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Stock market reactions to COVID-19 and containment policies: A panel VAR approach

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Abstract

This study examines how stock markets worldwide react to the ongoing COVID-19 and government containment policies measured by the Oxford COVID-19 Government Response Tracker using panel VAR model. We analyze 15 countries: the G7, BRICS, and four northern European countries, and find that the increases in confirmed cases and deaths cause more stock market volatility, though do not have significant effects on stock returns. When governments strengthen their containment policies, stock volatility rises, while stock returns decline temporarily. Next, we divide the sample period into the early and late stages of infection, and find that in the former, the increases in confirmed cases and deaths induce a rise in volatility, and the impact lasts longer. In addition, government containment policies depress stock returns significantly. Moreover, reinforcing containment policies decreases stock returns in countries that introduced stricter containment policies. However, these effects induced by government containment policies might be mitigated by economic support policies because economic support policies have positive effects on stock returns without increasing volatility.

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1. Introduction

The ongoing COVID-19 pandemic has drawn a lot of attention to the relationship between public health and economics. As Jones *et al*. (2020) state, individual behavior can create two negative externalities. One is the infection externality caused by the egoistic motivation in which the individual accounts only for the risk of being infected. The other is a congestion externality caused by an individual's unawareness of the possibility that his/her actions could increase the fatality risk for others through a collapse of the healthcare system (Eichenbaum *et al*., 2020). To address these externalities, governments in many countries introduced containment policies, including temporary border closures, lockdowns, and stay-at-home orders.

However, these containment policies might have two opposite effects on the economy. On the one hand, since containment policies would suppress the spread of infection and an early resumption of economic activities could be expected, implementing such containment measures might eliminate the longer-term economic uncertainty.[1] On the other hand, containment policies would depress economic activity through reductions in both supply and demand, at least in the short term. This is because containment policies require firms and stores to suspend their business and require households to stay at home, which disrupts supply chains and reduces demand, especially for service sectors that require face-to-face contact between consumers and producers.[2]

Stock price movements might also reflect the long- and short-term effects of containment policies. If investors have a longer-term perspective and favor containment policies, then stock markets would react positively. On the contrary, if investors have a short-term perspective and are concerned about the contraction of economic activity, then stock markets would react negatively.

In this study, we investigate how global stock markets globally respond to the ongoing COVID-19 pandemic and government containment policies. Considering economic interdependence, we employ a panel VAR model to analyze stock market reactions in 15 countries: the G7, BRICS, and four northern European countries.

We apply the *Oxford COVID-19 Government Response Tracker* (OxCGRT) to capture the country-specific responses to COVID-19 since the governments' responses to the outbreak differ. For example, in countries including China, the US, and major European countries, governments introduced legally binding policies such as border closures, lockdowns, and stay-at-home orders to flatten the curve of infections as much as possible, while in Sweden, the

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[1] For example, Correia *et al*. (2020) show that non-pharmaceutical interventions during a pandemic can reduce disease transmission without necessarily further depressing economic activity in the medium term.

[2] For example, Guerrieri *et al*. (2020) employ a two-sector model in which sector 1 requires face-to-face contact and show that containment measures preventing sector 1 agents from working may induce a demand-deficient recession in economies with low substitutability across sectors and incomplete markets.

government emphasized personal responsibility, social distancing, and good hygiene to slow the infection rate. Elsewhere, the Japanese government issued an emergency declaration and asked citizens to stay at home, which were based on voluntary compliance. To capture these varying government responses, we use the OxCGRT calculated by Oxford University, which provides a systematic cross-national, cross-temporal measure to understand how government responses evolved.

The remainder of this paper is organized as follows. Section 2 reviews the related literature and Section 3 discusses the empirical methods and data. Section 4 presents the results. Finally, the last section concludes.

