The Link between Public Health Crisis and Presidential Approval: Evidence from the COVID-19 in South Korea*

Na Kyeong Lee**, Jae Mook Lee***, Byung-Deuk Woo****

This study examines the relationship between the changes in the number of the COVID-19 confirmed cases and presidential approval ratings by using cases of infectious disease prevention management in Korea. Linking the pandemic quarantine with presidential approval, we apply a time-series spillover analysis to the daily poll data on Korean presidential approval ratings. The findings demonstrate that Moon's presidential approval ratings tend to rise with the health crisis caused by the spread of the COVID-19, because the public evaluating the countermeasures against the COVID-19 of Moon's administration are likely to support Moon when the issue of the COVID-19 is salient. We also find that changes in presidential approval ratings due to the fluctuations in the number of confirmed cases are not consistent but differentiated depending on the period, because of the fatigue of people with the pandemic.

Key Words: COVID-19, Presidential Approval Ratings, South Korea, Time-series Spillover Analysis

I. Introduction

Undoubtedly, a novel coronavirus (SARS-CoV-2 or COVID-19) emerging in the

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city of Wuhan, China in December 2019 is the most conspicuous event nowadays not only in the public health area (Jaspal et al. 2020; S. Kim and Kim 2021; Kimhi et al. 2020), but also in political and economic perspectives (Tisdell 2020; Bosancianu et al. 2020; van Holm et al. 2020; Latkin et al. 2021; Shao and Hao 2020). With the spread of the COVID-19 at an astonishing rate (Peeri et al. 2020), plenty of studies have examined the impact of the COVID-19 through the lens of politics. Some studies demonstrate the link between perceptions of risk during the pandemic and people's partisanship. (Barrios and Hochberg 2020; Apergis and Apergis 2020), while others have made efforts to understand government responses against the disease with the comparative perspective (Greer et al. 2020). In addition, public trust in the government's ability to manage the pandemic (Fancourt et al. 2020), consequences of policies against the COVID-19 (Naumann et al. 2020; Balmford et al. 2020), and political unrests generated by the COVID-19 (Galea and Abdalla 2020; Lipscy 2020) have also been examined.

Even though previous studies on the link between the COVID-19 and the political area broaden our understanding of political impacts of the COVID-19, the influence of the policy performance against the COVID-19 on presidential approval ratings has not yet been examined especially outside of the United States. Given that presidential approval fundamentally affects the president's political power and success in policy-making (Canes-Wrone 2010), the lack of studies on the link between the COVID-19 and presidential approval is unexpected. How does the increase of the new cases of the COVID-19 affect presidential approval ratings? This article examines this relationship through South Korea's case. The high transparency and accessibility of data on the daily confirmed cases and presidential approval ratings of South Korea provide us a valuable opportunity to investigate the association between the COVID-19 and presidential approval.

We should note that the academic attempt to link epidemics to presidential or governmental approvals is not a novel approach. Some previous literature hints that governmental and presidential approvals can be affected by their responses against epidemics. For instance, even though less central to his analysis, Kang (2019) mentioned that the outbreak of MERS in South Korea and the government's inadequate reaction made the public suspicious about the former president Park Geun-hye's disease control ability (see also Jhee and Park (2019)). Even earlier, AIDS policies of governments in African countries have also been studied as an important factor determining governmental supports from the public (Youde 2009; 2012).

Built on the previous literature suggesting the association between epidemic and presidential approval, this article contributes to the literature by demonstrating that Moon's presidential approval ratings tend to rise with the health crisis caused by the spread of
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The COVID-19, because the public evaluating the countermeasures against the COVID-19 of Moon's administration are likely to support Moon when the issue of the COVID-19 is salient. To examine this relationship empirically, we apply a VAR-based spillover analysis to the daily poll data on the Korean presidential approval ratings. Furthermore, our study also unveils that changes in presidential approval ratings due to the fluctuations in the number of the COVID-19 confirmed cases are not consistent but differentiated depending on the period, especially because of the fatigue of people with the pandemic.

This study proceeds as follows. In the next section, we introduce previous literature on presidential approval ratings, policy performance, and issue salience. Then, we demonstrate the mechanism of how heterogenous COVID-19 performance evaluation among the public affects Moon's approval ratings in South Korea. In the empirical section, model specifications and empirical results will be presented. Finally, we conclude with discussions about the potential limitations of our study.

II. Previous Studies on Presidential Approval and Policy Performance

Presidential approval is the most widely discussed political indicator in presidential system, because of the political and social importance of presidents and the crucial role of presidential approval in determining presidential power (Cohen 2002; Edwards III et al. 1995; Ostrom and Simon 1985; McAvoy 2006; Canes-Wrone 2010). Presidential approval has been used as a proxy for presidential strength. Related to approval ratings, a number of studies have examined various topics such as the link between presidential approval and the use of international military disputes based on the diversionary theory (Brulé 2008), public policies and presidential approval (Cavari 2017; Rottinghaus 2010), and presidential approval and presidential success in legislative branch (Barrett and Eshbaugh-Soha 2007; Alemán and Navia 2009).

