THE EFFECT OF THE COVID-19 PANDEMIC ON SOUTH KOREA’S STOCK MARKET AND EXCHANGE RATE

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This study examines COVID-19 pandemic effects on the stock market and exchange rate of South Korea. With daily data from January 2, 2019 to August 31, 2020, we show that a new infection spike increases stock price index volatility and decreases foreign investors’ holdings of domestic stocks, and indirectly leads to the depreciation of the South Korean won. We indicate that investors may have repurchased the South Korean won seven days after an infection spike, thereby slightly increasing its value. We also find that the Bank of Korea’s foreign exchange intervention had a short-run effect with a limited impact. The intervention did not have a significant effect on exchange rate volatility.

Keywords: COVID-19; South Korea; Stock market; Exchange rate; Foreign exchange intervention

JEL classification: F31

1. INTRODUCTION

THE COVID-19 pandemic has had significant impacts on the stock market and exchange rate in emerging countries. Upon the outbreak of the pandemic, investors withdrew their capital from emerging-market securities, leading to an increase in stock market volatility and depreciation of the currencies of these economies. South Korea was no exception and the nominal exchange rate of the South Korean won (KRW) to the US dollar (USD) spiked, reaching 1,570.3 won on March 2, 2020—the highest rate since July 14, 2009. South Korea employs a flexible exchange rate regime but the Bank of Korea...
(BOK) occasionally intervenes in the foreign exchange market to stabilize the value of the KRW. The decrease in foreign currency reserves held by the South Korean government from February to March in 2020 was the largest since November 2008, implying that the BOK attempted to stabilize the value of the KRW against market selling pressure. As a result, foreign currency reserves recorded the lowest level (US$4,002.1 billion) since May 2018. Although South Korea has been successful in dealing with the COVID-19 pandemic, it has experienced an outflow of capital. Analyzing the case of South Korea provides a useful example of how the COVID-19 pandemic impacts an economy even when its government successfully controls the rate of new infections.

This study empirically investigates how the COVID-19 pandemic affected the stock market and exchange rate of South Korea using a vector autoregressive (VAR) model. Using daily South Korean data from January 2, 2019 to August 31, 2020, we show that an exogenous positive shock on the number of daily new infections increases volatility in the South Korean stock market. In contrast, a rise in the number of daily new deaths caused by COVID-19 does not have a clear effect on stock market volatility. Given that the number of new deaths increases several days post a surge in the number of new cases, our empirical result implies that investors react when they observe a rise in new cases and that by the time of observing an increase in new deaths, they have already made their adjustments. We also focus on foreign investors’ holdings of South Korean domestic stocks to reveal how the exchange rate reacts to the pandemic as a result of stock market turmoil. Foreign investors’ stock holdings negatively react to an increase in the number of new cases but do not react to a surge in the number of new deaths. Similar to stock market volatility, foreign investors react to new cases but not new deaths.

Regarding the direct impacts of new cases and new deaths on the exchange rate, the KRW slightly depreciates and appreciates to the USD when the number of new deaths and new cases increases, respectively. This result implies that investors repurchased the KRW several days (seven days according to our estimation results) after a rise in new cases, but the KRW was sold when the number of deaths rose. However, the direct impacts of shocks on both variables are negligibly small. Therefore, the COVID-19 pandemic seems to have only minor direct impacts on the South Korean exchange rate. Clearly, however, the KRW depreciates significantly with a decrease in foreign investors’ stock holdings. As mentioned, foreign investors’ stock holdings falls with an increase in the number of new cases. In sum, our empirical investigation based on the VAR model indicates that the direct effect of the COVID-19 pandemic on the value of the KRW is negligible, but the indirect effect of foreign investors’ capital flight is significantly negative. In other words, a pure speculative attack on the KRW exchange rate did not happen to any significant extent in South Korea amid the outbreak of COVID-19.
the pandemic, but the indirect impact through the fundamentals (i.e., foreign investors’ stock holdings) was significant.