2. Related Literature

There is a growing number of studies investigating the effects of COVID-19 on stock prices. As Wagner (2020) points out, the outbreak of COVID-19 brought extreme uncertainty into the economy because no one knows how deadly the disease is, whether and when a vaccine will be available, what effects government policies will have, how people will respond, and so on. Baker *et al.* (2020) constructed a newspaper-based Infectious Disease Equity Market Volatility Tracker and show that the COVID-19 pandemic drove the tremendous surge in US stock market volatility compared to other epidemics since 1900.

Ashraf (2020) uses daily confirmed COVID-19 case and death data and finds that stock markets reacted more negatively to the growth in the number of confirmed cases compared to the growth in the number of deaths. Gormsen and Koijen (2020) use dividend futures market data and show that the forecast of annual dividend growth declined by 8% in both the US and Japan, and by 14% in the EU. Pagano *et al*. (2020) classify firms into high-, middle-, and low-resilience firms using Koren and Pető's (2020) measure of exposure to COVID-19, which represents the degree to which jobs can be done without close personal interactions. They find that high-resilience firms outperformed low-resilience firms. Ramelli and Wagner (2020) demonstrate that the US stock returns of firms with high exposure to China declined initially, and the stock returns of firms with more debt and less cash fell more significantly as the infection spread to Europe and the US. Zhang *et al.* (2020) find that global financial market risks increased substantially in response to the pandemic, and the uncertainty of the pandemic and its associated economic losses caused markets to become highly volatile and unpredictable. To extend this debate, we examine how stock market returns in 15 countries responded to COVID-19 and governments' containment policies using the panel VAR model and the OxCGRT.

3. Empirical Methodology and Data

We consider the following reduced k variate panel VAR model of order p with country-specific fixed effects:

$$Y_{it} = \Phi(L)Y_{it} + u_i + \varepsilon_{it}, \quad i = 1, \cdots, N, \quad t = 1, \cdots, T, \tag{1}$$

where Y_{it} is a $k \times 1$ vector of stationary endogenous variables, $\Phi(L) = \Phi_1 L + \Phi_2 L^2 + \cdots + \Phi_p L^p$ is a matrix polynomial in the lag operator L, and Φ_j ($j = 1, \cdots, p$) are the $k \times k$ matrices to estimate. u_i is a $k \times 1$ vector of country-specific fixed effects. ε_{it} is a vector of idiosyncratic errors. We assume that $E[\varepsilon_{it}] = 0$, $E[\varepsilon_{it}\varepsilon_{it}'] = \Sigma$, and $E[\varepsilon_{it}\varepsilon_{is}'] = 0$ for all $t > s$. We estimate equation (1) by using the least squares dummy variable (LSDV) estimator because it remains consistent when T approaches infinity, as Nickell (1981) and Hahn and Kuersteiner (2002) show.

We employ four variables as endogenous variables:

$$Y_{it} = \left[\mathrm{cov}\,id_{it}, stringency_{it}, uncerta\,\mathrm{int}\,y_{it}, return_{it}\right]', \tag{2}$$

where $\mathrm{cov}\,id_{it}$ measures the severity of COVID-19 infection spread, for which we use two variables: $\log(1+$ cumulative confirmed cases) and $\log(1+$ cumulative deaths).[3] We collect these data from the WHO's COVID-19 global data. $stringency_{it}$ is a *Stringency Index* that measures the strictness of containment policies, which we calculate from nine indicators: (i) school closing, (ii) workplace closing, (iii) cancelation of public events, (iv) restrictions on gathering, (v) closed public transport, (vi) stay-at-home requirements, (vii) restrictions on internal movement, (viii) restrictions on international travel, and (ix) public information campaigns. These data are available from the OxCGRT. $uncerta\,\mathrm{int}\,y_{it}$ represents stock market uncertainty. The implied volatility index (VIX) of the stock options market might be a suitable proxy for stock market uncertainty, though these data are not available for all stock markets. Therefore, we use the conditional variance of stock returns estimated from the GARCH (1,1) model. $return_{it}$ denotes stock market returns, which we calculate from each country's stock price index.[4] We acquired these data from *Datastream*.