Among those topics, the question of how presidential approval is being shaped has been positioned at the center of studies on presidential approval. Based on the crucial study from John Mueller (1970; 1973) about presidential approval rating, previous studies have examined various determinants of presidential approval rating at the aggregate level. Some scholars argue that the public evaluate their presidents from the perspective of economic condition and foreign policy achievements because the public assume that presidents are in charge of these issues (Cohen 2002; Edwards III et al. 1995; Enns and Lagodny 2020). Series of studies also suggest that presidential approval can be determined by the performance of a specific agenda or policy (Canare et al. 2020;
Carlin et al. 2015; Kam and Ramos 2008; Clarke et al. 2005). For instance, Kam and Ramos (2008) show that public opinion about presidents is largely affected by an event such as 9/11 in the U.S. In addition, Clarke et al. (2005) unveil the importance of social policies on presidential approval by disaggregating 240 Survey of Consumers datasets. Even policy performances on politically irrelevant events can affect presidential approval ratings (Busby et al. 2017; Achen and Bartels 2017). Achen and Bartels (2017) demonstrate that the incompetence of the federal government to deal with the death tolls and economic hardship caused by shark attacks in the affected areas of New Jersey negatively influences Wilson's vote share in that area in 1916.

The above-mentioned diverse explanations about the potential determinants of presidential approval ratings are mainly based on the public evaluations of the policy performance of presidents. The core assumption behind the link between policy performance and evaluation of presidents is that the saliences of all visible issues are homogenous and constant. However, as mentioned in the study from Edwards III et al. (1995), not all issues matter at the same rates to the public. The influence of public evaluations of policy performance on the presidential approval ratings is conditioned on the salience of the issues. The suggested mechanism among policy performance, issue salience, and presidential approval ratings is straightforward. The public usually have only a few issues that matter to them most (Converse 1964), and the performances of representatives on the few salient issues play as yardsticks for the public to assess their representatives (Mayhew 1974; Fenno 1978; Bianco 1994). If an issue is not salient to the public, the public do not refer to the policy performance of governments related to that issue when they evaluate the president (Edwards III et al. 1995), which is in the line with the satisficing theory developed by Simon (1957). Put it differently, the public decide whether they will support their presidents by giving weights toward policy performance of presidents according to their issue priorities. The moderating effect of issue salience on the relationship between policy performance and presidential approval can be simply illustrated as the below diagram.

Figure 1. The Diagram of the Causal Process
Series of studies support the above causal process with empirical evidence in the American context (Cavari 2019; Sanchez et al. 2015; McAvoy 2006; Krosnick 1990; Krosnick and Kinder 1990). For instance, McAvoy (2006) examines the time-varying nature of issue salience of foreign and economic policy. At the individual level, Sanchez et al. (2015) using the survey of 800 registered Latino/a voters administered in 2013 show that Latino voters with priority on immigrant issues are less likely to support President Obama. More recently, Cavari (2019) finds the moderating impact of individual issue salience on the association between policy performance and overall assessment of presidents, based on the time-series cross-sectional individual-level data of presidential approval in the United States from Reagan to Obama.

This causal relationship is also broadly examined outside of the U.S. (Singer 2011; Fournier et al. 2003). Analyzing cross-national survey data from the Comparative Study of Electoral Systems (CSES), Singer (2011) finds that economic issues are not always salient toward the public, unlike the long-lasting assumption that voters always prioritize the economic performance of governments. Fournier et al. (2003) examine the relationship between issue salience and Canadian government evaluation. They show that voters with a certain issue priority tend to evaluate the government based upon its performance on the issue.

III. COVID-19 in South Korea and Evaluation on COVID-19 Responses

This article applies the logic among policy performance, issue salience, and presidential approval to examine the impacts of the COVID-19 on Moon Jae-in's approval ratings. Compared to the former conservative presidents, Park Geun-hye and Lee Myung-bak who were involved in corruption scandals, Moon has enjoyed relatively high public approval ratings (Hahm 2021). Based on the extreme public disappointments with Moon's predecessors, the collapse of the conservatives, and multiple summit meetings with Donald Trump and Kim Jong-un, Moon can maintain relatively high approval ratings despite the lack of the leadership qualities such as the ability to compromise with opposition leaders and his failures in economic policies (Hahm and Heo 2020; Hahm 2020). According to the surveys from Gallup Korea, Moon's approval ratings decreased from over 70% in 2017 to the range between 39% and 49% in the second half of 2019 because of the controversy over Cho Kuk, who was nominated for justice minister for prosecution reform. His approval ratings turned into an upward trend again with the outbreak of
coronavirus in early 2020, recording 71% in May 2020 (Gallup Korea, 2020). We argue that the rebound in Moon's approval ratings is from the positive public evaluation on the policy performance against the COVID-19 from Moon's administration. We present our explanations about the trend in COVID-19, the evaluation of the performance of Moon's administration against the COVID-19, and our hypotheses in order.

In 2020, the salience of the COVID-19 unquestionably outweighs other issues including economic and foreign issues. Among the total 3,452,272 news articles in South Korea from February 1st to December 31st in 2020, 1,284,639 (37.21%) articles covered issues related to the COVID-19. The rate is relatively higher than that of articles about economic and foreign policy issues by around 20%.

