Journal of
Risk and Financial Management

MDPI

Article

Spillovers of the COVID-19 Pandemic: Impact on Global Economic Activity, the Stock Market, and the Energy Sector

Md. Bokhtiar Hasan [1], Masnun Mahi [2], Tapan Sarker [3,*] and Md. Ruhul Amin [1]

[1] Department of Finance and Banking, Islamic University, Kushtia 7003, Bangladesh; bokhtiar_bank@yahoo.com (M.B.H.); ruhul1112003@yahoo.com (M.R.A.)
[2] Department of Finance and Banking, Faculty of Business and Accountancy, University of Malaya, Kuala Lumpur 50603, Malaysia; masnunmahi@um.edu.my
[3] Department of Business Strategy and Innovation, Griffith University, Brisbane, QLD 4111, Australia
* Correspondence: tapan.sarker@griffith.edu.au

Abstract: In this study, we examine the effect of the COVID-19 pandemic on global economic activity, the stock market, and the energy sector considering the sizable damaging impacts in these crucial aspects. Our results, based on the structural vector autoregression (SVAR) model for the data from 21 January 2020, to 26 February 2021, indicate that the COVID-19 cases significantly and negatively impact all the endogenous variables such as Baltic dry index (BDI), MSCI world index (MSCI), and MSCI world energy index (MSCIE). Our results also reveal that of the three variables, the stock markets indices (MSCI and MSCIE) are comparatively more affected by COVID-19 cases. The findings imply that the stock markets are more sensitive to the COVID-19 pandemic than the real economy. The results further indicate that of the three variables, the MSCIE index is the most affected by COVID-19 due to two factors: one is the dwindling power consumption caused by COVID-19 and the other is the decline in oil price because of the Russia–OPEC price war. Our findings enhance the understanding of the spillover impacts of the global health crisis on economic activity, the stock market, and the energy sector. Moreover, our study offers insights for policymakers and governments into the relationship dynamics of COVID-19 that would help them be more cautious in taking preventive measures against the health crisis to save the economy, the stock market, and the energy sector from falling into a more deepened crisis.

Keywords: COVID-19; coronavirus; pandemic; economic activity; stock market; energy sector; spillover; structural VAR

JEL Classification: C32; F44; G15; I10

Citation: Hasan, Md. Bokhtiar, Masnun Mahi, Tapan Sarker, and Md. Ruhul Amin. 2021. Spillovers of the COVID-19 Pandemic: Impact on Global Economic Activity, the Stock Market, and the Energy Sector. *Journal of Risk and Financial Management* 14: 200. https://doi.org/10.3390/jrfm14050200

Academic Editor: Andreia Dionísio

Received: 17 March 2021
Accepted: 28 April 2021
Published: 1 May 2021

1. Introduction

The first outbreak of the novel coronavirus disease (COVID-19) was reported in Wuhan, China, on 31 December 2019, and it later began to spread very quickly to other countries.[1] Realizing its dreadfulness, the World Health Organization (WHO) declared COVID-19 as a global pandemic on 11 March 2020. In response, governments worldwide have taken various measures, such as lockdowns and social distancing, to prevent the COVID-19 contagion and ensure public health safety. However, the measures have proven costly for the countries' economies and are intensely affecting economic activities around the world (IMF 2020). In early 2020, the IMF (2020) projected the global gross domestic product (GDP) growth for 2020 at −4.90 percent, a demotion of 1.9 percent and 8.2 percent points from April 2020 and January 2020 forecasts, respectively. Although their revised projections indicate that the world economy is likely to recover in 2021, the global GDP in 2021 is expected to be around 6.5% lower than in the pre-COVID-19 projections of January 2020.[2] The statistics indicate the lasting and damaging impact of the COVID-19 pandemic. In terms of economic loss, the Asian Development Bank (ADB) estimated that the global

costs of the COVID-19 pandemic could range from USD 2 trillion to USD 4.1 trillion, which is 2.3 to 4.8 percent of the global GDP.[3]

Apart from the economy, the financial markets have also been heavily affected by COVID-19 due to the vast economic costs generated by the pandemic (Goodell 2020). The impacts of epidemics or pandemics like severe acute respiratory syndrome (SARS) in 2002–2003, swine flu in 2009, Middle East respiratory syndrome coronavirus (MERS-CoV) in 2012, and Ebola virus disease (EVD) in 2014–2016 on financial markets have been documented in past literature (Chen et al. 2009; Hsieh 2013; Chen et al. 2018; Giudice and Paltrinieri 2017; Ichev and Marinč 2018; Joo et al. 2019). Even though the existing literature streams recognize the impacts of pandemics on stock market performances, the shocks generated by COVID-19 are distinctive. Notably, the COVID-19 pandemic differs from comparable pandemics or epidemics due to its high contagiousness, which triggers a lot of uncertainty in the real economy and financial markets (Albulescu 2020). For instance, considering the S&P Dow Jones Indices, the global stocks lost their market capitalizations by around USD 6 trillion in just one week from 24 to 28 February 2020, as investors speculated economic depression due to COVID-19. Even the U.S. S&P 500 wiped off about USD 5 trillion for the same period (Ozili and Arun 2020). Hence, being a health crisis or non-economic crisis, COVID-19 has created momentous havoc in global economic activity as well as in the financial markets (Baldwin and Mauro 2020), which might further lead to an impact on other sectors.

Since it is still underway, it is not yet possible to accurately estimate the economic and financial impact of the COVID-19 pandemic. However, a growing body of studies has already evaluated the effect of COVID-19 on economies' different sectors, for example, economic activities (Yilmazkuday 2020; Ozili 2020), financial markets (Ashraf 2020; He et al. 2020; Zhang et al. 2020; Chaudhary et al. 2020; Al-Awadhi et al. 2020; Onali 2020; Hassan and Gavilanes 2021), and oil price (Ozili and Arun 2020; Yilmazkuday 2020; Hassan and Gavilanes 2021). Except for a few studies, such as Onali (2020) and Yilmazkuday (2020), all of these studies display a significant adverse effect of the COVID-19.

The oil price crisis during the COVID-19 turbulence may lead to a higher probability of tail-risks on oil-derived assets (Dutta et al. 2020). In fact, along with the oil price crisis, the COVID-19 pandemic may affect the entire energy sector.[4] In addition, various containment measures taken to reduce the spread of COVID-19 have severely disrupted industrial productions and consequently had an adverse impact on the whole energy sector due to reduced power consumption in recent months (Albulescu 2020). Similarly, a reduction in the movement of people and goods resulted in a fall in demand for aviation fuel, coal, and other energy products, which subsequently resulted in a fall in energy prices (Ozili and Arun 2020). Thus, the energy sector is coming out as one of the biggest losers during the pandemic (Ramelli and Wagner 2020).

The impact of the COVID-19 pandemic on the energy sector is further highlighted by the International Energy Agency (IEA). They projected a fall of 6% global energy use in 2020, which is more than seven times the impact of the global financial crisis of 2008.[5] Although some authors have discussed the potential effects of COVID-19 on the energy sector, no one has empirically examined them. An updated assessment by IEA (2020) indicated that the impacts vary by fuel.[6] The estimated falls of oil and coal demand were 8% and 7%, respectively; while the reduction in natural gas demand was around 3%, global electricity demand looks set to be down by 2%. Therefore, the impacts of COVID-19 on the energy sector need to be investigated in an aggregate manner rather than exploring the impact on oil price in isolation. The analysis would greatly assist in understanding the crisis dynamics more clearly.

From the above discussion, it is conceivable that the impacts of COVID-19 on economic activity and financial markets are documented in earlier studies; however, understanding is still limited, particularly in the case of economic activity, and thus needs further investigation. Specifically, the studies primarily focus on the COVID-19's impacts either from economic or financial market perspectives. However, examining the effects on eco-

nomic and financial activities together would provide a thorough understanding of their responses to the COVID-19 pandemic. Furthermore, the literature ignores the impact on vital economic sectors like energy. Even though a few researchers incorporate the oil price crisis into their studies, a comprehensive effect of COVID-19 on the overall energy sector is still missing.

To fill the existing gap in the literature, in this study, we strive to provide empirical evidence of the impact of the COVID-19 pandemic on the energy sector with global economic activity and the stock markets. We employed the structural vector autoregression (SVAR) model on a relatively larger sample from 21 January 2020 to 26 February 2021. The results suggest that the COVID-19 pandemic tends to affect all the endogenous variables, but to different degrees, significantly negatively. Our findings further indicate that compared to the economic activity, the financial markets and energy sector are more sensitive to the COVID-19 crisis. Our supplementary analysis also suggests that the financial markets and energy sector are also negatively affected by economic activity. Our findings augment the understanding of the spillover impacts of COVID-19 on global economic activity, stock markets, and the energy sector. Moreover, our study offers insights to policymakers and governments about the relationship dynamics of COVID-19 with several aspects.

Our study differs from other relevant studies that were recently conducted on several grounds and offers some novel contributions to the existing body of knowledge. First, most of the previous studies focused on either global economic activity or stock markets to see the impact of COVID-19. We complement the current understanding with the inclusion of the energy sector, which is indicated as one of the hardest-hit sectors during the pandemic. To the best of our knowledge, our study examines the effect of COVID-19 on the overall energy sector for the first time. The inclusion of the sector would help comprehend the recent energy crisis, thus enhancing the understanding of the factors' dynamics.

Second, most of the studies perform investigations focusing on a particular economy, whereas our research offers a global perspective of the crisis by considering indices that represent global activities. Moreover, the earlier studies were conducted mainly on a small sample covering only the first three quarters of 2020. Conversely, we provide empirical evidence with more extended data periods covering the second wave of COVID-19 that would accommodate more information regarding the impacts of the COVID-19 pandemic. Third, we contribute to the literature by providing a cross-discipline understanding of the linkages between health and the economic and financial crisis with the fresh empirical evidence from the COVID-19 pandemic. Fourth, our study further contributes to the financial crisis literature by showing that non-financial or non-economic factors can trigger both financial and economic meltdowns in an unprecedented way. Finally, our study offers policymakers and governments an insight into the relationship dynamics of the COVID-19 pandemic. The rest of the paper is organized as follows. Section 2 presents relevant review of literature. Section 3 explains the materials and methods to be applied in this study. Section 4 represents the estimated results and discussion of the research, and finally, Section 5 concludes the study with policy implications.

