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Stock Return and the COVID-19 pandemic: Evidence from Canada and the US

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ARTICLE INFO

JEL classification:
C32
G31

Keywords:
COVID-19
Stock return
GARCH-in-Mean VAR

ABSTRACT

We investigate the dynamic responses of stock return to the unexpected changes in the COVID-19 cases and the uncertainty associated with the pandemic. Using daily data from Canada and the US, we find there is a negative effect of an increase in the COVID-19 cases on the stock market in general. Moreover, the stock return responses are asymmetric in the increase and decrease in the cases in Canada. The asymmetry is caused by the negative impact of uncertainty about the pandemic. We also find that uncertainty adversely affects the US stock market. However, the magnitude is small.

1. Introduction

The ongoing COVID-19 pandemic has dragged down the economy at the global and country levels since the beginning of 2020. Along with the outbreak and the increase in the COVID-19 cases over time, the overall economic environment and economic activity get depressed. Financial markets are also hit hard so that stock market crashes were observed in Asia, Europe, and North America, see Corbet et al. (2020) and Zhang et al. (2020). It is obvious that the change in the infection cases signals the potential trajectory of the economy and strict regulatory interventions of government, such as quarantine and lockdown. Therefore, the financial market should respond to unexpected changes in COVID-19 cases. For example, Ashraf (2020) finds stock markets reacted negatively to the growth in COVID-19 cases based on panel data. On the other hand, COVID-19 also brings a lot of uncertainties to the economy. Baker et al. (2020) find that about half of the projected output in contraction in 2020 is related to the COVID-induced economic uncertainty. Especially, the uncertainty about the COVID-19 cases itself could be a signal as well to the financial market and its participants about the development of the pandemic. It follows that how the financial market reacts to the surge in the infection cases, and its uncertainty needs an investigation. One may wonder if the financial market worries more about the rise in COVID-19 cases or the uncertainty about the pandemic.

US has had the highest number of confirmed COVID-19 cases since March 2020. Therefore, it is one of the two countries considered in the paper. The other country, which is studied, is Canada. The development of the outbreak in Canada has a similar pattern to the one in the US, and therefore we have both of them for comparison. Daily COVID-19 cases and stock index are obtained for both countries. A structural VAR model, which is modified to accommodate GARCH-in-mean errors, is adopted. The model could capture the time-varying volatility of the changes in COVID-19 cases. The volatility is then utilized to measure the uncertainty about the growth in the cases.

Our analysis is conducted based on the impulse response functions corresponding to the structural VAR model. We find an unexpected increase in the COVID-19 cases hurts the stock return with persistence in Canada. Notably, the empirical evidence shows that the uncertainty associated with COVID-19 cases amplifies stock return responses to make them worse. The resulted consequence is that the responses of stock return are asymmetric in the increase and decrease in the COVID-19 cases in Canada. Regarding the stock return
in the US, it is interesting that the uncertainty associated with COVID-19 is not a big concern of the US stock market. Moreover, the unexpected changes in the country’s COVID-19 cases only have a contemporaneous effect on the stock return. Overall, it is evident that the increases in the COVID-19 cases depress the stock market in general. Moreover, the uncertainty associated with the COVID-19 cases worries stock markets and its participators as well. However, the uncertainty is a larger concern of the Canadian stock market, compared with how the US stock market reacts to it.

The rest of the paper is organized as follows. Section 2 discusses the model and data. We present the empirical results in Section 3 and conduct the robustness check in Section 4. The final section concludes the paper.

2. Specification and Data

We use the model documented in Elder and Serletis (2010). It is a bivariate structural GARCH-in-Mean VAR in stock return and the growth rate of total COVID-19 cases, as follows

\[ Bz_t = C + \sum_{i=1}^{k} \Gamma_i z_{t-i} + \Psi h_t + \epsilon_t \quad (1) \]

where \( z_t \) is a column vector, which includes the change in the total COVID-19 cases, \( \Delta \ln c_t \), and the stock return, \( \Delta \ln r_t \). It follows that \( z_t = [\Delta \ln c_t \; \Delta \ln r_t] \). \( \Omega_{t-1} \) denotes the information set at time \( t-1 \), and

\[ B = \begin{bmatrix} 1 & 0 \\ b & 1 \end{bmatrix}; \quad \Gamma_i = \begin{bmatrix} \gamma_{i,11} & \gamma_{i,12} \\ \gamma_{i,21} & \gamma_{i,22} \end{bmatrix}; \quad \Psi = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}; \quad h_t = \begin{bmatrix} h_{c,t} \\ h_{r,t} \end{bmatrix}; \quad \epsilon_t = \begin{bmatrix} \epsilon_{c,t} \\ \epsilon_{r,t} \end{bmatrix}. \]