Considering the fact that the economic and foreign policy issues are largely affected by the COVID-19 in 2020, it is not an exaggeration to say that the issue of the COVID-19 dominated every month in 2020. However, even though the salience of the COVID-19 is relatively higher than that of economic or foreign policy, the degree of the salience of the COVID-19 fluctuates with the number of newly confirmed cases. When the number of confirmed cases increases, the percentage of respondents answering that the issue of the COVID-19 is the most important issue increases. In addition, the percentage of respondents who worry about the infection of the COVID-19 and about economic hits rooted in the COVID-19 also increases with the rise in the number of confirmed cases (Hankuk Research 2020).

There are three huge waves of the COVID-19 in South Korea. After the first confirmed case of the COVID-19 in South Korea was reported on January 20th, the epidemic's trajectory presented a continuous and rapid uptrend. Because of geographical proximity to Wuhan, where is the center of the COVID-19 outbreak, and the high rates of travelers from China, South Korea in the early stage of the COVID-19 pandemic became the second-highest country with the number of cases after China. The number of confirmed patients increased dramatically due to the Shincheonji Church of Jesus mass infection in the Daegu cluster after February 20th. The incidence of new COVID-19 cases was over 800 cases per day from late February to early March (Oh et al. 2020). The COVID-19 was transmitted by the confirmed patients outside of Daegu, which was the main reason

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1 The number of articles is calculated based on the database from BIGKINDS managed by the Korea Press Foundation. It collects all news articles published by 54 presses in South Korea over three decades. 37.21% articles include keywords such as the "COVID-19," "coronavirus," and "confirmed cases". We should note that there are no upper- and lower-case letters in Korean language, which assures us that there are no missing articles because of capitalization.

2 For instance, during the period when the COVID-19 hit the economy of South Korea, Moon's administration has offered emergency coronavirus relief funds to make South Korea economically more active. See B. H. Kim (2020) for more information about budgetary responses of South Korea against the COVID-19.
behind the rapid growth of the COVID-19 cases in South Korea. Even though the trend of newly confirmed cases decreased after a few weeks, the scar of Shincheonji mass infection makes Daegu is the third-ranked region with the number of cases following the two metropolitan areas in South Korea including Seoul and Gyeonggi-do as illustrated in Figure 2.

Note: The number of cumulative positive cases is based on the data from the Statistics Korea on December 31st, 2020. The "ggplot2" package in R is applied to visualize the confirmed positive cases according to the regions in South Korea.

Figure 2. The Number of Cumulative Positive Cases in South Korea by Regions

After the Shincheonji mass infection, the number of newly confirmed patients had fluctuated slightly around 50 per day until the second mass infection starting from "Sarangjeil Presbyterian Church" and the massive assembly at "Gwanghwamun" in Seoul on August 15th. Religious gatherings in South Korea were mostly conducted in non-face-to-face ways under the government's quarantine guidelines, but several religious groups, including "Sarangjeil Presbyterian Church," pushed for regular face-to-face gatherings without social distancing among the church members. According to the Korea Disease Control and Prevention Agency (KDCA)\(^3\), at least 1,500 confirmed patients have been traced to the mass infection from "Sarangjeil Presbyterian Church."\(^4\)
Following this second mass infection from the church, the public "Gwanghwamun" rally severed as a catalyst for the massive spread of the COVID-19 in August. The rally was organized by politically far-right groups and voters, and the main purpose of the assembly was to criticize Moon's administration. Jeon Kwang-Hoon, one of the leaders in the rally, argued that Moon's administration committed the COVID-19 virus attacks. The police estimated that around 20,000 people including confirmed patients from the "Sarangjeil Presbyterian Church" participated at the rally. Some participants did not wear masks and disregarded social distancing. The "Gwanghawmun" rally seriously facilitates the spread of the COVID-19 in South Korea and the number of confirmed cases related to the rally is around 1,000. Those two major events in August attributed to the high number of positive cases in Seoul and Gyeonggi-do.

As that of other countries, the number of confirmed cases increased during November and December 2020 due to the third wave of the COVID-19 in the winter season. According to the data from the Statistics Korea, the daily averages of newly confirmed positive cases in November and December are 259 and 858 respectively. Especially, the daily average in December largely exceeds that in the period of the two previous mass infections.

Despite the increasing number of cumulative confirmed cases, South Korea was able to control the number of new confirmed cases and keep a low mortality rate. The responses against the COVID-19 outbreak and preparedness activities from Moon's administration have been positively assessed not only by news media but also by scholars (Moradi and Vaezi 2020; Oh et al. 2020; M. H. Kim et al. 2020; Lee and Lee 2020). Learning from the policy failure precedence of pandemic governance during the case of Middle East Respiratory Syndrome (MERS) in 2015, Moon's administration, based on the crucial role of the KDCA, responds to the COVID-19 swiftly by exponentially increasing the amount of Real-Time Polymerase Chain Reaction (RT-PCR) test-kits through Public-Private Partnership (PPP) on Emergency Use Activation (EUA) (Park and Chung 2021). Among scholars, the systematic four-levels outbreak alert system comprised of 1) attention to the outbreak, 2) caution and cooperation, 3) alerts and initiation of the response system, and 4) mobilization of nationwide response system is evaluated as having played an important role in the successful disease control in South Korea (Moradi and Vaezi 2020). Also, South Korea's strategies such as the implementation of aggressive measures

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3 On September 12th, 2020, the Korea Centers for Disease Control (KCDC) was elevated to the KDCA. This article uses the current acronym, KDCA, because the timeline of this study is after the elevation.