2. Literature Review

Considering the ongoing pandemic, it seems early to investigate the impacts of COVID-19 on economies and markets. However, Goodell (2020) delineated some research agenda relevant to COVID-19 in his recent publication. Specifically, the author suggests looking into the impacts on the economy and financial markets, among others. Furthermore, some recent studies have already addressed such issues. For instance, Ashraf (2020) investigated the stock market reactions to the increase in COVID-19 cases between 22 January 2020 and 17 April 2020 and found an adverse reaction of stock markets to COVID-19 cases. He also added that the negative market responses were more robust at the beginning of the COVID-19 outbreak. He et al. (2020) revealed that COVID-19 negatively impacted stock markets in the eight most infected countries only in the short run. They also found a bidirectional spill-over effect of COVID-19 between Asian countries and European and

American countries. Zhang et al. (2020) confirmed that COVID-19 significantly increases global financial markets' risks. They also suggested that the severity of the outbreak in individual countries has also affected their respective stock markets. Chaudhary et al. (2020) unveiled a significant negative mean return for all the sample stock markets during the COVID-19 period. They further revealed that the stock markets were mainly impacted in the first quarter of COVID-19, while the markets bounced back from the second quarter of COVID-19, but the volatility is still higher than in regular times.

Similarly, Al-Awadhi et al. (2020) and Sun et al. (2021) found a significant negative effect of COVID-19 on the Chinese stock market, while Yilmazkuday (2020) and Baek et al. (2020) found a significant negative impact of COVID-19 on the US stock market. Yilmazkuday (2020) also revealed a significant negative link between COVID-19 and economic activity measured by the Baltic Exchange dry index. In comparison, Onali (2020) reported mixed results regarding the COVID-19 impact on stock markets. However, based on GARCH (1, 1), the author found no significant connection between COVID-19 and stock returns in the US stock market. In contrast, the VAR model interestingly found a significant positive linkage between the same.

Furthermore, some studies focused on the impact of the COVID-19 pandemic on the energy sector; however, they mainly analyzed the oil price effect. For instance, Sharif et al. (2020) examined US stock markets' reaction to both the COVID-19 outbreak and the oil price crisis. Though both COVID-19 and the oil price crisis have affected stock markets significantly, the oil crisis has had more substantial effects on stock markets. Ozili and Arun (2020) found that although in early 2020, the oil price fell due to the oil price war between Russia and Saudi Arabia, the plunge of the oil price has been aggravated by the decrease in the demand for oil caused by the COVID-19 pandemic. Likewise, Hassan and Gavilanes (2021) documented a significant negative influence of COVID-19 on crude oil prices. In contrast, Yilmazkuday (2020) revealed that the COVID-19 cases in China did not significantly impact oil prices. The author suggested that the oil price plunge is mainly explained by the OPEC disagreement rather than the pandemic.

Some more recent studies focused on other vital sectors too to see the impact of COVID-19. For instance, Chevallier (2021) examined the effects of COVID-19 on macro-financial variables and CO_2 emissions and found an adverse influence. Ho and Gan (2021) investigated the impact of different health pandemics from 1996 to 2019, including COVID-19, on the foreign direct investment (FDI) of 142 economies. Using the new world pandemic uncertainty index (WPUI), their findings showed a negative effect of pandemics, particularly in Asia-Pacific countries and emerging economies. On the other hand, Hassan and Gavilanes (2021) observed the global commodity markets with the first affected countries' stock markets to observe the impact of COVID-19. Their findings indicated a significant negative effect of COVID-19 on stock returns and commodity prices such as platinum, silver, West Texas intermediate (WTI), and Brent crude oil in the short run. The volatility spillover between the US economy's seven main sectors during various crises, including COVID-19, was examined by Laborda and Olmo (2021). Their research unveiled that during the 2008 global financial crisis, the banking and insurance sectors were the primary channels by which shocks were transmitted to the rest of the economy, while the energy and technology sectors have been the key drivers in times of COVID-19.

3. Materials and Methods

To investigate the effect of the COVID-19 pandemic on global economic activity, financial markets, and the energy sector, we used different representative proxies. The daily global COVID-19 cases were taken as a proxy for the COVID-19 pandemic. On the other hand, Baltic Exchange dry index (BDI)[7] was chosen as a proxy for global economic activities, since the real global activities are reflected in the BDI (Kilian 2009; Fan and Xu 2011; Qiu et al. 2012; Makridakis et al. 2020; Yilmazkuday 2020). The MSCI world index (MSCI)[8] was chosen to represent world financial market activities. The index was selected as it captures both large and mid-cap representations across 23 developed countries' markets

with 1583 constituents and covers approximately 85% of the free float-adjusted market capitalization in each country. Comparably, the MSCI world energy index (MSCIE)[9] was chosen as a proxy for the global energy sector. It captures the large and mid-cap segments across 23 developed markets countries, including only the energy sector securities as per the Global Industry Classification Standard.

For all the variables, we considered the daily data spanning from 21 January 2020 to 26 February 2021. The starting date of the sample is considered 21 January, as it is the date on which the human-to-human COVID-19 transmission was first confirmed. Since then, the impact of the pandemic aggravated the panic of a major outbreak as millions traveled for China's New Year holiday.[10] The sample data for the total number of daily confirmed cases of COVID-19 were obtained from the work of Roser et al. (2020), which compiled the real-time data of the COVID-19 pandemic, while the market indices (MSCI and MSCIE) data were collected from Thomson Reuters DataStream. However, unlike COVID-19 cases, the indices data have missing observations on holidays and weekends. Hence, to maintain the consistency among the observations of all variables, the missing observations were filled by applying the linear interpolation method.

To accomplish the objective of this study, the structural vector autoregression (hereafter, SVAR) model is employed. The chosen model offers some advantages over the traditional VAR estimation model. The traditional VAR model is criticized in the literature as atheoretical—an economic structure that is difficult to reconcile with theory—and the estimated shocks are in general not pure shocks but rather linear combinations of structural disturbances (Keating 1992; Raghavan et al. 2012). Consequently, the impulse response functions (IRFs) associated with traditional VAR analysis have no clear economic interpretations (Raghavan et al. 2012). In contrast, the structural VAR imposes an analytical model on the contemporaneous movements of the variables and allows for the identification of the parameters of the model and the structural shocks (McPhail 2011). This feature makes it particularly useful for the policy and macroeconomic shocks, and the IRFs analysis is extremely helpful in tracking the impact of an exogenous shock on the response variables in the system (Nasir et al. 2019).

There are four variables in the study: BDI, MSCI, and MSCIE are endogenous ($n = 3$). In contrast, the other variable, daily global COVID-19 cases, is exogenous ($m = 1$).[11] The model includes all variables in their first differences to avoid the unit root problem of the data series. Since the study has an exogenous variable, and the main objective of this study is to examine the effect of the exogenous variable on the endogenous variables, the model is termed as structural VARX (Ocampo and Rodríguez 2012). Before formulating model, let Δb_t be the rate of change in BDI, Δf_t be the rate of change in MSCI, Δe_t be the rate of change in MSCIE, and Δc_t be the rate of change in daily global COVID-19 cases. The general form of the structural VARX model is as follows:

$$Ay_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B_o x_t + B_1 x_{t-1} + \ldots + B_p x_{t-p} + Dd_t + \varepsilon_t \quad (1)$$

for $t = 1, 2, \ldots, T$, where, $y_t = (\Delta b_t, \Delta e_t, \Delta f_t)'$ is an $n_y \times 1$ vector of endogenous variables, $x_t = \Delta c_t$ is an $n_x \times 1$ vector of exogenous variables, d_t is a $q \times 1$ vector of deterministic variables (i.e., intercept, trend, and seasonal variables), $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \ldots, \varepsilon_{ny\,t})'$ is an $n_y \times 1$ vector of serially uncorrelated errors distributed independently of x_t with zero mean and constant positive variance-covariance matrix, $\theta = (\Omega_{ij})$, where Ω_{ij} is the (i,j)th element of θ.

The above structural VARX model (1) is now translated into a compact form for estimation purpose, which states the endogenous variables in terms of the predetermined and exogenous variables as follows:

$$y_t = \Phi_1 y_{t-1} + \ldots + \Phi_2 y_{t-p} + \Upsilon_o x_t + \Upsilon_1 x_{t-1} + \ldots + \Upsilon_p x_{t-p} + \Psi d_t + u_t \quad (2)$$

where $\Phi_i = A^{-1}A_i$, $\Upsilon = A^{-1}B_i$, $\Psi = A^{-1}D$, $u_t = A^{-1}\varepsilon_t$ is independent and identically distributed (i.e., i.i.d.). $(0, \Sigma)$ with $\Sigma = A^{-1}\theta A'^{-1} = (\sigma_{ij})$. It notes that the recursive structure imposed on A^{-1} requires ordering of the endogenous variables used in the estimation

(i.e., $y_t = (\Delta b_t, \Delta e_t, \Delta f_t)'$). The block exogeneity is imposed here, i.e., Δe_t and Δf_t can contemporaneously be affected by the shocks of Δb_t, but not vice versa (Yilmazkuday 2020).

4. Empirical Results

4.1. Descriptive Statistics

First, we illustrate the daily time-series data of the global COVID-19 cases from the human-to-human COVID-19 transmission periods in Figure 1. Then to understand the initial behavior of our endogenous variables, we provide the results of descriptive analysis considering both after and before the human-to-human COVID-19 transmission periods. In doing so, we took 289 observations for each period. The daily prices of BDI, MSCI, and MSCIE for both periods are graphed in Figures 2–4, respectively.

Figure 1 shows that the global COVID-19 cases started to grow rapidly from early March 2020 to mid-April, and then they remained steady until May. They again started to grow from June, which turned into a sharp escalation from the beginning of October and remained until December. However, it started declining from January 2021. Conversely, Figure 2 shows that the downtrend of BDI commenced from before the COVID period, which continued after COVID-19 to mid-February. It remained somewhat steady from the end of February to April, and after that, it began sharply escalating until June. However, it showed two significant declines in early July and early October, probably due to the corresponding increase of the COVID-19 cases.

Figure 3 displays that the prices of MSCI were at an increasing trend before the COVID-19 period, which continued even after the COVID-19 period. However, MSCI started sharply declining from mid-February when the COVID-19 cases began to rise abruptly. It bounced back to an increasing trend from early April. However, MSCI also witnessed two quick declines in early September and mid-October, when the COVID-19 cases sharply increased.