Our sample consists of 15 countries: the G7 countries (Canada, France, Germany, Italy, Japan, the UK, and the US), BRICs (Brazil, China, India, and Russia), and four northern European countries (Denmark, Finland, Norway, and Sweden). We use daily data and our

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[3] The results are similar to those obtained using $\log(1+$ cumulative confirmed cases per million population) and $\log(1+$ deaths per million population).

[4] The stock price indexes for each country are as follows: Canada: S&P/TSX Composite; France: CAC 40; Germany:DAX 30; Italy: FTSE MIB; Japan: Nikkei 225; UK: FTSE 100; US: S&P 500 Composite; Brazil: Bovespa; China: Shanghai A; India: NIFTY 500; Russia: RTS Index; Denmark: OMX Copenhagen 20; Finland: OMX Helsinki; Norway: OSE; and Sweden: OMX Stockholm 30.

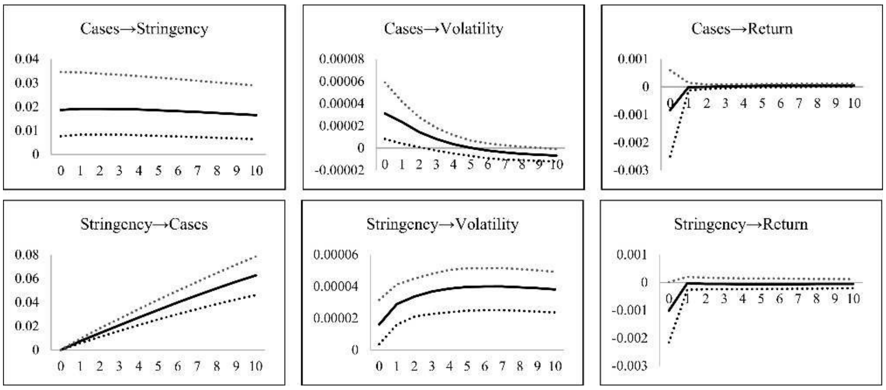
sample period runs from 3 January 2020 to 30 September 2020. Each variable has 4,080 observations.

4. Empirical Results

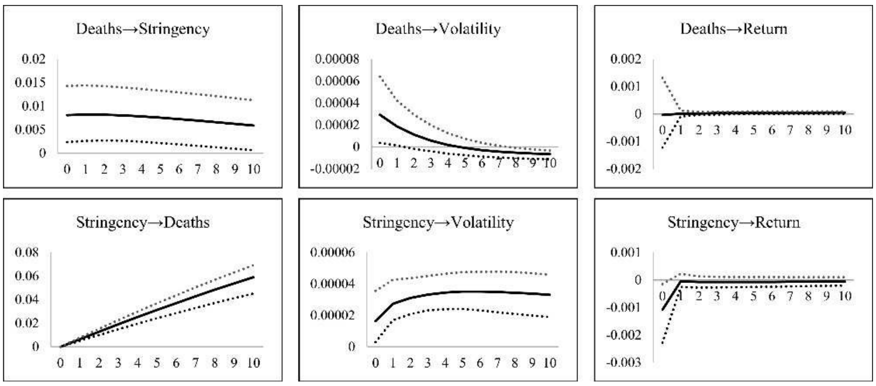
Figure 1 shows the impulse response functions for a one-standard deviation shock to $covid$ or $stringency$.[5] We can see that the increases in confirmed cases and deaths significantly strengthen government containment policies and increase stock market uncertainty. However, they have no significant effects on stock returns. Moreover, when governments strengthen their containment policies, stock volatility rises, while stock returns decline temporarily. Hence, the spread of COVID-19 infection itself does not affect stock returns, but the government' s containment policies in response to it depress stock returns. This result implies that investors might be concerned about the contraction of economic activity following containment policies and react negatively. The confirmed cases and deaths increase significantly positively in response to increases in the stringency of containment policies. This occurs because reinforcing containment policies might mitigate the spread of infection, but the infection rate is greater than the mitigation rate.