4 The Seoul city government filed a lawsuit against "Sarangjeil Presbyterian Church" for 3.4 million dollars in social and public health damages (Chung and Lee 2020).
to prevent community transmission, establishment of diagnostic capacity, and reallocation of clinical resources have been regarded as the factors of the dramatic decrease in the new COVID-19 incidence (Oh et al. 2020).

In terms of public's policy evaluation, the public tend to attribute the successful control of the COVID-19 to president Moon Jae-in as previous studies show that the public tend to attribute the failure and the success of the government to the president (Edwards III et al. 1995; Foster and Palmer 2006). In accordance with the pragmatic views from media and scholars toward Moon's administration, the aggregated public evaluation of the outbreak response is also positive. According to the weekly survey from a Korean survey institute "Hankook Research," more than 60% of 1,000 respondents have answered "Very Well" or "Well" to the question "Do you think president Moon and the government are responding well to the COVID-19?" Especially, from the end of April to early August, over 75% of 1,000 respondents support the COVID-19 responses from Moon's administration. Compared to the public evaluation of government responses toward the COVID-19 in other countries, the aggregated public evaluation of Moon's administration is astonishingly high. Undoubtedly, the successful control of the COVID-19 is the driving factor behind this highly positive evaluation. In addition, the public's experience of the relatively poor response from the impeached president Park Geun-hye to the MERS outbreak in 2015 might lead the public to value the response from Moon's administration more highly.

Likewise, the aggregated public evaluation on the governmental responses against the COVID-19 from Moon's administration is largely positive. Therefore, consistent with the previous work on issue salience, policy performance, and presidential approval, we expect that Moon Jae-in's approval ratings increase when the newly confirmed cases of the COVID-19 increase. To be specific, we expect that the largely positive public evaluations on the policy performance against the COVID-19 of Moons' administration are translated into the increase of Moon's presidential approval ratings, especially when the issue of the COVID-19 becomes more salient with the increase in the number of newly confirmed cases during and after the waves of the mass infection. At first glance, our expectation might be seen counterintuitive because the public might attribute the causes of the three waves of mass infections to the failure of the government's countermeasures against the COVID-19. However, the public tended to blame the individual violations of the governmental guidelines, and the positive evaluations on the countermeasures of Moon's administration were still high even after the mass infections (BBC Korea 2020; KBS 2020).

In addition to the general influence of the newly confirmed cases on the relationship
between policy performance and Moon’s approval, we also expect that the causal process is augmented after the first wave of the mass infection in February. This expectation is based on a branch of retrospective theories and rational expectation theories (Lewis-Beck 1988; Fiorina 1978; Erikson et al. 2000; Huber et al. 2012) arguing that the public at aggregated-level tend to rely on the past experience to evaluate their governments. In South Korea's case, the public experience of the successful management from Moon's administration during the first mass infection makes the public give more supports to Moon's administration during the second and the third waves of the COVID-19 with the expectation that Moon's administration will once again be good at dealing with the COVID-19.

Hypothesis 1: When the newly confirmed positive cases of the COVID-19 increase, Moon's approval ratings increase, while all other things being equal (Ceteris Paribus).

Hypothesis 2: The relationship between the number of newly confirmed cases of the COVID-19 and Moon's approval ratings is relatively stronger during the second and the third waves of the COVID-19 in South Korea than during the first wave, while all other things being equal (Ceteris Paribus).

IV. Empirical Analysis

A. Data and Operationalization

This study examines the relationship between the presidential approval ratings and the number of the newly confirmed COVID-19 cases. The presidential approval ratings are based on the daily poll results conducted by Realmeter, a leading Korean polling company. Realmeter's regular national survey uses mobile phones and landlines to extract samples at 80% and 20% ratios, and actual surveys are conducted in parallel with telephone interview (CATI) and automated response (ARS) methods.

The approval rating question was measured on a 4-point scale according to the degree of likeness and dis-likeness of respondents. Using this question, we devised a comprehensive index of presidential approval (Presidential Approval Index or PAI) indicating the degree of support for the president as below,
Approval Index

\[
(1.0 \times \text{Strongly Approve} + 0.5 \times \text{Somewhat Approve} - 0.5 \\
\times \text{Somewhat Disapprove} - 1.0 \times \text{Strongly Disapprove})/ \\
\text{Total Respondents} \times 100 + 100
\]

We adopted this way of operationalization from KOSTAT as they construct various indices such as Consumer Sentiment Index (CSI), employing a series of survey questions, measured in a similar way.

The number of confirmed COVID-19 cases per day is based on official data released by the Korea National Statistical Office (KNSO). The Central Disaster Management Headquarters (CDM) and Central Disease Control Headquarters (CDC) in Korea count the number of confirmed coronavirus cases across Korea every day and disclose them to the public. The number of confirmed cases has been accurately measured in Korea compared with in other countries because South Korea implements various types of screening tests including drive-through and walk-through tests which are highly accessible by the public (Choi et al. 2020).