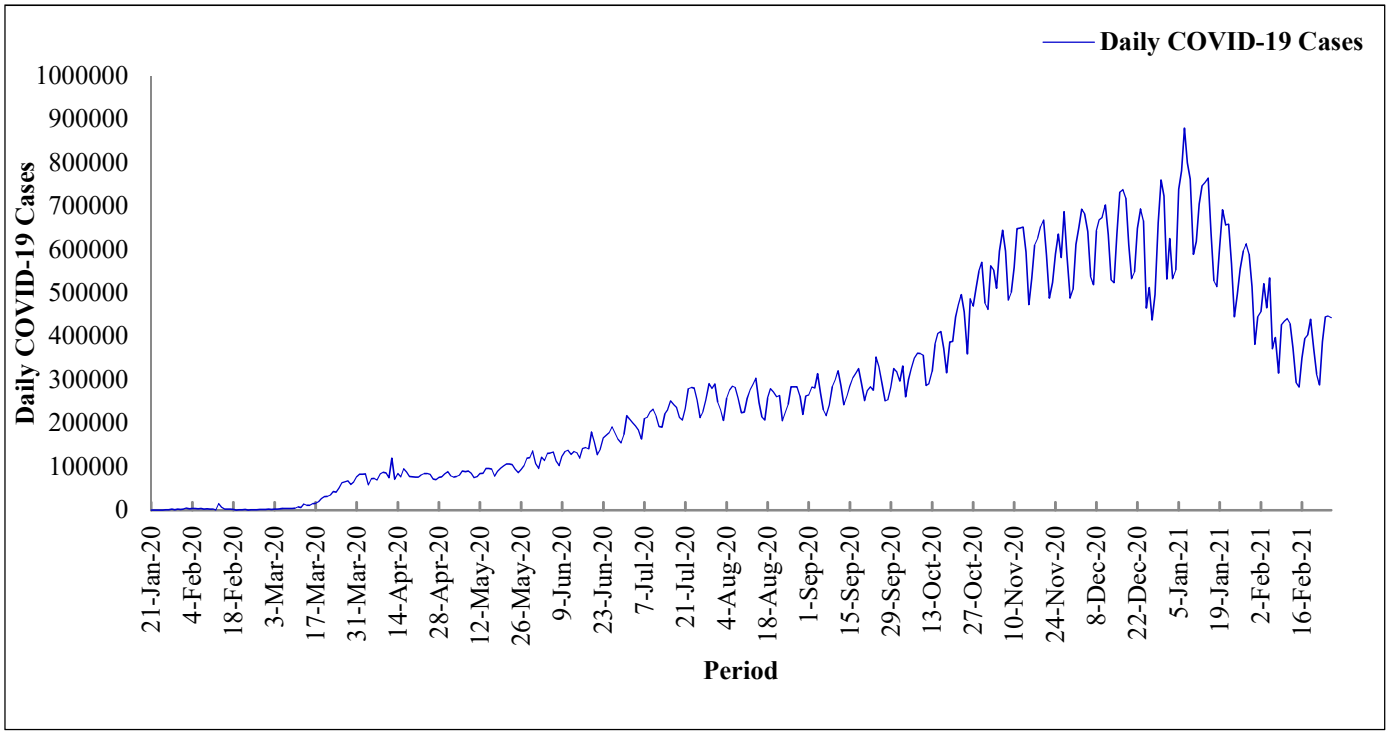

Figure 1. Daily movements of the COVID-19 cases.

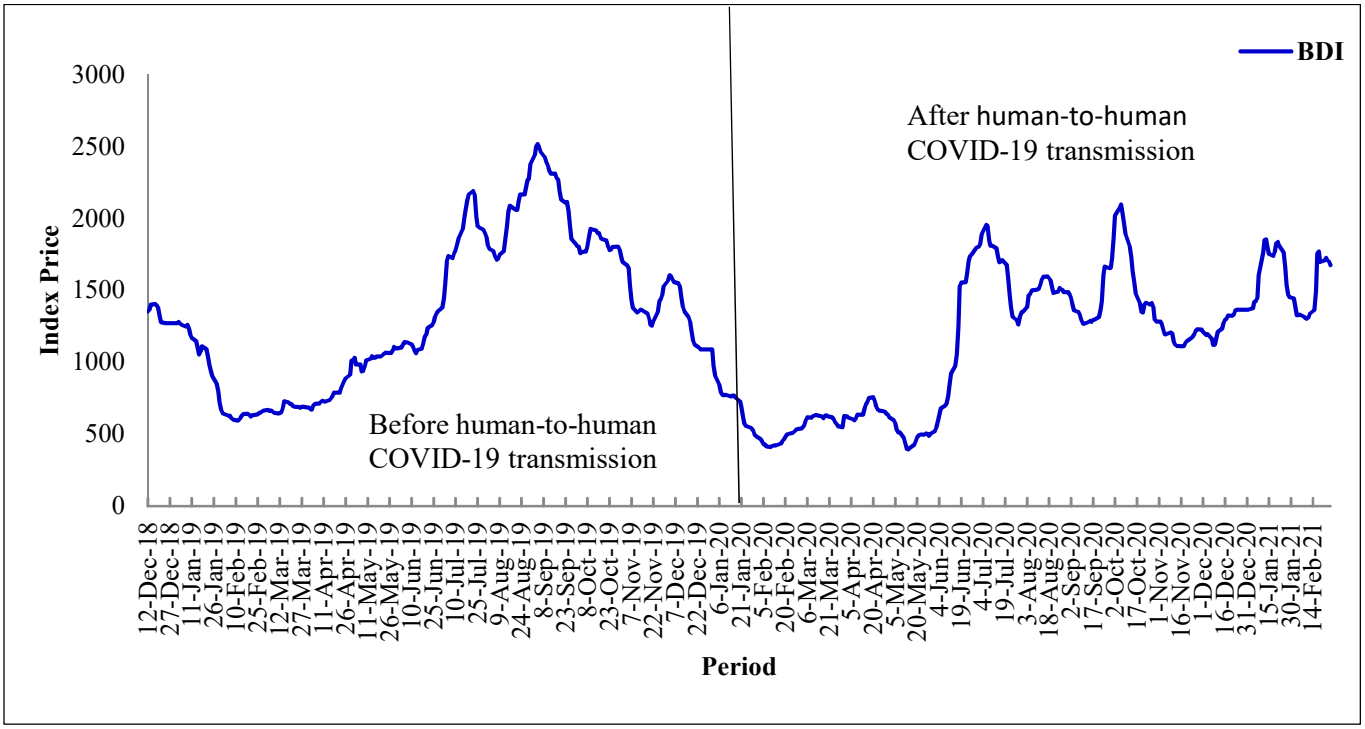

Figure 2. Daily movements of the Baltic Exchange dry index (BDI).

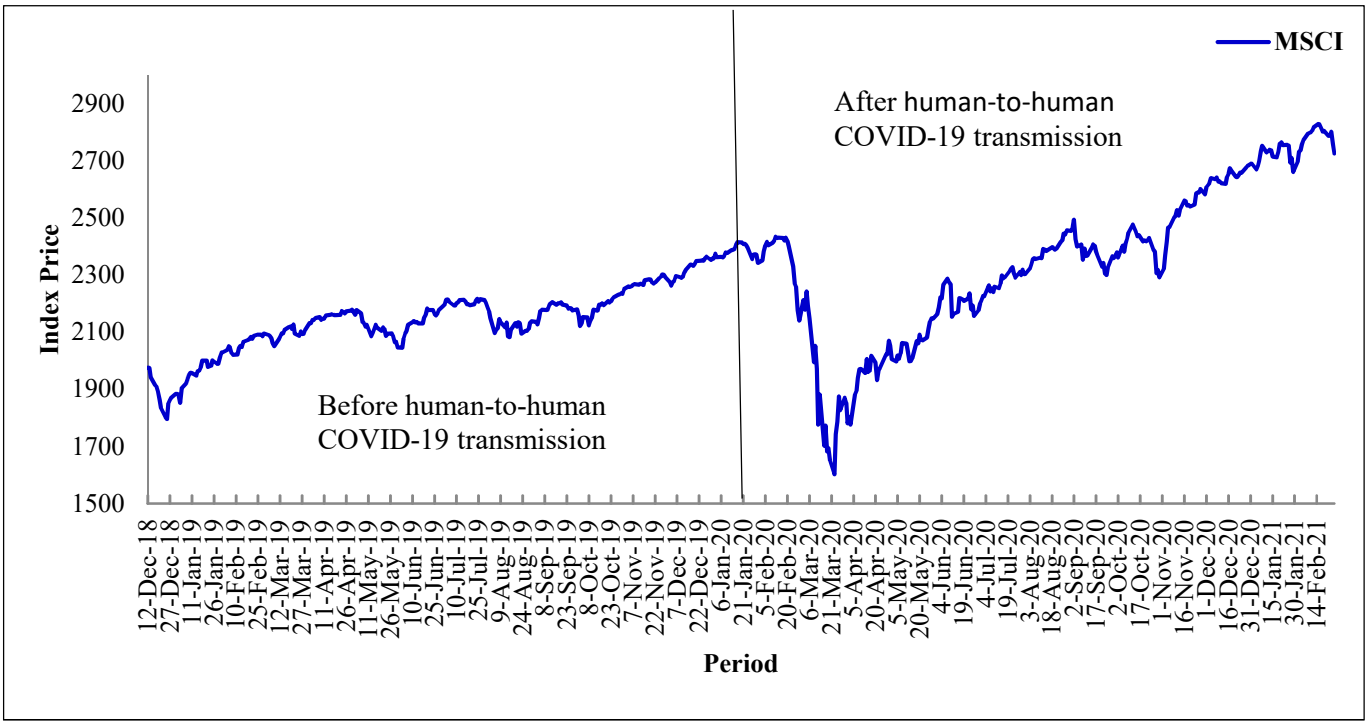

Figure 3. Daily movements of the MSCI world index (MSCI).