In addition, we examine the effectiveness of foreign exchange intervention conducted by the BOK. Unfortunately, the BOK does not report the level of daily intervention to the public. Thus, we identify the date of the first intervention based on the news source derived from Thomson Reuters Eikon. In the VAR analysis, we do not observe a significant effect of the intervention on the exchange rate. However, the VAR analysis of the intervention has two shortcomings. First, the VAR analysis does not provide information about the effectiveness of the intervention on exchange rate volatility, which has been actively discussed in the literature. Second, we employ 21-day lags based on the Akaike information criteria (AIC). In this sense, our VAR analysis indicates long-run relations between the variables. An intervention is usually conducted to mitigate a short-run instability of the exchange rate. Thus, other estimation models can be applied. To focus more on the short-run effectiveness of the intervention both on the exchange rate level and volatility, we also conduct ordinary least squares (OLS) and generalized autoregressive heteroskedasticity (GARCH) estimations without lagged dependent variables. From these models, in contrast to the VAR analysis, we obtain a significant effect on the exchange rate level; however, the impact is quantitatively limited, that is, the intervention increased the value of the KRW only by 1%. Regarding exchange rate volatility, the intervention does not have any significant effects. Accordingly, the BOK’s intervention may have a significant small impact only on the exchange rate level in a very short run.

This study contributes to economic policy analysis of the COVID-19 pandemic. A growing number of researchers are actively discussing the effectiveness of economic policies for mitigating the negative impact of COVID-19 on economic activities. For instance, using the data of private companies for event studies, Chetty et al. (2020) show that state-ordered reopenings of economies have had limited impact on local employment in the United States. Examining emerging countries in East Asia, Kimura et al. (2020) emphasize the importance of regional policy coordination to mitigate and isolate the negative impact of the pandemic. Regarding economic policies for financial market stabilization, Zhang, Hu, and Ji (2020) map the general patterns of country-specific and systematic risks and analyze the consequences of policy interventions such as quantitative easing in the United States. Sharif, Aloui, and Yarovaya (2020) examine the connectedness between the spread of COVID-19 proxied by the number of newly infected cases, oil price volatility, the stock market, geopolitical risk, and economic policy uncertainty in the United States. Based on this, we examine the COVID-19 spread in South Korea by separating the effects of new cases and new deaths. More importantly, using the VAR model, we investigate not only
the direct effect of COVID-19 on the exchange rate, but also the indirect effect as a result of foreign investors’ capital flight.

The remainder of this paper is organized as follows. In Section 2, we briefly overview the spread of COVID-19 in South Korea. Section 3 presents our empirical results, and Section 4 concludes the paper.

2. THE COVID-19 PANDEMIC IN SOUTH KOREA

The solid line in Figure 1 presents the number of new COVID-19 infections in South Korea from December 2, 2019 to August 31, 2020. The data is obtained from the website of the World Health Organization (WHO). The first case was confirmed on January 19, 2020. In our dataset, the first case was recorded on January 20, 2020 because January 19, 2020 was a Sunday. The number of new cases recorded on January 20, 2020, totaled five. The peak of new cases came after nearly 32 business days on March 3, 2020, and the reported number of new cases on this day was 600, while the cumulative number of new cases was

![Figure 1. New Cases and New Deaths in South Korea](image-url)

Source: Daily numbers of new cases of infections and new deaths obtained from the World Health Organization.
Note: The left and right vertical axes present the number of new cases and new deaths, respectively.
[Colour figure can be viewed at wileyonlinelibrary.com]
4,816. For comparison purposes, the number of new cases in the United States equaled 44 on March 3, 2020. The peak in the United States during the same period (74,354 new cases) happened on July 19, 2020. Accordingly, the peak of the infection occurred much earlier in South Korea than in the United States. As a result of the South Korean government’s active efforts to prevent the spread of the infection, the number of new cases rapidly decreased during the month after the peak. The number of new cases was less than 10 between April 29, 2020 and May 7, 2020. Since the government partly deregulated restrictions for certain social activities, the number of new cases increased but remained below 100 until August 13, 2020. However, on August 14, 2020, the number of new cases rapidly increased and reached 103. The dotted line in Figure 1 presents the number of new deaths. March 19, 2020 was considered the peak of new deaths, approximately two weeks after the peak of new cases. The number of new deaths totaled 10. The number of new deaths remained less than three to the end of the sample period. The cumulative number of deaths reached 324 at the end of August. Similar to infections, the peak of deaths in the United States (6,409 on April 17, 2020) was somewhat delayed compared to the peak in South Korea (10 on March 19, 2020).