**B. Model**

To examine the spillovers across the president approval ratings and the number of confirmed cases, we implement a vector autoregressive (VAR) model and explore the variance decompositions. Variance decomposition allows us to separate overall variation in the endogenous variables into the component shocks in the system. Then, we obtain the relative important facts for every random shock, which affects the variables. The decomposition provides the answer to the question: what fraction of the h-step ahead error variance in forecasting is due to the shocks to any other variance within the system.

To construct a spillover index for data series, we employ an approach suggested by Diebold and Yilmaz (2009). The spillovers are based on Vector autoregressive (VAR) models by adding variance decomposition which allows to detect spillover effect across time series. Then, the spillover index is derived from variance decomposition associated

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5 De Vries et al. (2020) argue that a "crisis signal" in other countries can create a rally-round-the-flag effect, which leads citizens to give their supports to the incumbents by demonstrating that the Italian lockdown increases citizens' supports for governments in France, Germany, Poland, and Spain. However, considering that we never sure about to which countries individual citizens react, we focus on the number of confirmed cases in South Korea rather than arbitrarily selecting referenced countries. In addition, given that public does not always have the detailed information (Price 2017), assuming that public uses the detailed information about other countries to evaluate their governments is unrealistic.
with multiple variables vector autoregression. Now, the number of variables is $N$. First, we consider VAR($p$) with $k$ variables as the following equation

$$ Y_t = \phi_0 + \phi_1 Y_{t-1} + \cdots + \phi_p Y_{t-p} + \nu_t $$

(1)

where $Y_t = [y_1, y_2, \ldots, y_N]'$ and $\phi_0$ is a $(k \times 1)$ vector of constants and $\phi$s are $(k \times k)$ coefficient matrices. $\nu_t$ is a sequence of serially uncorrelated random vectors with the concurrent full rank covariance matrix. We demean the series and denote $Z_t = Y_t - \mu$ where $E[Y_t] = \mu$. By successive substituting on the right-hand side of equation (1), a moving representation is obtained given covariance stationarity. For the sake of simplicity in illustration, we consider a first-order bivariate VAR which is VAR(1) with $k=2$ as following:

$$ Z_t = \Phi Z_{t-1} + \nu_t $$

(2)

The equation (2)’s moving average representation exists and is provided by $Z_t = (1 - \Phi L)^{-1} \nu_t = \Theta(L) \nu_t$, where $(1 - \Phi L)^{-1} = \Theta(L)$ and $\Theta(L) = I - \Theta_1 L - \Theta_2 L^2 - \cdots - \Theta_p L^p$. Subsequently, the moving average representation is rewritten as $Z_t = H(L) u_t$, where $H(L) = \Theta(L) Q_t^{-1}$, $u_t = Q_t \nu_t$, $E[u_t u_t'] = I$, $Q^{-1}$ is the unique lower-triangular Cholesky factor of the covariance matrix of $\nu_t$.  

In our study, $Z$ will be a vector of the degree of approval toward the president’s leadership and corona confirmed cases. In turn, the one-step ahead error vector that is derived by one-step ahead forecast such as $Z_{t+1,i} = \Phi Z_t$ is given by

$$ \hat{\nu}_{t+1,i} = Z_{t+1,i} - Z_{t+1,i} = H \kappa_t = \begin{pmatrix} h_{0,11} & h_{0,12} \\ h_{0,21} & h_{0,22} \end{pmatrix} \begin{pmatrix} \nu_{1,1,t+1} \\ \nu_{2,1,t+1} \end{pmatrix} $$

(3)

which has the covariance matrix $E(\hat{\nu}_{t+1,i} \hat{\nu}_{t+1,i}') = H \Sigma \bar{H}$. The variance of the one-step ahead error in forecasting $Z_{1,t}$ and $Z_{2,t}$ are $h_{0,11}^2 + h_{0,12}^2$ and $h_{0,21}^2 + h_{0,22}^2$, respectively. 

6 $u_t = [u_{1,t} \ u_{2,t}]'$ are structural shocks that are uncorrelated with one another.

7 The forecast error variable at time $t$ is defined as the difference in realization ($Z_{t+1,i}$) and forecasted values ($Z_{t+1,i}$). The existence of the difference is due to the structural shocks in the system, $u_t$. The forecast error variance is measured as the squares of the forecast errors since the zero mean forecast error. For a $k$ variable system, the total forecast error variance of variable $i$ at horizon $m$, $\Omega_i(m)$, is defined as: $\Omega_i(m) = \sum_{n=1}^{m} \sum_{j=1}^{k} h_{m,i,j}^2$. 


Hence, a forecast error variance decomposition at different horizons leads to quantify how important each shock is in explaining the variation in each of the variables in the system over the period (Sims 1980).

Let cross variance shares consider spillover that is measured by the fraction of the one-step ahead error variances in forecasting $Z_{it}$ due to the shocks to $Z_{jt}$ for $i \neq j$ for $i,j = \{1, 2\}$. Then, the spillover index is defined as follows:

$$Spillover \_Index = \frac{h_{0,12}^2 + h_{0,21}^2}{h_{0,11}^2 + h_{0,12}^2 + h_{0,21}^2 + h_{0,22}^2} \times 100$$

The spillover index is interpreted as a measure of total spillover $h_{0,12}^2 + h_{0,21}^2$ relative to total forecast error variation. Having illustrated the Spillover index given VAR(1), we easily extend to high-order VAR models and $h$-step ahead forecasts.