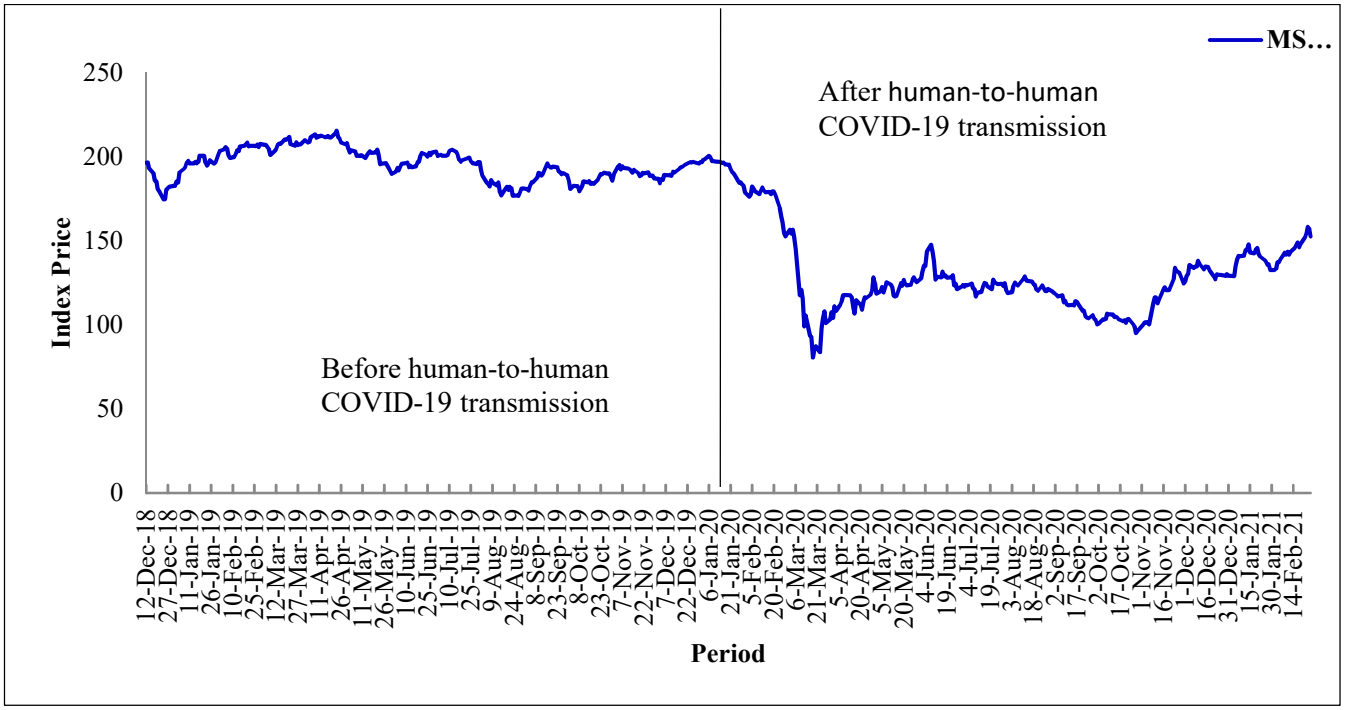

Figure 4. Daily movements of MSCI world energy index (MSCIE).

In contrast, MSCIE was relatively stable before the COVID-19 period, but it began to decline rapidly from the beginning of the COVID-19 period to mid-March. However, similar to the other two indices, it showed a downward trend during the September–October period.

It was observed that all three indices touched the bottom line after the human-to-human COVID-19 transmission period. The illustrative analysis initially showed evidence that the first wave of the COVID-19 pandemic significantly and negatively affected all variables' daily prices. It was also unearthed that in early October 2020, the second wave of COVID-19 that hit the world, especially Europe (Yarovaya et al. 2020a), also negatively affected all the variables, but not as strongly as the first wave.

For further empirical analyses, we transformed all the variables in log return (in percentage). Table 1 summarizes the descriptive statistics of the three endogenous variables, i.e., BDI, MSCI, and MSCIE, of this study before and after the human-to-human COVID-19 transmission periods. From Table 1, we notice that the mean values of the daily returns of both MSCI and MSCIE were significantly lower in the post-COVID-19 period than in the pre-COVID-19 period. On the other hand, the mean returns of BDI were higher in the post-COVID-19 period than in the pre-COVID-19 period. However, such counterintuitive mean return may come from the aggregation of a comparatively larger sample period of our study. Interestingly, the volatilities, measured by the standard deviation of all three variables, were considerably higher in the post-COVID-19 period than in pre-COVID-19. Overall, the summary statistics indicate that the COVID-19 pandemic has had an adverse effect on all the sample variables.

Table 1. Summary statistics: the returns of the daily prices of BDI, MSCI, and MSCIE.

	Before Human-to-Human COVID-19 Transmission			After Human-to-Human COVID-19 Transmission		
	BDI	**MSCI**	**MSCIE**	**BDI**	**MSCI**	**MSCIE**
Mean	−0.2335	0.0686	−0.0067	0.2878	0.0420	−0.0853
Median	−0.0432	0.081	0.0405	0.0779	0.1477	−0.2064
S.D.	2.8149	0.677	1.0065	3.9374	1.7551	3.22401
Kurtosis	4.9375	5.8453	3.9622	6.9976	13.5794	13.9996
Skewness	−0.2998	−0.2603	−0.1627	1.0925	−1.2581	−1.1572
Min.	−11.047	−2.4804	−3.3208	−10.0694	−10.4411	−21.2318
Max.	10.1959	3.0403	3.2443	20.3366	8.4063	15.6704
Count	289	289	289	289	289	289

Table 2 presents the correlation matrix of the variables used in this study for the COVID-19 period. The correlation matrix reveals that the rate of changes in the daily prices of BDI, MSCI, and MSCIE had a negative correlation with those of the daily confirm cases of COVID-19.

Table 2. Correlation matrix.

	COVID-19 Cases	**BDI**	**MSCI**	**MSCIE**
COVID-19 Cases	1			
BDI	−0.0047	1		
MSCI	−0.0032	−0.0783	1	
MSCIE	−0.0165	−0.1212	0.8466	1

The overall results of the descriptive statistics discussed above primarily signify that the COVID-19 cases have an adverse effect on all the endogenous variables, i.e., BDI, MSCI, and MSCIE. With the initial findings from the descriptive analyses, the following section analyzes the SVAR estimations and the cumulative impulse response of the variables.

4.2. Structural Vector Autoregression (SVAR)

Before running the SVAR estimate, we need to test the stationarity of the data of the variables used in this study. We used both ADF and PP tests, and the results are exhibited in Table 3. The results of both tests confirm that all the variables are stationary at their levels, invalidating the cointegration test's assumption.

Table 3. Unit root test.

Variable	**ADF Test**		**PP Test**	
	Statistic	***p*-Value**	**Statistic**	***p*-Value**
COVID-19 Cases	−5.7556	0.0000	−29.6280	0.0000
MSCI	−7.5545	0.0000	−64.3032	0.0001
MSCIE	−7.2902	0.0000	−41.1184	0.0001
BDI	−5.5706	0.0000	−38.3640	0.0001

Notes: ADF (H0) and PP (H0): Variables has a unit root.

However, our study employs the SVAR estimates with impulse response functions (IRFs) to examine the dynamic interactions between the variables under consideration. The SVAR estimation more effectively captures the effects of variables of interest on other variables by estimating the IRFs (Raghavan et al. 2012). Under IRFs, a unique shock is given to each variable in the VAR system and observes how other variables respond to the shock. Using the SVAR model, we estimate the impulse responses of the COVID-19 cases to endogenous variables such as MSCI, BDI, and MSCIE. The analysis facilitates our understanding of the specific effect of COVID-19 on the variables. The cumulative IRFs were estimated based on the Cholesky decomposition method. The results are reported in

Table 4 and are graphically illustrated in Figures 5–7 for MSCI, BDI, and MSCIE, respectively. The red lines in the figures represent cumulative IRFs and the green bands are 95% confidence intervals for the IRFs.

Table 4 shows the cumulative response of MSCI to COVID-19 cases for several time horizons (after 1 day, after 1 week, after 2 weeks, and after 1 month). The results suggest that a one percent increase in COVID-19 cases causes about 0.93 percent, 1.17 percent, 1.42 percent, and 1.44 cumulative decreases in MSCI after 1 day, 1 week, 2 weeks, and 1 month, respectively. It further reveals that the cumulative reduction of MSCI is increasing over time in the long run, which is also corroborated by the pattern curve of the IRF, as shown in Figure 5. The figure shows that in response to the COVID-19 shock, MSCI tended to sharply decline just after one day, which continues for about three days. Afterwards, it witnessed some sharp ups and downs, which eventually dried out after 17 days. Overall, it suggests that the COVID-19 cases have a significant negative effect on MSCI.

Table 4. The cumulative impulse of COVID-19 cases on MSCI, BDI, and MSCIE.

	After 1 Day	After 1 Week	After 2 Weeks	After 1 Month
Impulse of COVID-19 cases on MSCI	−0.0093	−0.0117	−0.0142	−0.0144
Impulse of COVID-19 cases on BDI	−0.0095	−0.0056	−0.0028	−0.0019
Impulse of COVID-19 cases on MSCIE	−0.0165	−0.0191	−0.0245	−0.0262