Figure 2 shows the daily transition of the volatility index of the South Korean stock market (KVI) and foreign investors’ holdings (FIH) of South Korean domestic stocks. The former volatility index represents the volatility of the Korea Composite Stock Price Index of the Korea Stock Exchange and is reported by Thomson Reuter Eikon (code: .KSVKOSPI). FIH data are obtained from the website of the Korea Exchange (KRX). The figure reveals that KVI and FIH rapidly increased and decreased, respectively, post the outbreak of the pandemic. The peak of KVI in the figure is March 19, 2020, which is 4.3 times higher than the bottom on January 10, 2020. On January 20, 2020, the first infected case was recorded in South Korea. Therefore, volatility in the South Korean stock market rapidly increased after the outbreak of COVID-19. After this peak, KVI decreased gradually and remained stable between 20 and 30 since early July. FIH has a clear negative correlation with KVI, indicating that foreign investors’ capital flight was associated with an increased risk in the stock market. FIH decreased approximately one month after the first observation of infection in South Korea. On the day of the first observation, cumulative holdings were 622,686 billion KRW and on March 19, 2020, the holdings recorded the lowest level of 400,257 billion KRW. The rate of decrease between these two dates was 33.9%. The holdings were restored to the same level as before the pandemic by early August.

KRX’s data for FIH in Figure 2 presents timely information because it is provided on a daily basis. However, since it only releases the data of stock holdings, we lack knowledge about the bond market. To compensate for this shortcoming,
Figure 3 presents the monthly movement of foreign investors’ cumulative holdings of Korean stocks and bonds. The data in this figure are obtained from monthly documents released on the website of the Financial Supervisory Service of South Korea. Left and right vertical axes indicate stock and bond holdings in terms of billion KRW, respectively. Stock holdings decreased by 2.0% from December 2019 to January 2020, and by 6.3% from January to February. Stock holdings continued to decrease by 14.0% from February to March. After reaching the lowest level in March, stock holdings recovered and were restored to the same level as before the pandemic in August. Consistent with Figure 2, Figure 3 indicates that foreign investors withdrew from the South Korean stock market as a reaction to the outbreak of COVID-19.

In contrast, bond holdings significantly increased after the pandemic. This increase reflects investors’ risk aversion. From December 2019 to January 2020, bond holdings increased from 123,651 billion KRW to 128,373 billion KRW. The rate of increase between these periods was 3.8%. Bond holdings have monotonically increased to date and have reached 150,976 billion KRW. These results
imply that foreign investors switched from stocks to bonds, preferring low-risk securities. Although foreign investors actively purchased South Korean bonds, the selling of stocks dominated and overall pressure on the South Korean financial market was negative. In fact, the sum of stocks and bonds decreased by 15.2% from December 2019 (the peak) to March 2020 (the bottom).

Figure 4 presents the daily nominal exchange rate of the KRW to the USD. The vertical axis is the value of the KRW in terms of the USD. Note that a rise and a fall refer to depreciation and appreciation of the KRW, respectively. After the first case of infection on January 20, 2020, the rate increased (i.e., the KRW started depreciating) to the USD. From this first day to the peak on March 23, 2020, the KRW depreciated by 9.8%. After the peak, the KRW gradually appreciated and was almost restored to its value prior to the outbreak. To offset rapid depreciation after the pandemic, the BOK seemed to engage in a foreign exchange intervention. Based on the news obtained from the Thomson Reuter Eikon database, we identified the date of the intervention as March 19, 2020 when the first news about the South Korean intervention was reported.

Source: Based on the monthly data obtained from the Financial Supervisory Service of Korea. 
Note: The left and right vertical axes present foreign investors’ cumulative holdings of stocks and bonds in terms of billion KRW, respectively. 
[Colour figure can be viewed at wileyonlinelibrary.com]
Figure 5 shows the monthly transition of foreign currency reserves. Consistent with our identification of the date of the intervention, foreign currency reserves fell sharply by 2.3% between February and March 2020. This significant fall indicates the BOK’s intervention to support the value of the KRW.