C. Empirical Results

To test the two hypotheses in our study, we first examine the changes in the President Approval Index (PAI) in Korea during 2020. The left and right sides of Figure 3 indicate the President Approval Index showing overall approval ratings and strongly approve and disapprove ratings respectively. The index score above 100 (red-dotted horizontal line) indicates that there are more people who support the president than those who do not. Similarly, an index score below 100 means that there are more people who are dissatisfied

Note: Figure 1 presents both the President Approval Index(left) and the percentages of who either strongly approve or disapprove of the president's performance. The red line of the right panel indicates 'strongly disapprove' and the blue line signifies 'strongly approve'.

Figure 3. Presidential Approval Ratings (PAI and Strongly Approve or Disapprove)
with the performance of state affairs than those who give support. As we can see, the overall trend for the PAI index is quite similar to the pattern in the right panel showing the percentage of people who show strong favors for the presidential performance.

As expected, Figure 1 shows a tendency for the PAI to rise or rebound when the number of newly confirmed cases increases during the first and the second waves of mass infections in Korea. According to the PAI graph, the PAI skyrocketed after the end of February, when the newly confirmed cases reached over 500 because the first mass confirmation of the COVID-19 occurred in the Daegu cluster and neighboring provinces. Even though the PAI turns to a decreasing trend after May 1st, the positive evaluation lasted between March 19th and July 8th. It can be explained by the relatively successful disease control of the Korean government toward the first catastrophic mass infection. The Korean government promptly declared the region as a special disaster zone, provided transparent information to the public, and implemented an effective patient triage and diagnostic system while protecting health care workers and patients (J.-H. Kim et al. 2020). This so-called K-quarantine became known to the world as a successful model of infectious disease quarantine management, and the COVID-19 outbreak in South Korea's southwestern part was well finished.

As July entered, negative evaluations of the presidential performance began to increase, with the lowest score in August (especially among those who showed strong opposition). We believe this is related to the conservative church members' Gwanghwamun rally, which has consistently led to strong protests since the Moon Jae-in administration's inauguration. During the second mass corona infection crisis triggered by the rally, the number of confirmed cases increases from under 100 to around 400, and the PAI dramatically increases simultaneously. It means that the public gives their support for Moon's administration based on their previous experience of the successful countermeasures from the government during the first wave. This tendency also provides empirical evidence for our statement that the positive public evaluation of the government's reactions against the COVID-19 is translated into the support for Moon when the issue of the COVID-19 is salient.

After the increase during the second mass infection at the end of August, the PAI continuously decreases. Although the third wave of mass infections occurs as winter approaches and the daily average of confirmed cases reaches 858 in December, the PAI only slightly rebounds. This unexpected tendency can be explained by the increased public fatigue related to the COVID-19. In other words, the tightening of quarantines and regulations has led to public opposition to the president, especially among citizens who have a strong antipathy to Moon's administration. The increase in the rate of the respondents strongly disapprove of Moon's performance during this period explains the
deepening political polarization among the public in Korea.

Next, to investigate when the public evaluation toward president Moon is more sensitive, we apply VAR models. First, a unit root test has been carried out for all variables using the Phillips-Perron (PP) test (Phillips and Perron 1988) and the KPSS test (Kwiatkowski et al. 1992). The results of unit root tests are provided in Table 1.8

<table>
<thead>
<tr>
<th>Variable</th>
<th>Phillips - Perron(PP) Test</th>
<th>KPSS Test</th>
</tr>
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<tr>
<td></td>
<td>Intercept</td>
<td>Intercept and Trend</td>
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<tr>
<td>Strongly Approve</td>
<td>-22.8764 ***</td>
<td>-32.5831 ***</td>
</tr>
<tr>
<td>Approve</td>
<td>-28.0620 ***</td>
<td>-31.9961 ***</td>
</tr>
<tr>
<td>Strongly Disapprove</td>
<td>-17.3731 ***</td>
<td>-17.5705 ***</td>
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<td>Disapprove</td>
<td>-37.4631 ***</td>
<td>-34.8681 ***</td>
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<tr>
<td>ΔPAI</td>
<td>-18.4134 ***</td>
<td>-18.8951 ***</td>
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<tr>
<td>COVID-19</td>
<td>-3.0098 **</td>
<td>-3.6613 **</td>
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</tbody>
</table>

Note: ΔPAI presents the log difference of President’s Approval Index. The critical values for PP test for the models with intercept only are -3.4497, -2.8700, and -2.5713 at 1%, 5% and 10% levels of significance respectively. The critical values with trend and intercept are -3.9858, -3.4233 and -3.1346 at 1%, 5% and 10% levels of significance respectively. The critical values for the KPSS test with intercept only are 0.7390 (1%), 0.4630 (5%) and 0.3470 (10%). The critical values with intercept and trend are 0.2160(1%), 0.1460 (5%) and 0.1190 (10%).

We employ the standard PP tests to confirm the null hypotheses of non-stationarity of approval ratings and the COVID-19. Also, we use the KPSS test to test the null of stationarity. Given the results from Table 1, the first differences of all the series are determined to be stationary.