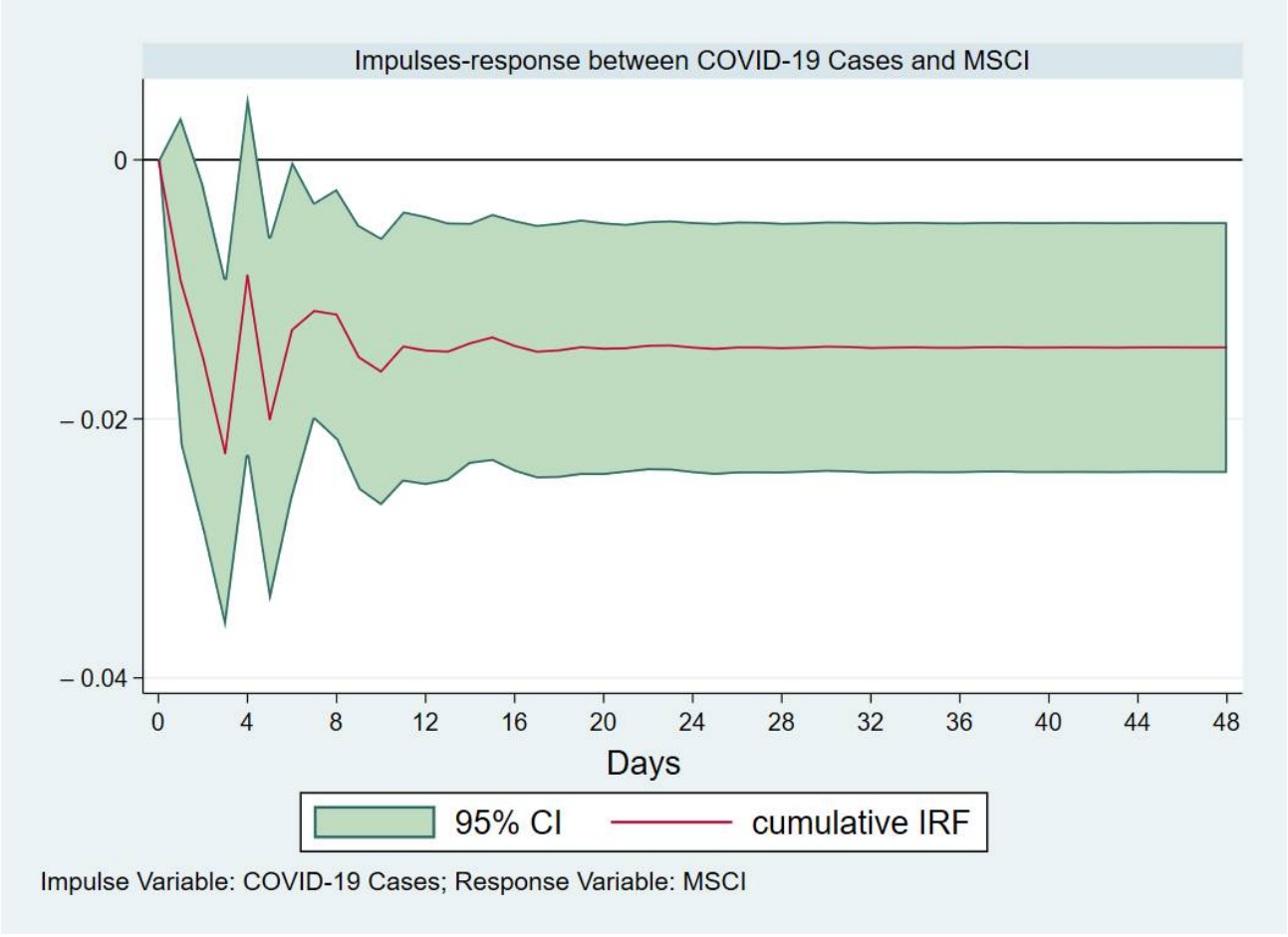

Figure 5. Cumulative impulse response of MSCI to COVID-19 cases. Note: The red line represents the estimates, while the green bands represent lower and upper bounds to the 95% confidence intervals.

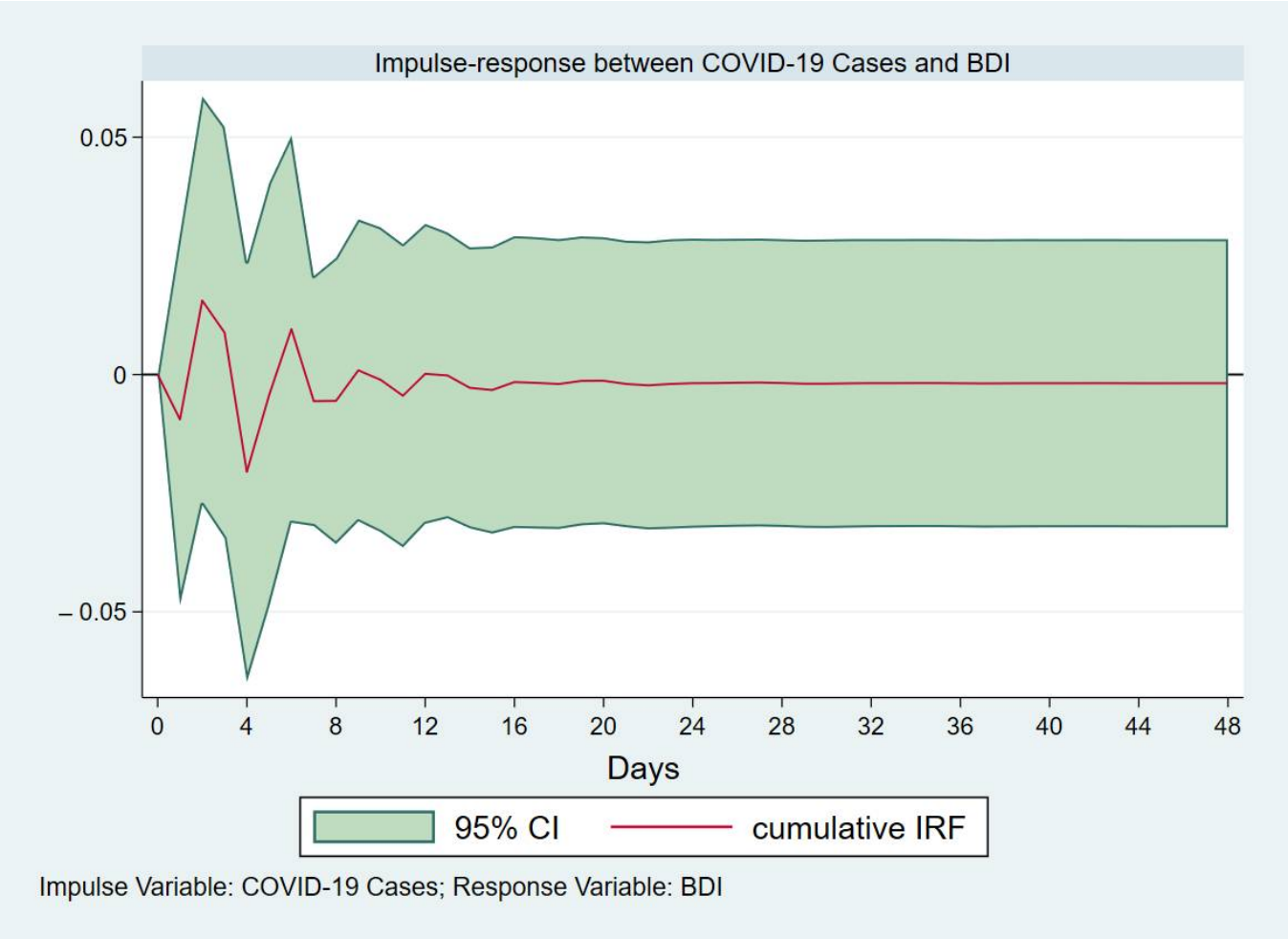

Figure 6. Cumulative impulse response of BDI to COVID-19 cases. Note: The red line represents the estimates, while the green bands represent lower and upper bounds to the 95% confidence intervals.

Similarly, from Table 4, the cumulative response of BDI to the COVID-19 cases indicates that the COVID-19 cases are likely to have a significant negative impact on BDI. A one percent increase in the COVID-19 cases tended to produce about 0.95 percent, 0.56 percent, 0.28 percent, and 0.19 percent cumulative decline in BDI after 1 day, 1 week, 2 weeks, and 1 month, respectively. Although the cumulative reduction of BDI decreases over time in the long run, the cumulative value remains negative, which is also documented by the pattern curve of the IRF, as shown in Figure 6. We also observed that the IRF pattern curve shows severe volatility (ups and downs) for up to 2 weeks and then moves out.

Likewise, the effect of COVID-19 cases on MSCIE is also negative and significant, as seen in Table 4. If the COVID-19 cases increase by one percent, the cumulative response of MSCIE reduces by 1.65 percent, 1.91 percent, 2.45 percent, and 2.62 percent after 1 day, 1 week, 2 weeks, and 1 month, respectively. It is observed that the cumulative response of MSCIE is negative and significant for up to 2 weeks. Following that, it vanishes, as verified by the IRF curve of MSCIE shown in Figure 7.

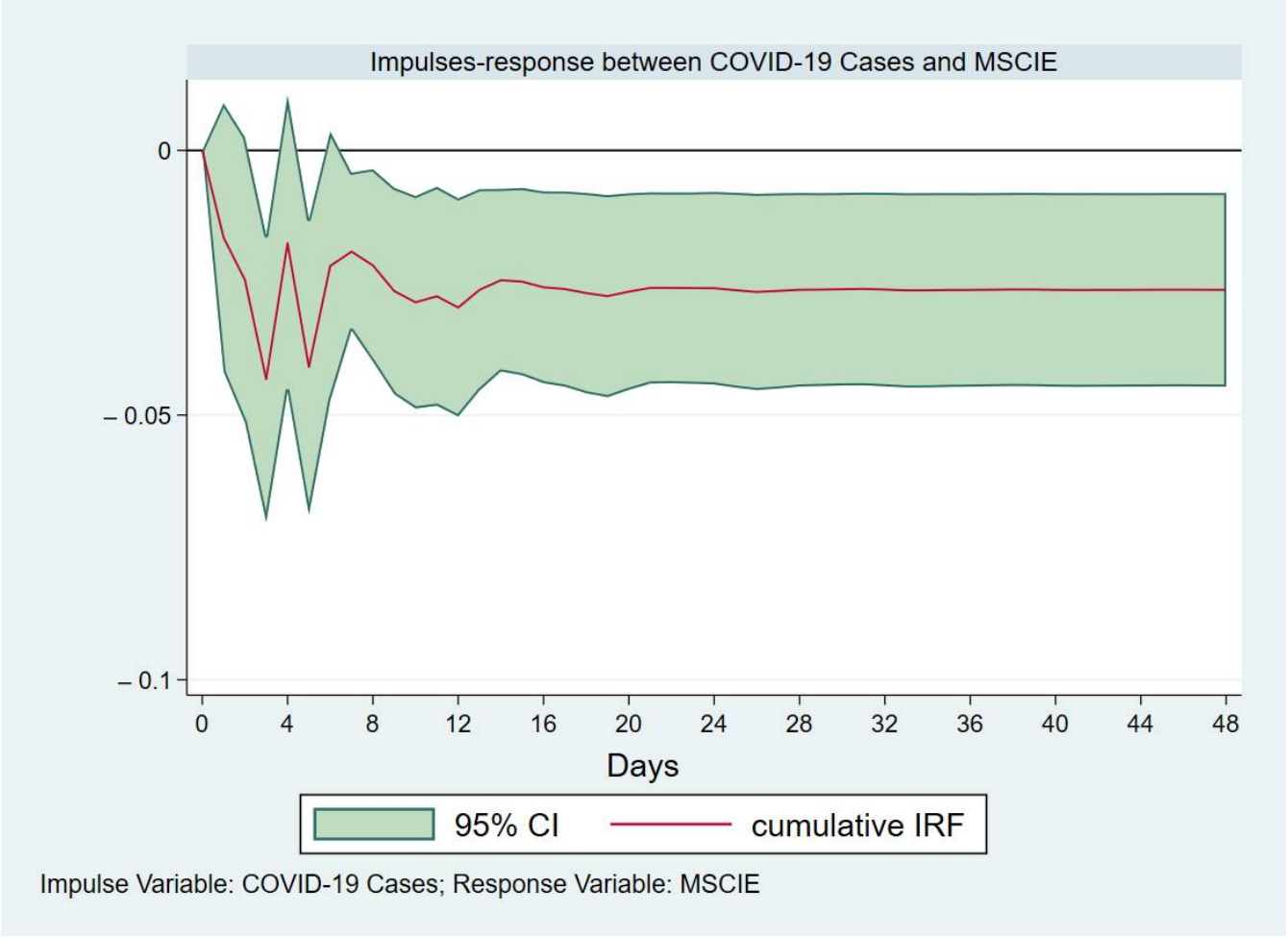

Figure 7. Cumulative impulse response of MSCIE to COVID-19 cases. Note: The red line represents the estimates, while the green bands represent lower and upper bounds to the 95% confidence intervals.