3. EMPIRICAL ANALYSIS

3.1. VAR Estimation

We model the dynamics of COVID-19 variables (new cases and new deaths), stock market variables, and the exchange rate by applying the widely used VAR model. In particular, we estimate the following reduced-form VAR model:

$$ y_t = \Gamma_0 + \sum_{i=1}^{k} \Gamma_i y_{t-i} + \gamma x_t + u_t, $$

(1)
where $y_t = (NC_t, ND_t, \Delta \ln KVI_t, \Delta \ln FIH_t, \Delta \ln KRW_t)'$ is a vector of endogenous variables. The data sources of these variables are same as those in Section 2. $NC_t$ and $ND_t$ are the number of new cases of infection and deaths at date $t$, respectively. These numbers are obtained from the website of the WHO. $KVI_t$ is KVI obtained from Thomson Reuter Eikon. $FIH_t$ is foreign investors’ holdings of South Korean domestic stocks obtained from the KRX website, and $KRW_t$ is the daily nominal exchange rate of the KRW to the USD obtained from Thomson Reuter Eikon.

The variable $x_t$ is a vector of exogenous variables that includes only the intervention dummy variable ($INT_t$), which takes 1 on the day when the news for the BOK’s intervention was first reported (March 19, 2020) and 0 otherwise. The date of intervention is identified from online news provided by Thomson Reuter Eikon. According to the BOK (2019), foreign exchange intervention is carried out only when there are excessive exchange rate fluctuations over a short period.

$^2$ $NC_t$ and $ND_t$ may be exogenous to other variables, thus the use of the near-VAR model with block exogeneity is another possible option. Nevertheless, there are no significant impacts of other variables on $NC_t$ and $ND_t$. Therefore, basic results do not change if we treat $NC_t$ and $ND_t$ as exogenous variables in the VAR system.
Lee and Kim (2020) use the rolling-window approach that allows time-varying coefficients to analyze the effectiveness of the BOK’s foreign exchange intervention. They employ monthly data for international reserves and show that the BOK’s intervention aims to stabilize the KRW exchange rate rather than to depreciate it. This finding seems to be consistent with the BOK’s (2019) statement that, in principle, its intervention aims to offset the short-term excessive fluctuation of the exchange rate.\(^3\) The COVID-19 pandemic is obviously such a situation where the BOK can intervene to stabilize the short-run fluctuations of the exchange rate. Therefore, we examine whether the BOK’s intervention was effective to mitigate the short-run fluctuation of the exchange rate and restore the value of the KRW. Since the spread of COVID-19 led to a dramatic fluctuation in the KRW in the short run, monthly frequency is not appropriate for our purpose. Therefore, we identify the timing of the intervention from daily news sources and then examine the intervention effect on a daily basis. From this perspective, our approach is similar to Chang, Suardi, and Chang (2017) who examine the effect of foreign exchange intervention of Asian central banks using daily news. The error term \(u_t\) is \(E(u_t) = 0\) and \(E(u_t'u_t') = \Omega\). The sample period of all estimations in this section is from the beginning of January 2019 (January 2, 2019) to the end of August 2020 (August 31, 2020). The descriptive statistics are provided in Table 1. Table 2 shows the results of the unit root tests of each variable. It indicates that all variables are stationary.

We employ the AIC to choose the final models from various possible VAR specifications. The lag order of the VAR process in equation (1) is chosen as 21.\(^4\) We calculate accumulated impulse responses using Cholesky restrictions. In this study, we assume the most exogenous variable is \(NC_t\), and the second is \(ND_t\) with our expectation that new COVID-19 cases have a delayed effect on new COVID-19 deaths. The third and fourth variables are (log differences of) \(KV_t\) and \(FIH_t\). These variables are closing values in the South Korean market. We use the closing price of

\(^3\) In contrast, Pontines and Rajan (2011) use monthly data to estimate the intervention reaction function of Asian central banks, including the BOK, and show that all the sampled central banks react more strongly to currency appreciations than depreciations. This result implies that the BOK and other Asian central banks fear currency appreciation, and foreign exchange intervention can be carried out to depreciate their own currencies. Ryoo, Kwon, and Lee (2013) discuss the development in Korean foreign exchange market and describe the BOK’s foreign exchange intervention policy since the introduction of the flexible exchange rate regime.