Figure 1. Impulse Response Functions: 15 Countries, Full Sample, Stringency

(i) $covid_{it}$: Confirmed Cases



(ii) $covid_{it}$: Confirmed Deaths



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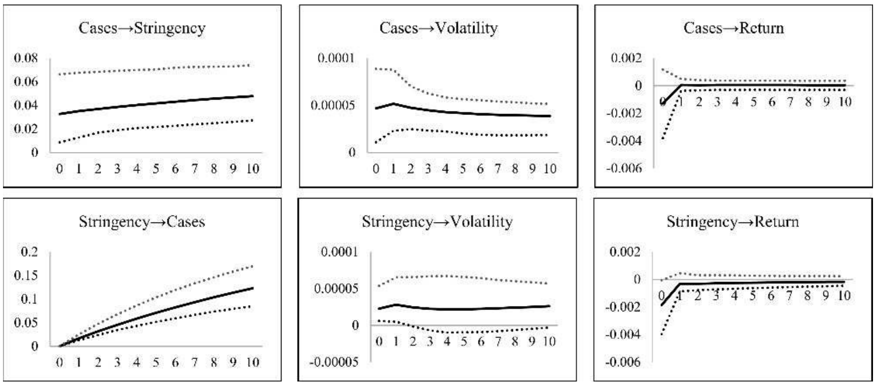
[5] We obtain our results by setting lag length p=1 in the estimation of equation (1). The results are similar when setting p=2.

To investigate whether the reaction changed over time, as the lack of information about the disease could bring extreme uncertainty into the economy at an early stage, we divide the sample period into two sub-sample periods. The first period is from 3 January 2020 to 31 March 2020, which corresponds to the early stage of infection, and covers 11 March when the WHO declared a pandemic. As Figure 2 shows, at the early stage of infection, the increases in confirmed cases and deaths induce a rise in volatility, and the impact lasts longer, implying that a rise in confirmed cases and deaths might have caused more uncertainty at the early stage. The implementation of government containment policies depresses stock returns temporarily in the first sub-sample period, while there is no significant impact on the returns in the second sub-sample period.

Figure 2(a). Impulse Response Functions: 15 Countries, 1st Sub-sample, Stringency

(i) *covid$_{it}$*: Confirmed Cases



(ii) *covid$_{it}$*: Confirmed Deaths

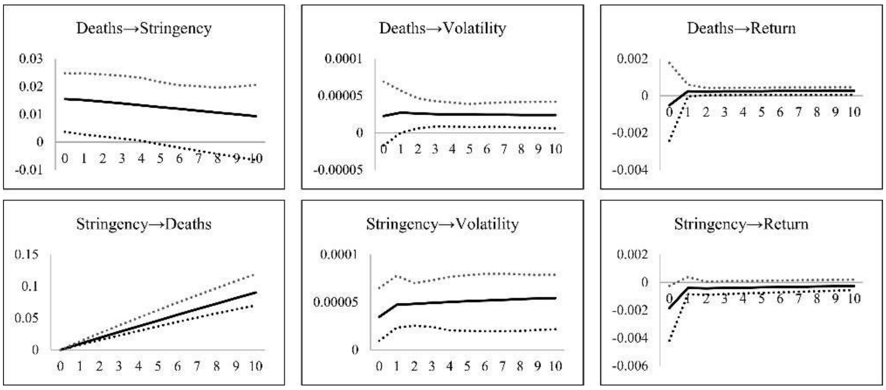
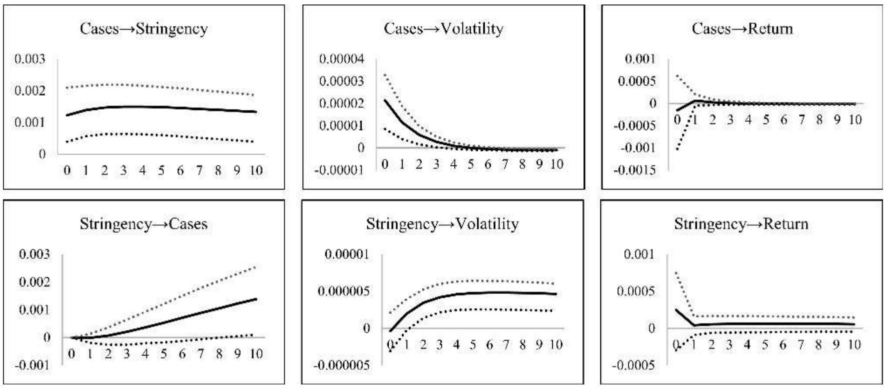
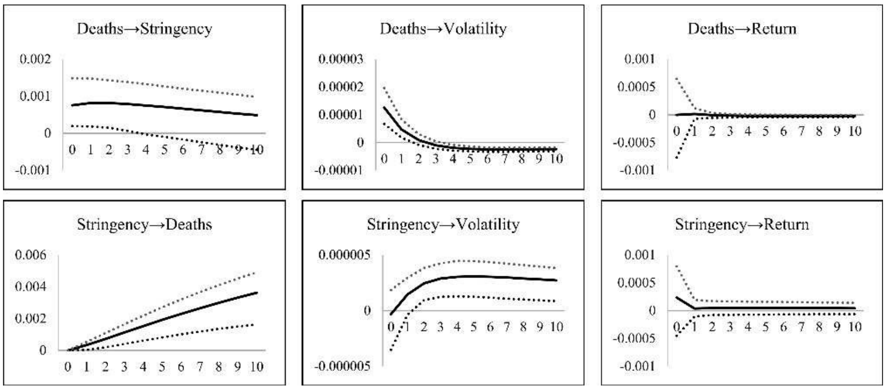