From the above analysis, it appears that the three endogenous variables, i.e., BDI, MSCI, and MSCIE, have been significantly and negatively impacted by the COVID-19 pandemic. At the same time, MSCI and MSCIE have been more affected than BDI. The findings indicate that the financial markets are more sensitive to the COVID-19 crisis. Since investors fear a recession caused by the sharp escalation of the COVID-19 crisis, they react immediately to the stock markets with a very pessimistic attitude (Yarovaya et al. 2020b), resulting in a significant negative effect of COVID-19 on stock markets. Another important finding from the above analysis is that the cumulative IRFs values for all the three endogenous variables against COVID-19 remain negative in the long run, indicating that the COVID-19 pandemic is hitting the financial and economic markets in the long run. Hence, it seems that the pandemic might have long-lasting effects on economic and financial markets (Jordà et al. 2020). However, financial markets may be affected by the COVID-19 pandemic in two ways: the first is due to the shock created by the COVID-19 pandemic, and the second is due to the economic crisis caused by the COVID-19. These could be the possible reasons why stock markets are more affected by COVID-19 than economic activity. We have further examined the effect of BDI on the MSCI and MSCIE indices for comprehending whether the contagion effects of COVID-19 impact on economic activity that might translate into the other sectors; here, for example, the overall stock markets and the energy sector. Table 4 reports the impulse responses of MSCI and MSCIE to BDI.

From Table 5, we find a significant negative impact of BDI on both indices. In particular, MSCI declined by 2.61 percent after just one day with a one percent change in BDI. Although MSCI has shown a tendency to recover in the subsequent period, it has immediately come

down after one day of recovery, which is also noticeable from the cumulative response graph presented in Figure 8 It was also observed that the IRF curve shows extreme volatility in the initial days for two weeks; after that, it gradually smooths out.

Table 5. Cumulative impulse of BDI on MSCI and MSCIE.

	After 1 Day	After 1 Week	After 2 Weeks	After 1 Month
Impulse of BDI on MSCI	−0.0261	−0.0067	−0.0065	−0.0068
Impulse of BDI on MSCIE	−0.0206	−0.0012	−0.0161	−0.0176

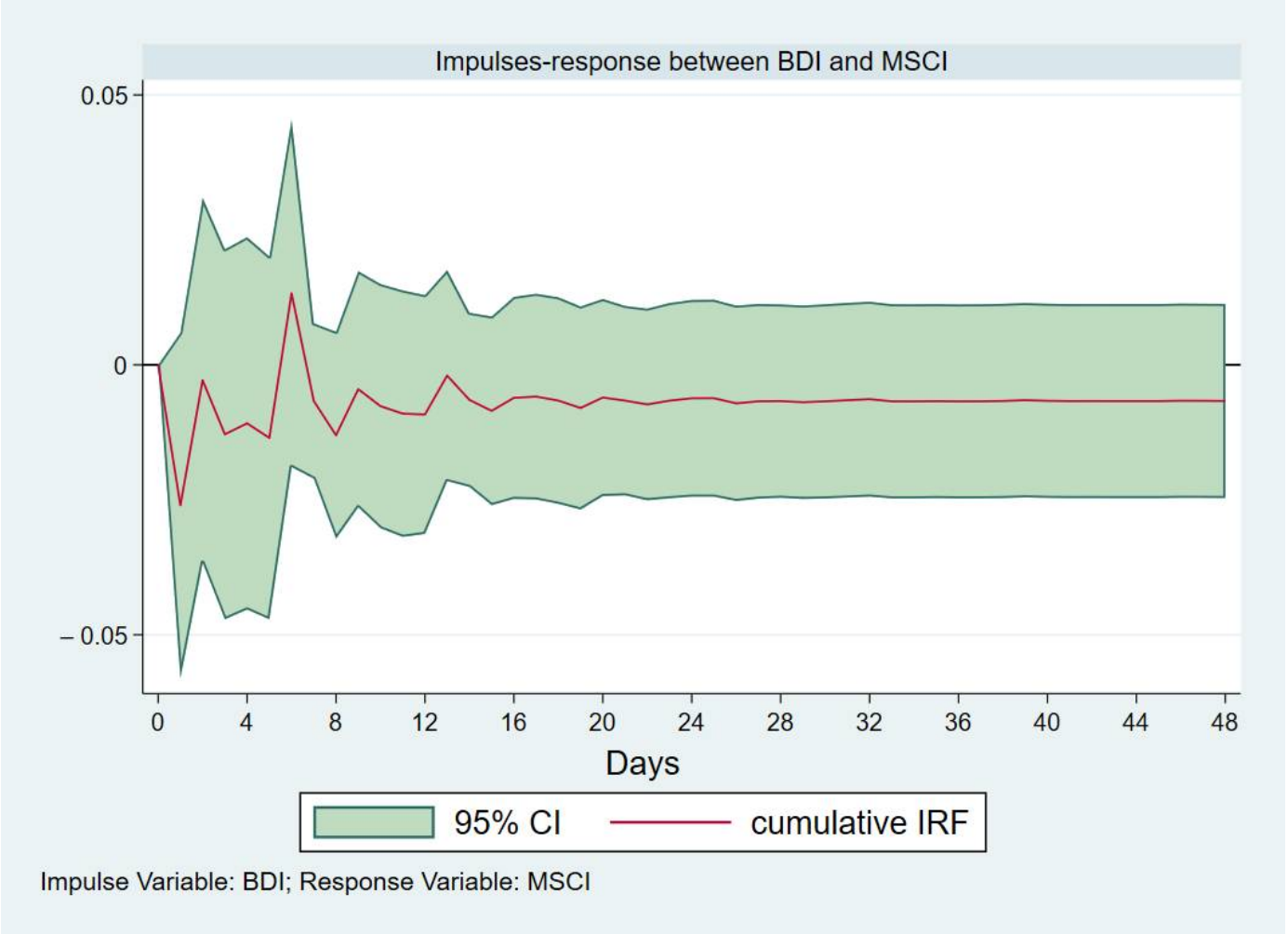

Figure 8. Cumulative impulse response of MSCI to BDI. Note: The red line represents the estimates, while the green bands represent lower and upper bounds to the 95% confidence intervals.

Similarly, a one percent change in BDI is likely to generate about 2.06 percent cumulative reduction in MSCIE after just one day. Though MSCIE recovers somewhat for the next day, it cannot hold on and, as a result, drops more sharply from the next day and continues for several days. However, the ups and downs of the cumulative IRF of MSCIE remain for about one month. After that, it dries off. The findings are also demonstrated by the IRF curve shown in Figure 9 The overall results of the supplementary analysis confirm that the two indices are significantly and negatively affected by economic activity. Nonetheless, in the short run the MSCI index is relatively more affected, while the MSCIE index is relatively more impacted in the long run. The results also indicate that the volatility spillover of

COVID-19 has shifted from economic activity to financial markets, and therefore, financial markets have been more affected by COVID-19 than economic activity.