The system is identified by assuming that the diagonal elements of \( B \) are unity, that \( B \) is lower triangular, and that the structural shocks, \( \epsilon_t \), are uncorrelated. The lower triangle form of \( B \) actually assumes only the changes in the cases of COVID-19 have a contemporaneous effect on the stock return.

We use a univariate GARCH(1,1) specification to model the conditional variance of the growth rate in the COVID-19 cases, \( h_{z,t} \), and the conditional variance of the stock return, \( h_{r,t} \), as follows

\[ h_{c,t} = d_{c,1} + d_{c,2} \epsilon_{c,t-1} + d_{c,3} \epsilon_{r,t-1} + \epsilon_{c,t} \quad (2) \]

\[ h_{r,t} = d_{r,1} + d_{r,2} \epsilon_{c,t-1} + d_{r,3} \epsilon_{r,t-1} + \epsilon_{r,t} \quad (3) \]

Here and after, we call \( \epsilon_{c,t} \) COVID-19 shock. Moreover, \( h_{c,t} \) is referred to as COVID-19 uncertainty. We estimate the bivariate structural GARCH-in-Mean VAR, consisting of equations (1)-(3), using full information maximum likelihood. We get the daily data for total COVID-19 cases in Canada over the period from January 21, 2020 to July 2, 2020. The daily data for the US covers COVID-19 cases over the period from January 21, 2020\(^1\) to July 2, 2020. The data is publicly available at the World Health Organization (WHO). Regarding the stock return in the US, we use the S&P 500 index from Yahoo Finance. On the other hand, the S&P/TSX index obtained from Yahoo Finance is utilized to measure Canada’s stock return. Figure 1 plots the COVID-19 cases’ growth rate and stock return in the two countries. The summary statistics are presented in Table 1.

3. Empirical Results

We estimate the model for \( k = 10 \), which is suggested by AIC, in equation (1) for each country. \( \psi \) in equation (1) is a key parameter since it measures the impact of COVID-19 uncertainty on the stock return. We find that COVID-19 uncertainty has a negative effect on the stock return: \( \psi = -0.154 \) (with a standard error of 0.024) for the Canadian economy, while it is -0.045 (with a standard error of 0.010) based on the US data. It shows that the local COVID-19 uncertainty worries the Canadian stock market and its participators at a higher level.

To assess the dynamic response of stock return to COVID-19 shocks, we plot the impulse response functions in Figures 2-3 for the two countries. They are obtained as in Elder (2003) and are based on a shock, which is the unconditional standard deviation of the change in the cases of COVID-19. In doing so, we also report the impulse responses of the stock return to both positive and negative COVID-19 shock to address whether the relationship between the stock market and the COVID-19 cases is symmetric or not.

As shown in the upper panel in Figure 2, the stock return’s dynamic responses to a COVID-19 shock are asymmetric in Canada. In particular, the positive and negative COVID-19 shocks both harm the stock return. Moreover, the positive shock decreases the stock return continuously up to 4 days. To assess how COVID-19 uncertainty contributes to the dynamics of the stock return, we compare the impulse responses of stock return with those impulse responses when \( \psi \) is restricted to be equal to zero. We report these constrained

\(^1\) Canada reported the first case on January 27, 2020.  
\(^2\) US had its first case on January 21, 2020.
impulse responses, plotted as dashed lines, in the lower panel in Figure 2. In doing so, we also repeat the unconstrained impulse responses (from the upper panel in Figures 2), plotted as solid lines, and suppress the error bands for clarity. Therefore, the solid lines in the lower panel are constructed by using the parameter estimates from the bivariate GARCH-in-mean VAR. The dashed lines are constructed by using the same parameter estimates but with $\psi$ constrained to zero.