Figure 2(b). Impulse Response Functions: 15 Countries, 2nd Sub-sample, Stringency

(i) ***covid**$_{it}$*: **Confirmed Cases**



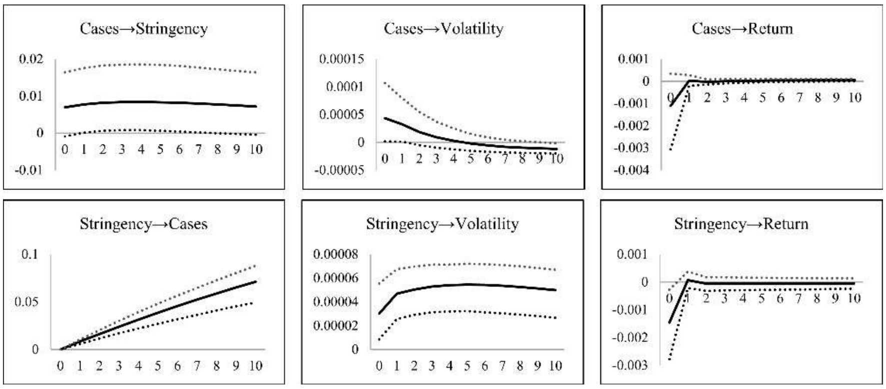
(ii) ***covid**$_{it}$*: **Confirmed Deaths**



Apart from the differences in reactions over time, the reaction may have changed in the degree of strictness of the containment measures. To examine this possibility, we arrange the 15 countries in decreasing order based on the time average of the *Stringency Indices*. We classify the upper 8 countries (Canada, Italy, the UK, the US, and BRICs countries) as strict countries, and classify the lower 7 countries (France, Germany, Japan and the four north European countries) as loose countries. As Figure 3 illustrates, the containment measures implemented in the strict countries induced a higher volatility than that of the loose countries. The stock returns declined temporarily in strict countries, while there is no significant impact on the returns in the loose countries. This result might suggest the existence of a threshold value above which the containment measures cause more stock market volatility and depress returns.