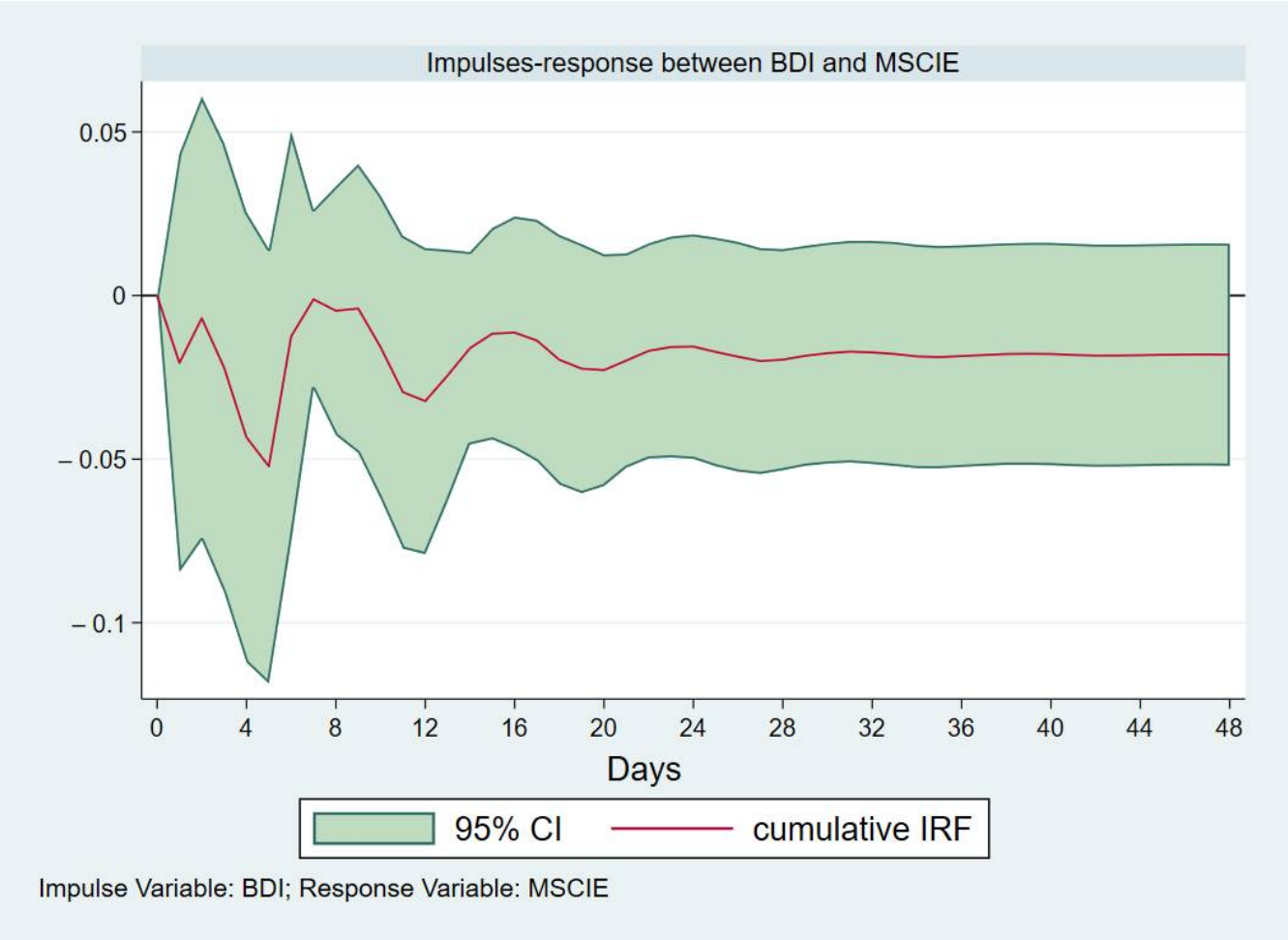

Figure 9. Cumulative impulse response of MSCIE to BDI. Note: The red line represents the estimates, while green bands represent lower and upper bounds to the 95% confidence intervals.

Overall, the findings of the SVAR impulse response functions suggest that COVID-19 cases have significantly and adversely affected all three endogenous variables, i.e., BDI, MSCI, and MSCIE. The findings are expected as the COVID-19 pandemic has created an unprecedented shock and uncertainty over the global business activity, which in turn has led the global economy and the financial markets to a crisis (Choi et al. 2020; Yarovaya et al. 2020b). However, the findings are in accord with the recent studies conducted by Ozili and Arun (2020), Baldwin and Mauro (2020), and Chowdhury et al. (2021) in terms of a significant negative effect of COVID-19 on economic activity. COVID-19 has severely disrupted the global demand and supply chain, resulting in reducing both imports and exports globally (Baldwin and Tomiura 2020), which has been reflected in the decrease in BDI. The findings are also consistent with Al-Awadhi et al. (2020); Ashraf (2020); He et al. (2020); Sharif et al. (2020); Zhang et al. (2020); Baker et al. (2020); Chaudhary et al. (2020); and Chowdhury et al. (2021) who found a significant negative effect of COVID-19 on stock markets. Concerning the MSCIE index, our findings have a partial similarity with Sharif et al. (2020), who found a significant negative association between the COVID cases and oil prices. Since the MSCIE index is formed by the stocks of energy-relevant firms, including oil companies' stocks, the index is likely to be negatively impacted by COVID-19.

Our findings further indicate that among the three endogenous variables, the MSCIE index is relatively more affected by COVID-19. To avert the spread of deadly COVID-19, various preventive measures such as lockdowns, social distancing, and travel restrictions have been undertaken by the governments of different countries worldwide, which has forced different industries to either stop or curtail their production. Consequently, power consumption, particularly oil and gas, has been significantly reduced (Albulescu 2020). Moreover, some governments have taken steps to adjourn the payments of various utility bills, such as gas and electricity bills, which has adversely affected the cash flows of such companies.[12] Moreover, the oil prices have recently plummeted significantly due to the Russia–OPEC price war[13] and the trade war between the US and China (Ramelli and Wagner 2020; Sharif et al. 2020). These may be the causes for which the energy index, i.e., MSCIE, is relatively more affected by COVID-19 than the other two endogenous variables.

Our supplementary analysis also finds that both the MSCI and MSCIE indices are significantly and negatively affected by the BDI index. These findings are expected, as the link between economic activity and stock markets are evident, as shown in earlier literature (Grahama et al. 2016; Giannarakis et al. 2017; Lin et al. 2019).

5. Conclusions

Our study intended to see the statistical evidence of the effect of COVID-19 cases on global economic activity (BDI), stock markets (MSCI), and the energy sector (MSCIE). To accomplish this objective, we employed a structural vector autoregression (SVAR) model for the data period 21 January 2020 to 26 February 2021. Our results suggest that COVID-19 cases negatively affect all endogenous variables such as BDI, MSCI, and MSCIE. The results further indicate that the stock markets indices, i.e., MSCI and MSCIE, are comparatively more affected by the COVID-19 cases. Our supplementary analysis also finds that the two stock indices are also negatively affected by BDI. Therefore, it emerges that the stock markets are affected by both the COVID-19 pandemic and the economic crisis caused by COVID-19. The results further indicate that of the three variables, the MSCIE index is the most affected by COVID-19, attributable to two factors: one is the dampened energy demand caused by COVID-19 and the other is the plummeted oil price due to the Russia–OPEC price war.

Our findings show the spillover effects of COVID-19 cases on economic activity, stock markets, and the energy sector. Furthermore, we shed light on the contagion effect of COVID-19 on economic activities to further explain the financial markets and energy sector crisis. Unlike previous studies, our research was conducted on extended data periods covering the second wave of COVID-19 that would endow the study with more information regarding the impacts of the COVID-19 pandemic. Nonetheless, our results offer insights to policymakers and governments into the relationship dynamics between COVID-19 and several aspects. Specifically, the findings suggest that governments should be more cautious in taking preventive measures against the health crisis to save the economy, stock markets, and energy sector from falling into a more profound crisis. While several countries announced different fiscal and monetary stimuli to keep the financial and economic activities going, policies should be formulated to increase demand and avert further crisis.

Our spillover effect can be useful to investors and financial market regulators to predict future market crises. They need to adapt their investment strategies when anticipating a non-economic crisis, such as a health crisis, to avoid financial loss, as a non-economic crisis can transform into an economic and financial crisis. Additionally, investors need to be aware if the COVID-19 cases start escalating again, as our investigations indicate that the economic and financial markets are inversely related to the COVID-19 case.

Our study has some drawbacks that can be addressed in future research. We focused on only three sectors of the economy to observe COVID-19's influence. Future studies can include other sectors such as banking, insurance, pharmaceuticals, technology, biotechnology, macroeconomy, etc. Moreover, future studies can use additional variables like the

implementation of lockdowns across countries and enhance the findings. Future studies can also explore how different preventive measures have played an essential role in this scenario since we notice a contagion effect on the stock markets and the energy sector. With descriptive statistics, our study found the impact of the second wave of COVID-19. Thus, future studies are suggested comparing the effects of the two waves of COVID-19 using more advanced methods to precisely understand their relative impacts.

Author Contributions: Conceptualization, M.B.H. and M.M.; methodology, M.B.H. and M.M.; software, M.M.; validation, M.B.H., T.S. and M.R.A.; formal analysis, M.B.H. and M.M.; investigation, M.B.H. and M.M.; resources, M.B.H. and M.M.; data curation, M.B.H. and M.M.; writing—original draft preparation, M.B.H. and M.M.; writing—review and editing, M.B.H., M.M., T.S. and M.R.A.; visualization, M.B.H. and M.M. supervision, T.S.; All authors have read and agreed to the published version of the manuscript.

Funding: There is no funding source.

Data Availability Statement: The data sources are given in the data and methodology section. The datasets can be provided at reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

Notes

1 The information is obtained from World Health Organization (WHO) website: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen (accessed on 23 February 2021).

2 World Economic Outlook Update (June 2020) Available at: https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020#:~:text=Global%20growth%20is%20projected%20at,Economic%20Outlook%20(WEO)%20forecast.&text=In%202021%20global%20growth%20is,19%20projections%20of%20January%202020 (accessed on 24 February 2021).

3 'COVID-19 pandemic's global cost may exceed $4T' report by Anadolu Agency. Available at: https://www.aa.com.tr/en/economy/covid-19-pandemics-global-cost-may-exceed-4t/1790582 (accessed on 24 February 2021).

4 Impact of Covid-19 on the global energy sector. Available at: https://www.pv-magazine.com/2020/04/24/impact-of-covid-19-on-the-global-energy-sector/ (accessed on 24 February 2021).

5 5 things to know about how coronavirus has hit global energy. Available at: https://www.weforum.org/agenda/2020/05/covid19-energy-use-drop-crisis/ (accessed on 22 February 2021).

6 World Energy Outlook flagship report (October 2020). Available at: https://www.iea.org/reports/world-energy-outlook-2020 (accessed on 25 February 2021).

7 The Baltic dry index, which measures the cost of shipping goods around the world. The index is reported daily by the Baltic Exchange in London. It provides a benchmark for the price of moving the major raw materials by sea. The Baltic dry index is not restricted to Baltic Sea countries or to a few commodities like crude oil. Instead, the Baltic dry index takes into account 23 different shipping routes carrying coal, iron ore, grains and many other commodities. (tradingeconomics.com) (accessed on 26 February 2021).

8 For details, see the link, https://www.msci.com/documents/10199/149ed7bc-316e-4b4c-8ea4-43fcb5bd6523 (accessed on 22 February 2021).

9 https://www.msci.com/documents/10199/de6dfd90-3fcd-42f0-aaf9-4b3565462b5a (accessed on 26 February 2021).

10 Timeline: How the new coronavirus spread by Al Jazeera (Available at: https://www.aljazeera.com/news/2020/01/timeline-china-coronavirus-spread-200126061554884.html) (accessed on 26 February 2021).

11 The daily global COVID-19 cases are an exogenous variable, as it is not affected at all by other variables included in the model.

12 https://www.forbes.com/sites/allbusiness/2020/04/22/how-to-reduce-or-delay-paying-your-bills-during-the-covid-19-crisis/#584ce515835a (accessed on 24 February 2021).

13 https://www.pv-magazine.com/2020/04/24/impact-of-covid-19-on-the-global-energy-sector/ (accessed on 23 February 2021).

References

Al-Awadhi, Abdullah M., Khaled Alsaifi, Ahmad Al-Awadhi, and Salah Alhammadi. 2020. Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance* 27: 1–5. [CrossRef] [PubMed]

Albulescu, Claudiu. 2020. Coronavirus and Oil Price Crash. Available online: https://ssrn.com/abstract=3553452 (accessed on 12 February 2021).

