**	11.5115

Note: All the variables are expressed in their returns form. The degrees of freedom and lag length are presented in squared brackets; ***, ** and * denote statistical significance at 1%, 5% and 10%, respectively.

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