\(^4\) To select the appropriate length of lags, we set the maximum lag length at 25 (approximately one month of business days). A five-day lag is chosen based on the Schwarz-Bayesian information criteria (SBIC). We employ the AIC result since the lags of six business days are too short to analyze the relation between new COVID-19 cases and new COVID-19 deaths. Nevertheless, the results do not change qualitatively if we employ a five-day lag.
the KRW in the New York market. $KRW_t$ (the log difference) is the most endoge-
nous variable because of the time difference between South Korea and New York.5

Figures 6 and 7 present the accumulated impulse responses of endogenous vari-
ables to one standard deviation innovations in the number of new cases and deaths
($NC_t$ and $ND_t$) and other endogenous variables ($\Delta \ln KVIt$, $\Delta \ln FIHt$, and $\Delta \ln KRWt$), respectively. In equation (1), the coefficient of $INT_t$ in the equation for $\Delta \ln KRWt$ is negatively estimated ($-0.0173$) but not significant. For this coefficient, the $t$-value and standard error are $0.0160$ and $-1.0815$, respectively. Therefore, impulse responses in Figures 6 and 7 are calculated without exogenous variables.

Table 1. Descriptive Statistics

| Variable | Mean  | SD    | Max    | Min    | Obs. | Source                   |
|----------|-------|-------|--------|--------|------|--------------------------|
| $KRW$   | 1,180 | 33    | 1,273  | 1,110  | 434  | Thomson Reuter Eikon (TRE) |
| $FIH$   | 551,006,555 | 36,676,990 | 623,472,927 | 400,257,397 | 434  | Korea Exchange           |
| $INT$   | 0     | 0     | 1      | 0      | 434  | TRE                      |
| $NC$    | 31    | 86    | 600    | 0      | 434  | WHO                      |
| $ND$    | 1     | 2     | 10     | 0      | 434  | WHO                      |
| $KVI$   | 20    | 10    | 69     | 12     | 434  | TRE                      |

Note: The sample period is from January 2, 2019 to August 31, 2020.

Table 2. Unit Root Tests

|        | $NC$      | $ND$      | $\Delta \ln KVIt$ | $\Delta \ln FIHt$ | $\Delta \ln KRWt$ |
|--------|-----------|-----------|-------------------|-------------------|-------------------|
| ADF    | $-2.67^{**}$ | $-2.05^{**}$ | $-26.71^{***}$    | $-12.18^{***}$    | $-13.37^{***}$    |
| PP     | $-11.68^{***}$ | $-10.32^{***}$ | $-26.71^{***}$    | $-21.53^{***}$    | $-22.29^{***}$    |

Note: Null hypothesis: a variable has a unit root. ADF and PP indicate the Augmented Dickey-Fuller test statistic and the Phillips-Perron test statistic, respectively. Lags are based on SBIC. It is not including intercept and trend. $^{***}$, $^{**}$, and $^*$ indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Figures 6 and 7 present the accumulated impulse responses of endogenous variables to one standard deviation innovations in the number of new cases and deaths ($NC_t$ and $ND_t$) and other endogenous variables ($\Delta \ln KVIt$, $\Delta \ln FIHt$, and $\Delta \ln KRWt$), respectively. In equation (1), the coefficient of $INT_t$ in the equation for $\Delta \ln KRWt$ is negatively estimated ($-0.0173$) but not significant. For this coefficient, the $t$-value and standard error are $0.0160$ and $-1.0815$, respectively. Therefore, impulse responses in Figures 6 and 7 are calculated without exogenous variables.

Figure 6 shows that an exogenous positive shock on $NC_t$ clearly increases volatil-
ity in the South Korean stock market ($\Delta \ln KVIt$). Regarding the shock on $ND_t$, stock market volatility does not respond although the response becomes slightly significant several days after the shock. Therefore, the main driver behind the increase in stock

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5 We confirm that the results of this study do not change if we employ other Cholesky orderings of the variables. We also confirm impulse responses when we use dataset $y_t = (NC_t, ND_t, 100 \times \Delta \ln KVIt, 100 \times \Delta \ln FIHt, 100 \times \Delta \ln KRWt)^t$. In addition, we tried considering new cases and new deaths in the United States, and confirm that the results of impulse responses in Figures 6 and 7 do not qualitatively change when the KRW appreciates to a positive shock on infection cases in the United States.
Figure 6. Accumulated Impulse Responses to Shocks on New Cases and New Deaths of COVID-19