Ashraf, Badar Nadeem. 2020. Stock markets' reaction to COVID-19: Cases or fatalities? *Research in International Business and Finance* 54: 1–18. [CrossRef]
Baek, Seungho, Sunil K. Mohanty, and Mina Glambosky. 2020. COVID-19 and stock market volatility: An industry level analysis. *Finance Research Letters* 37: 1–10. [CrossRef]
Baker, Scott R., Nicholas Bloom, Steven J. Davis, Kyle J. Kost, Marco C. Sammon, and Tasaneeya Viratyosin. 2020. *The Unprecedented Stock Market Impact of COVID-19*. NBER Working Papers 26945. Cambridge: National Bureau of Economic Research, Inc.
Baldwin, Richard, and Beatrice Weder di Mauro. 2020. *Economics in the Time of COVID-19*. London: Centre for Economic Policy Research.
Baldwin, Richard, and Eiichi Tomiura. 2020. *Thinking Ahead about the Trade Impact of COVID-19*. London: Centre for Economic Policy Research.
Chaudhary, Rashmi, Priti Bakhshi, and Hemendra Gupta. 2020. Volatility in International Stock Markets: An Empirical Study during COVID-19. *Journal of Risk and Financial Management* 13: 208. [CrossRef]
Chen, Chun-Da, Chin-Chun Chen, Wan-Wei Tang, and Bor-Yi Huang. 2009. The Positive and Negative Impacts of the Sars Outbreak: A Case of the Taiwan Industries. *The Journal of Developing Areas* 43: 281–93. [CrossRef]
Chen, Mei-Ping, Chien-Chiang Lee, Yu-Hui Lin, and Wen-Yi Chen. 2018. Did the S.A.R.S. epidemic weaken the integration of Asian stock markets? Evidence from smooth time-varying cointegration analysis. *Economic Research-Ekonomska Istraživanja* 31: 908–26. [CrossRef]
Chevallier, Julien. 2021. COVID-19 Outbreak and CO_2 Emissions: Macro-Financial Linkages. *Journal of Risk and Financial Management* 14: 12. [CrossRef]
Choi, Yukyung, Glenn Levine, and Samuel W. Malone. 2020. The Coronavirus (COVID-19) Pandemic: Assessing the Impact on Corporate Credit Risk. *Moody's Analytics*. Available online: https://www.moodysanalytics.com/articles/2020/coronavirus-assessing-the-impact-on-corporate-credit-risk (accessed on 15 February 2021).
Chowdhury, Emon Kalyan, Iffat Ishrat Khan, and Bablu Kumar Dhar. 2021. Catastrophic impact of Covid-19 on the global stock markets and economic activities. *Business and Society Review*. Forthcoming. [CrossRef]
Dutta, Anupam, Debojyoti Das, R. K. Jana, and Xuan Vinh Vo. 2020. COVID-19 and oil market crash: Revisiting the safe haven property of gold and Bitcoin. *Resources Policy* 69: 1–6. [CrossRef]
Fan, Ying, and Jin-Hua Xu. 2011. What has driven oil prices since 2000? A structural change perspective. *Energy Economics* 33: 1082–94. [CrossRef]
Giannarakis, Grigoris, Christos Lemonakis, Asterios Sormas, and Christos Georganakis. 2017. The effect of Baltic Dry Index, gold, oil and USA trade balance on Dow Jones Sustainability Index world. *International Journal of Economics and Financial Issues* 7: 155–60.
Giudice, Alfonso Del, and Andrea Paltrinieri. 2017. The impact of the Arab Spring and the Ebola outbreak on African equity mutual fund investor decisions. *Research in International Business and Finance* 41: 600–12. [CrossRef]
Goodell, John W. 2020. COVID-19 and finance: Agendas for future research. *Finance Research Letters* 35: 1–5. [CrossRef] [PubMed]
Grahama, Michael, Jarkko Peltomäki, and Vanja Piljak. 2016. Global economic activity as an explicator of emerging market equity returns. *Research in International Business and Finance* 36: 424–35. [CrossRef]
Hassan, Sherif M., and John M. Riveros Gavilanes. 2021. First to React Is the Last to Forgive: Evidence from the Stock Market Impact of COVID 19. *Journal of Risk and Financial Management* 14: 26. [CrossRef]
He, Qing, Junyi Liu, Sizhu Wang, and Jishuang Yu. 2020. The impact of COVID-19 on stock markets. *Economic and Political Studies* 8: 275–88. [CrossRef]
Ho, Linh Tu, and Christopher Gan. 2021. Foreign Direct Investment and World Pandemic Uncertainty Index: Do Health Pandemics Matter? *Journal of Risk and Financial Management* 14: 107. [CrossRef]
Hsieh, Shu-Fan. 2013. Individual and institutional herding and the impact on stock returns: Evidence from Taiwan stock market. *International Review of Financial Analysis* 29: 175–88. [CrossRef]
Ichev, Riste, and Matej Marinč. 2018. Stock prices and geographic proximity of information: Evidence from the Ebola outbreak. *International Review of Financial Analysis* 56: 153–66. [CrossRef]
IMF. 2020. *The Great Lockdown: Worst Economic Downturn since the Great Depression World. World Economic Outlook*. Washington, DC: IMF.
Joo, H., B. Maskery, A. Berro, L. Rotz, Y. Lee, and C. Brown. 2019. Economic Impact of the 2015 MERS Outbreak on the Republic of Korea's Tourism-Related Industries. *Health Security* 17: 100–8. [CrossRef]
Jordà, Òscar, Sanjay. R. Singh, and Alan. M. Taylor. 2020. History shows COVID-19's economic fallout may be with us for decades. *Finance & Development* 57: 12–15.
Keating, John. 1992. Structural Approaches to Vector Autoregressions. *Federal Reserve Bank of St. Louis Review* 74: 37–57. [CrossRef]
Kilian, Lutz. 2009. Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review* 99: 1053–69. [CrossRef]
Laborda, Ricardo, and Jose Olmo. 2021. Volatility spillover between economic sectors in financial crisis prediction: Evidence spanning the great financial crisis and Covid-19 pandemic. *Research in International Business and Finance* 57: 1–13. [CrossRef]
Lin, Arthur J., Hai Yen Chang, and Jung Lieh Hsiao. 2019. Does the Baltic Dry Index drive volatility spillovers in the commodities, currency, or stock markets? *Transportation Research Part E: Logistics and Transportation Review* 127: 265–83. [CrossRef]
Makridakis, Spyros, Andreas Merikas, Anna Merika, Mike G Tsionas, and Marwan Izzeldin. 2020. A novel forecasting model for the Baltic dry index utilizing optimal squeezing. *Journal of Forecasting* 39: 56–68. [CrossRef]

McPhail, Lihong Lu. 2011. Assessing the impact of US ethanol on fossil fuel markets: A structural VAR approach. *Energy Economics* 33: 1177–85. [CrossRef]
Nasir, Muhammad Ali, Ahmed Abdulsalam Al-Emadi, Muhammad Shahbaz, and Shawkat Hammoudeh. 2019. Importance of oil shocks and the GCC macroeconomy: A structural VAR analysis. *Resources Policy* 61: 166–79. [CrossRef]
Ocampo, Sergio, and Norberto Rodríguez. 2012. An Introductory Review of a Structural VAR-X Estimation and Applications. *Revista Colombiana de Estadística* 35: 479–508.
Onali, Enrico. 2020. COVID-19 and Stock Market Volatility. Available online: https://ssrn.com/abstract=3571453 (accessed on 18 February 2021).
Ozili, Peterson K. 2020. COVID-19 pandemic and economic crisis: The Nigerian experience and structural causes. *Journal of Economic and Administrative Sciences*. Forthcoming. [CrossRef]
Ozili, Peterson K., and Thankom Arun. 2020. Spillover of COVID-19: Impact on the Global Economy. Available online: https://ssrn.com/abstract=3562570 (accessed on 16 February 2021).
Qiu, Cheng, Gregory Colson, Cesar Escalante, and Michael Wetzstein. 2012. Considering macro-economic indicators in the food before fuel nexus. *Energy Economics* 34: 2021–28. [CrossRef]
Raghavan, Mala, Paramsothy Silvapulle, and George Athanasopoulos. 2012. Structural VAR models for Malaysian monetary policy analysis during the pre-and post-1997 Asian crisis periods. *Applied Economics* 44: 3841–56. [CrossRef]
Ramelli, Stefano, and Alexander F. Wagner. 2020. Feverish Stock Price Reactions to COVID-19. *Review of Corporate Finance Studies* 9: 622–55. [CrossRef]
Roser, Max, Hannah Ritchie, Esteban Ortiz-Ospina, and Joe Hasell. 2020. Coronavirus Pandemic (COVID-19). Published Online at OurWorldInData.org. Available online: https://ourworldindata.org/coronavirus (accessed on 16 February 2021).
Sharif, Arshian, Chaker Aloui, and Larisa Yarovaya. 2020. COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach. *International Review of Financial Analysis* 70: 1–9. [CrossRef]
Sun, Yunchuan, Mengyuan Wu, Xiaoping Zeng, and Zihan Peng. 2021. The impact of COVID-19 on the Chinese stock market: Sentimental or substantial? *Finance Research Letters* 38: 101838. [CrossRef]
Yarovaya, Larisa, Nawazish Mirza, Syed Kumail Abbas Rizvi, Irum Saba, and Bushra Naqvi. 2020a. The Resilience of Islamic Equity Funds during COVID-19: Evidence from Risk Adjusted Performance, Investment Styles and Volatility Timing. Available online: https://ssrn.com/abstract=3737689 (accessed on 16 February 2021).
Yarovaya, Larisa, Roman Matkovskyy, and Akanksha Jalan. 2020b. The COVID-19 Black Swan Crisis: Reaction and Recovery of Various Financial Markets. Available online: https://ssrn.com/abstract=3611587 (accessed on 16 February 2021).
Yilmazkuday, Hakan. 2020. COVID-19 Effects on the S&P 500 Index. Available online: https://ssrn.com/abstract=3555433 (accessed on 17 February 2021).
Zhang, Dayong, Min Hu, and Qiang Ji. 2020. Financial markets under the global pandemic of COVID-19. *Finance Research Letters* 39: 1–6.