As shown in the lower panel, when COVID-19 uncertainty is accounted for, the response of stock return to a positive COVID-19 shock is significantly influenced by it. It implies that the response of stock return to a positive COVID-19 shock is amplified when we allow feedback from the conditional standard deviation of the changes in the COVID-19 cases. This pattern is also observed when the COVID-19 shock is negative. These results show that the COVID-19 uncertainty is a big concern of the Canadian stock market.

According to Figure 3, the US stock return’s dynamic responses to a COVID-19 shock seem symmetric. Notably, COVID-19 shock affects the stock market contemporaneously. A positive shock, which is obviously bad news, decreases the return of stock right away.
However, the impact is relatively less persistent compared with the results based on the Canadian market. The lower panel in Figure 3 shows the unconstrained impulse responses and constrained impulse responses of the US stock return. One could see that the COVID-19 uncertainty doesn’t worsen the US stock market that much, even though the market minds it. Overall, one could see the response of stock return to a positive COVID-19 shock is negative. In general, the market response to the increase in COVID-19 cases is stronger initially, and this response is likely to decay over time. The uncertainty associated with the changes in the cases is a concern of the stock market. Especially, the COVID-19 uncertainty is a bigger concern of the Canadian stock market. Moreover, our results show that COVID-19 uncertainty could cause the stock market’s asymmetric responses to the increase and decrease in COVID-19 cases.

4. Robustness check

It is important to point out that there are a lot of factors driving stock returns. Other than the growth in COVID-19 cases, stock returns are related to other economic factors and contemporaneous events. Moreover, independently running the model for each country implies a latent assumption. The assumption is that the two countries are totally independent. Therefore, a robustness check is necessary to be carried out. We then use abnormal stock returns rather than the stock returns in the model for each country. The abnormal return could reflect the effects of economic events and market information on the stock market. In general, the abnormal return $a_r$ is the difference between the actual stock return and expected stock return: 

![Response of stock return to COVID-19 shocks](image_url)
\[ \text{art} = \Delta \ln r_t - \Delta \ln \tilde{r}_t, \]  
\[ \text{(4)} \]

where
\[ \Delta \ln \tilde{r}_t = \ln r_t - \ln r_{t-1} \]

Note \( \Delta \ln \tilde{r}_t \) is the expected stock return. It is the log-difference between the expected stock market index and the stock market index in the last time period. We use the stock market index future for a measure of the expected stock market performance for each country. Especially, the S&P 500 futures are utilized for the US, and the S&P/TSX 60 futures are used for the Canadian stock market. All the data are still from Yahoo Finance.

After re-estimating the model in section 2 with abnormal returns for each country, we find that the COVID-19 uncertainty hurts the abnormal stock return: \( \psi = -0.002 \) (with a standard error of 0.001) for the Canadian economy, while it is \(-0.001\) (with a standard error of 0.001) for the US. The results still suggest that the Canadian stock market reacts to the COVID-19 uncertainty relatively stronger. The corresponding impulse response functions are provided in Figures 4 and 5. The asymmetric responses of the Canadian stock market are still evident. Notably, a positive COVID-19 shock decreases the abnormal stock return transitorily. However, a negative shock almost has no impact on abnormal returns.

The US stock market’s responses to the COVID-19 shocks show symmetry in Figure 5. Moreover, a positive COVID-19 shock decreases the abnormal stock return for 4 days. The lower panel in Figure 5 shows the COVID-19 uncertainty doesn’t amplify the responses significantly, and these results are consistent with the ones in Figure 3.

5. Conclusion

We investigate how the stock return responds to COVID-19 shock and uncertainty and whether the shocks have asymmetric effects on the returns. Using daily data, we find a negative effect of an increase in the COVID-19 cases on the stock market in general. Notably,
Fig. 4. Response of Canadian stock return (absolute return) to COVID-19 shocks

Fig. 5. Response of the US stock return (absolute return) to COVID-19 shocks
stock return responses are asymmetric in the increase and decrease in the COVID-19 cases in Canada. The asymmetry is attributed to the negative impact of the uncertainty about the development of the pandemic on the Canadian stock market. Regarding the US stock market, the uncertainty adversely affects the return, and the magnitude is small. Moreover, stock return responses are relatively symmetric in the increase and decrease in COVID-19 cases in the US. An area for potentially productive future research is digging into the details regarding why there is a difference between the two countries. The difference could be caused by the different weights in different industries, the firm sizes, and country-specific regulations on the stock market.

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