Figure 3(a). Impulse Response Functions: Strict countries, Full sample, Stringency

(i) $covid_{it}$: Confirmed Cases



(ii) $covid_{it}$: Confirmed Deaths

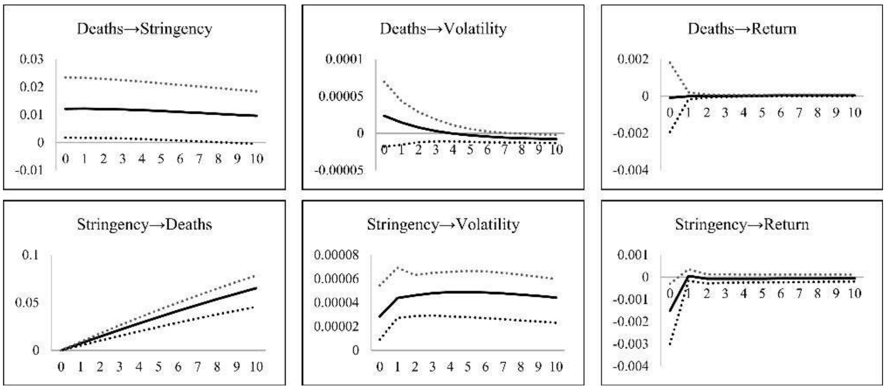
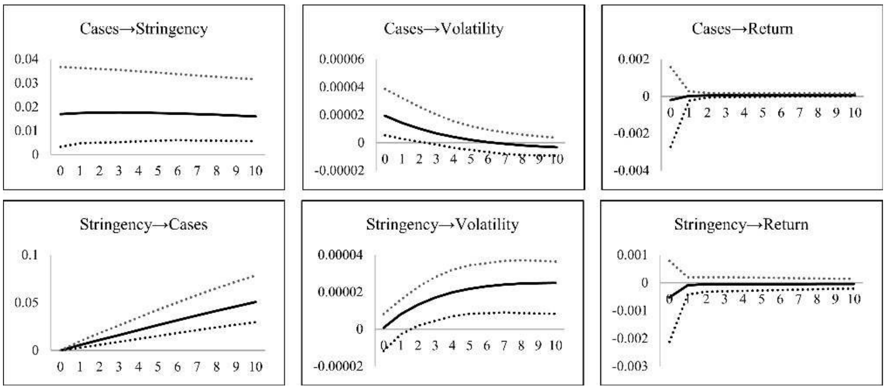
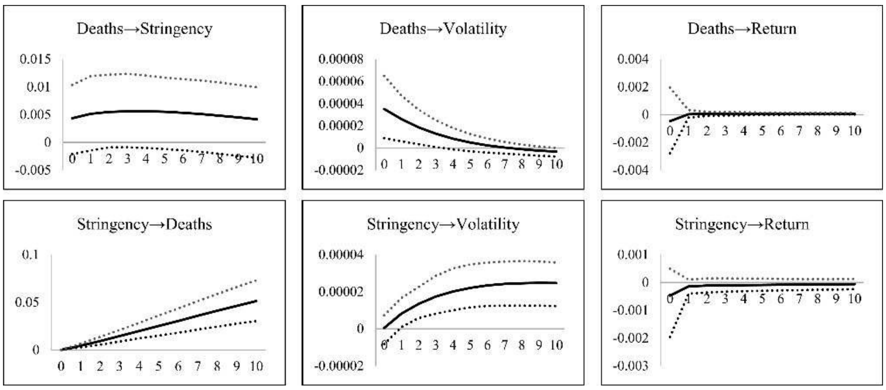


Figure 3(b). Impulse Response Functions: Loose Countries, Full sample, Stringency

(i) $covid_{it}$: Confirmed Cases



(ii) $covid_{it}$: Confirmed Deaths



Additionally, we use the *Economic Support Index* from the OxCGRT instead of the *Stringency Index* to investigate how stock markets react to the support measures related to COVID-19 because most countries implemented actions to support the economy simultaneously, which might affect the stock market.