Source: Authors' calculation based on the estimation results of equation (1). Note: Accumulated responses of endogenous variables to Cholesky’s one standard deviation innovations. The dotted lines indicate ±2 standard errors. The horizontal axis presents days from the occurrence of exogenous shocks. [Colour figure can be viewed at wileyonlinelibrary.com]
market volatility in South Korea is not a surge in the number of deaths but the number of new cases. The accumulated response of stock market volatility becomes clear ten days after the shock. Foreign investors’ stock holdings ($FIH_t$) also respond to the shock of the number of new cases. Especially, the response becomes clear 13 days after the shock. Again, $FIH_t$ does not significantly react to a rise in the

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number of deaths. Foreign investors react to an increase in new cases but not when the number of deaths increases. In sum, impulse responses indicate that the South Korean stock market turmoil is caused not by an increase in deaths but by an increase in new cases. It takes about ten days for stock market volatility and foreign investors’ stock holdings to reflect the impact of a surge in new infections.

For the exchange rate, from Figure 7, the KRW exchange rate negatively and significantly reacts to the shock on foreign investors’ stock holdings. In other words, the KRW depreciates after foreign investors’ stock holdings decrease. As shown in Figure 6, foreign investors’ stock holdings significantly fall with a rise in new cases. These results jointly indicate that a rise in the number of new cases served as the trigger for foreign investors’ capital flight and decreased the value of the KRW. Figure 7 also shows that $FIH$ significantly falls with a rise in $KVI_t$. From Figure 6, a surge in new cases led to an increase in $KVI_t$. Accordingly, it is implied that an increase in the number of new cases indirectly leads to significant depreciation of the KRW as a result of increased stock market volatility and a decrease in foreign investors’ stock holdings.

There are also direct impacts of shocks on $NC_t$ and $ND_t$ on the exchange rate. We observe an appreciation of the KRW seven days after a positive shock on new cases. This result implies that investors repurchased the KRW after its price fell enough (remember a decrease in price is contemporaneously caused by foreign investors’ capital outflow). We also observe a slight depreciation of the KRW after a shock on new deaths. This result implies that investors seriously considered a rise in deaths and sold the KRW after observing it.

### 3.2. GARCH Estimation for the Effectiveness of the Intervention

Our VAR analysis shows that the BOK’s intervention against a fall in the value of the KRW during the COVID-19 pandemic does not have a significant effect. Since we employ the 21-day lag based on the AIC, our VAR analysis may present the long-run relations between variables. It is worth considering the short-term effect of the intervention, since the intervention is usually conducted to offset short-run disturbances. More importantly, the VAR analysis does not enable us to examine the effect of the intervention on exchange rate volatility. Hence, we estimate GARCH models without the lagged dependent variable in addition to simple OLS estimations. Specifically, we estimate the following equation:

$$
\Delta \ln KRW_t = \alpha_0 + \alpha_1 \Delta \ln FIH_t + \alpha_2 INT_t + \epsilon_t,
$$

where $\epsilon_t$ is the disturbance. This specification is similar to Hoshikawa (2017), to which we add $\Delta \ln FIH_t$.

Table 3 shows the estimation results for equation (2). Newey-West heteroskedasticity and autocorrelation consistent standard errors for OLS estimation.
are reported in parentheses. Columns (I) and (II) present the estimation results based on the OLS. In column (I), we introduce only the log difference of $FIH_t$. Consistently with the VAR analysis, $\Delta \ln FIH_t$ has a significant negative effect on the exchange rate. In column (II), we add $INT_t$ to the estimation equation in column (I).6 In contrast to the VAR result, $INT_t$ has a significant negative effect on the exchange rate. Therefore, it is implied that the intervention had a significant effect on the exchange rate in the very short run. As we discussed in Section 3.1, the BOK intervenes in the foreign exchange market to stabilize the value of the KRW when fluctuation in the short-run exchange rate is excessive. Our empirical result implies that the BOK’s intervention had a significant effect of “leaning against the wind” caused by the COVID-19 pandemic. However, (the absolute value of) the coefficient is approximately 0.01 and the impact of the intervention is small. The BOK’s intervention had a significant effect but it only regained 1% of the value of the KRW against the market selling pressure caused by the COVID-19 turmoil.