Second, we estimate a VAR model to determine the optimal number of lags using Akaike Information Criteria (AIC), which identifies four lags as optimal.9 For the length of rolling windows in the daily data analysis, we use 60 days. For the length of the forecast period, 10 days are used.10

8 Before estimating VAR models, we conduct Jarque Bera test to check the normality. Please see Table A.1 in Appendix.
9 [VAR Lag Order Selection Criteria]

<table>
<thead>
<tr>
<th>Lag</th>
<th>AIC</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4*</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

10 We assess the autocorrelation of the residuals for the research via multivariate Portmanteau (Ljung-Box) test. The null hypothesis of the test is no autocorrelation. Table A.2 in Appendix reports the p-value and critical values for the Portmanteau tests for up to 7th-order serial correlation in the derived residuals $\hat{\mu} = [\hat{\mu}_1 \hat{\mu}_2]'$. Such results reveal no existence of serial correlation at the lag order $h = 1$ to 7.
Table 2 presents the spillover effect between the Approval Index and the COVID-19. According to Table 2, the shocks to the confirmed COVID-19 cases are responsible for 3.63 percent of the error variance in forecasting the 10-days-ahead Approval Index. The result of this spillover analysis confirms that the change in the number of confirmed COVID has a certain influence on the president's future approval rate, but in order to understand the dynamics of the change between the two variables, a more detailed analysis is needed by dividing the period. In Figure 1 above, we have confirmed that the potential impact of the COVID-19 on presidential approval ratings could vary somewhat over time. The approval rating continues to exceed 100 until the first half of 2020, and then plummets to less than 100 as the second half of 2020 begins in July. The large change in the presidential approval rating centered on this particular period led us to divide the period for the spillover analysis.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Approval Index</th>
<th>COVID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approval Index</td>
<td>96.37</td>
<td>3.63</td>
</tr>
<tr>
<td>COVID</td>
<td>4.40</td>
<td>95.60</td>
</tr>
</tbody>
</table>

Note: Table 2 provides the spillover results from VAR analysis by considering the study period.

In order to more closely examine the effect of the COVID confirmation on the presidential approval rating, we analyzed how the spillover changes during the entire study period, and the results are presented in Figure 2. Figure 2 shows the trend of spillover from March to December from the COVID-19 to the approval rating for President Moon. As expected, the spillover reveals a certain range of fluctuations during the period.

![Directional Spillover from COVID to PAI](image_url)

Note: The spillovers are from the COVID-19 to the Presidential Approval Index.
The spillover from the number of the COVID-19 confirmed cases to the approval index rises after the first wave of mass infection in the Daegu cluster. The directional spillover increases to more than 15 percent around July 1st, 2020, which means that 15 percent of the changes in Moon's approval index are largely explained by the newly confirmed cases. The spillover keeps the decreasing trend with some fluctuations until the second wave of mass infection in Seoul.

However, after facing the second wave in connection with conservative churchgoers and an anti-government rally, the spillover from the COVID-19 to the PAI gradually rises. From mid-September to early November, the PAI presented in Figure 1 decreases as the impact of the second mass infection fades and the spillover from COVID to approval index shows a general decline the early November. The spillover index decreases below 10 percent since November. During the period of high spillover, such as the two peaks in October, the PAI also increases.

At the beginning of the third wave in early November, the spillover starts to increase. However, compared to the spillover during the first and the second waves of mass infections, that is, as the coronavirus pandemic lasted for a year, life with infectious diseases became a part of normal life, thus the COVID-19 issue was no longer an important measure to evaluate the president's leadership and behavior.

As a sensitivity check of the spillovers, we also analyze the directional spillover for orders 4 to 6 and provide the plot of the minimum, the maximum, and the median (black solid line) spillovers shown in Figure A.1 in Appendix. In addition, we also consider the directional spillover index for forecast horizons from 8 to 10 days to check the sensitivity with minimum, maximum, and median values in Figure A.2 in Appendix. Based on both figures in the Appendix, we demonstrate that the directional spillover is not sensitive to the choice of order of vector autoregressions or the selected forecast horizons. Even when we replicate our analysis with presidential disapproval ratings instead of the PAI, we find similar patterns of the spillovers (See Table A.3 and Figure A.3 in Appendix).

Taken together, our study shows that the positive evaluation of the governmental responses toward the COVID-19 is reflected in the presidential approval ratings when the issue of the COVID-19 is salient, which is consistent with the theories about the relationship among presidential approval, issue salience, and policy performance. Furthermore, we find that the evaluation toward the president's leadership is more sensitive to the changes in the number of newly confirmed COVID-19 cases during the first and the second waves of the mass infections. Even though this finding does not meet our expectation that the association between the number of confirmed cases and Moon's approval is relatively stronger in the second and the third waves, it shows that the positive public evaluation
on the government response toward the COVID-19 does not have the same effect on the presidential approval rates, but is contingent on the people's increased fatigue about the COVID-19.

V. Conclusion and Discussion

The COVID-19 pandemic threatens the quality of people's lives. It has been revealed that the COVID-19 pandemic is closely associated with the increased rate of anxiety, depressive symptoms, and suicide among people (Gunnell et al. 2020; Cullen et al. 2020). In addition, the COVID-19 has negatively impacted social and economic areas. For instance, regardless of the differences in severity of the COVID-19 among individual countries, the risk of job loss has increased dramatically since the outbreak of the COVID-19, and the danger of mass infections has led to the closures of schools and daycare centers (Walger et al. 2020; Dang and Nguyen 2020).