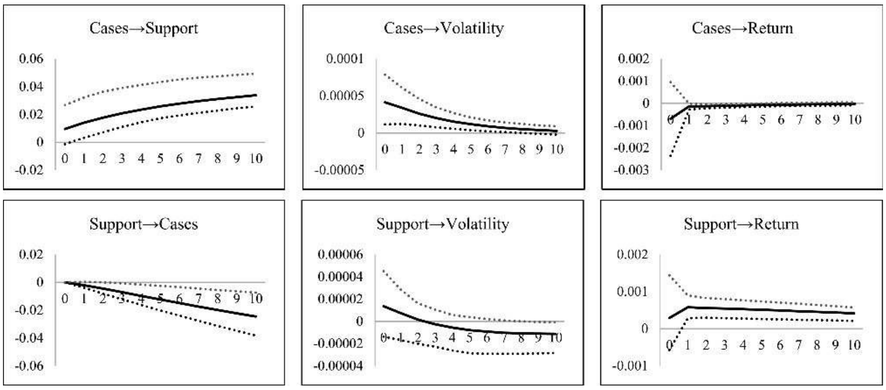
$$Y_{it} = \left[covid_{it}, support_{it}, uncertainty_{it}, return_{it}\right]' . \qquad (3)$$

We calculate the *Economic Support Index* from two indicators: (i) income support and (ii) debt/contract relief for households.

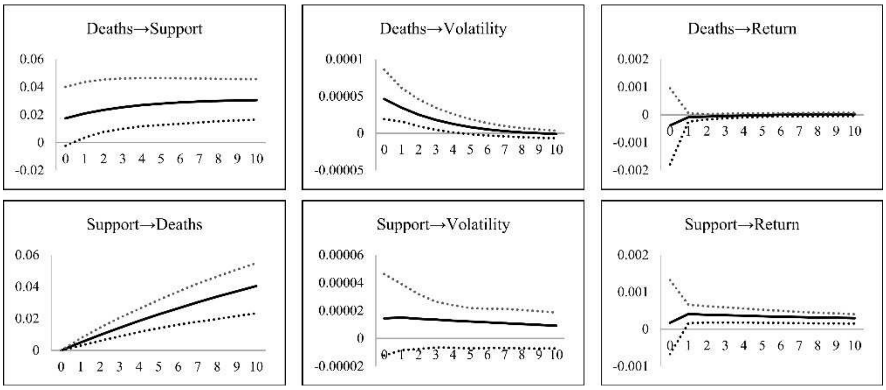
Economic support policies might have two opposite effects on the economy. On the one hand, these policies could stimulate the economy by propping up personal consumption and aggregate demand in the shorter term; thus, stock markets would react positively. On the other hand, in the longer term, these policies might decelerate the normalization of economic activities because economic activities could aid the spread of COVID-19, which leads to a negative stock market reaction. However, as Figure 4 shows, the confirmed cases decrease following economic support policies. One possible explanation is that people could earn income without going to work due to income support, which might flatten the curve of infection. Moreover, economic support policies have positive effects on stock returns without increasing volatility.

Figure 4. Impulse Response Functions: Strict Countries, Full Sample, Support

(i) *covid*$_{it}$: Confirmed Cases



(ii) *covid*$_{it}$: Confirmed Deaths



5. Conclusion

In this study, we examine how stock markets worldwide react to the ongoing COVID-19 and government containment policies using the panel VAR model. We analyze 15 countries: the G7, BRICS, and four northern European countries, and find that increases in confirmed cases and deaths cause higher stock market volatility, though have no significant effects on stock returns. On the other hand, when governments strengthen their containment policies, stock volatility rises and stock returns decline temporarily.

To verify whether the reaction changed over time, we divided the sample period and find that at the early stage of infection, the increases in confirmed cases and deaths induce a rise in volatility, and the impact lasts longer. In addition, government containment policies depress stock returns significantly, which implies that investors might be more concerned about the contraction of economic activity following the containment policies at the early stage of infection.

We also find that the reinforcement of containment policies decreases stock returns in the countries that introduced stricter containment policies, which suggests that there might exist a threshold value above which the containment measures cause more stock market volatility and depress returns.

However, economic support policies might mitigate the effects of government containment policies because such policies have positive effects on stock returns without increasing volatility, and might help to slow the rate of infection.

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