We also estimate equation (2) using the GARCH model. The GARCH model is generally used in the case of volatility change. We assume that the error term is $\epsilon_t = \nu_t \sqrt{h_t}$, where,

### Table 3. Estimation Results of OLS and GARCH Models

|                     | (I) OLS | (II) OLS | (III) GARCH |
|---------------------|---------|----------|-------------|
| Constant            | 0.0002  | 0.0002   | 0.0002      |
|                     | (0.0002)| (0.0002)| (0.0002)    |
| $\Delta \ln FIH$    | -0.1485*** | -0.1591*** | -0.1426*** |
|                     | (0.0204)| (0.0235)| (0.0203)    |
| $INT$               | -0.0117*** | -0.0104*** |            |
|                     | (0.0019)|          | (0.0016)    |
| Constant            |         |          | 0.0000**    |
|                     |         |          | (0.0000)    |
| Squared RESID(−1)   |         |          | 0.0581      |
|                     |         |          | (0.0361)    |
| $GARCH(−1)$         |         |          | 0.8169***   |
|                     |         |          | (0.0732)    |
| $INT$               |         |          | 0.0001      |
|                     |         |          | (0.0001)    |
| No. of observations | 434     | 434      | 434         |
| Adjusted $R$-squared| 0.1940  | 0.2050   | 0.2027      |

Note: Estimation results for equation (2). The sample period is from January 2, 2019 to August 31, 2020.

***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

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6 The BOK might carry out the intervention after seeing a rapid capital outflow by foreign investors, implying a multicollinearity between $\Delta \ln FIH_t$ and $INT_t$ in equation (2). Fortunately, this correlation does not seem problematic because the coefficient of $\Delta \ln FIH_t$ does not change much when $INT_t$ is introduced.
\[
    h_t = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 h_{t-1} + \beta_3 \text{INT}_t. \tag{3}
\]

Equation (3) shows the conditional variance dynamics, while \( \nu_t \) is white noise processes with zero mean and unit variance. If parameter \( \beta_3 \) in the variance equation significantly differs from zero, the intervention influences exchange rate volatility. Given the information set at time \( t - 1 \), \( h_t \) is predetermined in basic GARCH models. The numbers in parentheses in column (III) of Table 3 are Bollerslev and Wooldridge (1992) robust standard errors.

Regarding the exchange rate level, the result is identical to the results in OLS estimations. That is, the intervention had a significant negative effect on the exchange rate, even though the impact was limited. Concerning exchange rate volatility, the intervention did not have significant effects. Previous studies such as Dominguez (1998) and Nagayasu (2004) indicated that interventions generally increase exchange rate volatility. In this case, the BOK’s intervention affected the exchange rate level without affecting volatility.

4. CONCLUDING REMARKS

In this study, we empirically analyzed how the COVID-19 pandemic affected stock market variables and the exchange rate of South Korea. It is revealed that a growth in the number of new infection cases caused an increase in South Korean stock market volatility, leading to rapid foreign investors’ capital flight. As a result, the KRW sharply depreciated to the USD. For the direct impacts, we also indicate the possibility that investors repurchased the KRW seven days after a rise in new cases, thereby slightly increasing the value of the KRW. A rise in new deaths slightly decreased the value of the KRW. Overall, the COVID-19 pandemic significantly increased the KRW exchange rate mainly through the indirect channel of foreign investors’ capital flight. The BOK attempted to regain the value of the KRW by intervening in the foreign exchange market. This intervention has a significant short-run effect to regain the value of the KRW. However, the impact was quantitatively limited.

There are some policy implications emerging from the findings of this study. First, a direct impact of the spread of COVID-19 on the exchange rate was minor compare to an indirect impact as a result of foreign investors’ capital flight. In other words, pure speculative attack on the KRW exchange rate did not occur in South Korea amid the outbreak of the pandemic. Therefore, regulation policies, such as the short-selling ban introduced by the South Korean government after the spread of COVID-19, may contribute to stabilizing the value of the KRW exchange rate. Second, the foreign exchange intervention proved ineffective in supporting the value of the KRW. In fact, the short-run effect was significant but not quantitatively sufficient. Therefore, combined with the first policy implication, stock market regulations may become more effective in stabilizing the

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currency value than foreign exchange intervention against turmoil such as the COVID-19 pandemic, which occurs outside of the foreign exchange market.

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