With the global consensus on the severity of the COVID-19, some studies have demonstrated the association between the COVID-19 and a series of political indicators including political partisanship (Grossman et al. 2020), political decision effectiveness (Pierron et al. 2020), public trust (Painter and Qiu 2020), and government responses (Hale et al. 2020). While these studies have improved our understandings of the effects of the COVID-19 on political areas, the studies aiming to unveil how the COVID-19 affects presidential approval, one of the most important political indicators, are surprisingly underdeveloped.

Through the case study of South Korea, known for its successful countermeasures against the COVID-19, the empirical results from our study demonstrate that Moon's approval rate tends to increase during and after the three waves of mass infections in South Korea despite the extension of the strong social distancing measures and the possibility of enacting the unpopular lockdown measures upon waves. Also, we show that the impacts of the changes in the number of the COVID-19 confirmed cases on Moon's approval rate change over time by applying a VAR model, which is consistent in the different choice of order of vector regressions and the selected forecast horizons. With these findings, this article contributes to the COVID-19 literature by showing that the increase in the confirmed cases is not automatically translated into the decrease in presidential approval ratings, but the positive public evaluation of the governmental countermeasures against the COVID-19 can lead the public supports for presidents during the waves of mass infections. Also, we contribute to the literature of presidential
approval by providing robust empirical evidence that the translation of the positive public evaluations on policy performance from presidents into the presidential approval ratings is conditioned on the saliency of the policy.

It should be noted that, however, our empirical analysis on the impact of the COVID-19 on the presidential approval rate is not free from the innate limitation of the case study approach. As Lijphart (1971) mentioned, the use of the case study method without the combination of comparative or cross-national approaches does not guarantee the generalizability of the findings. Even though South Korea's case enables us to deeply examine the relationship among policy performance, issue salience, and presidential approval, we cannot assure that whether and how the government's performance concerning the COVID-19 is associated with the approval ratings in other countries' contexts. Thus, replicating our study with cross-national or comparative approaches is a natural extension. Also, examining the conditional relationship between the public's policy performance evaluation about the countermeasures from governments and other socio-economic factors will be promising.
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Appendix

Table A.1. Jarque Bera Test

<table>
<thead>
<tr>
<th></th>
<th>ΔPAI</th>
<th>ΔSr Approval</th>
<th>ΔApproval</th>
<th>ΔSr Disapprove</th>
<th>ΔΔdisapprove</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID19</td>
<td>1193.792***</td>
<td>28.442***</td>
<td>4.867*</td>
<td>30.861***</td>
<td>69.452***</td>
</tr>
</tbody>
</table>

Note: *** and * indicate the level of significance at 1% and 10%, respectively.

Given the Jarque-Bera tests shown in the Table A.1, we reject the null hypothesis that the distribution of the variable is normal. This indicates that using the Vector Autoregressive model is appropriate, rather than focusing solely on the conditional mean. Shi and Liu (2020) demonstrate the rejection of the hypothesis of normality indicates that using the VAR structure is more appropriate rather than focusing on the conditional mean only.

Table A.2. Portmanteau (Ljung-Box) Test

<table>
<thead>
<tr>
<th>lag (h)</th>
<th>p-value</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.5279</td>
<td>9.4877</td>
</tr>
<tr>
<td>2</td>
<td>0.8962</td>
<td>15.5073</td>
</tr>
<tr>
<td>3</td>
<td>0.9217</td>
<td>21.0261</td>
</tr>
<tr>
<td>4</td>
<td>0.9263</td>
<td>26.2962</td>
</tr>
<tr>
<td>5</td>
<td>0.9363</td>
<td>31.4104</td>
</tr>
<tr>
<td>6</td>
<td>0.9721</td>
<td>36.4150</td>
</tr>
<tr>
<td>7</td>
<td>0.2991</td>
<td>46.1943</td>
</tr>
</tbody>
</table>

Note: Figure A.1. indicates the directional spillover index to VAR orders 4-6. The black line presents the median values and grey shaded areas signifies the difference between maximum and minimum.

Figure A.1. Directional Spillover Index to VAR lag structures
To confirm robustness of our empirical findings, we analyze the directional spillover index using disapproval rating. For disapproval rating, we combine "strongly disapprove" and "somewhat disapprove" responses in presidential approval surveys.

Table A.3 provides the results from directional spillover between Disapproval and COVID-19. The shocks to the confirmed COVID-19 cases are responsible for 5.66 percent of the error variance in forecasting the 10-days-ahead ahead. This effect is similar to the magnitude of the spillover between API and COVID-19, which is 3.63 percent of the error variance in the manuscript.
The above figure indicates the trend of directional spillover effect of the COVID-19 on disapproval. Three notable high spillover spikes are observed during the study period. The first peak is appeared on July 1st, which is appeared to be similar to that of Figure 4 in the main manuscript. The second and third peaks are observed in October and December, respectively. The second peak is also appeared in the directional spillover index presented in Figure 4 in the manuscript. Even though the third peak shows a different pattern from that used by PAI in the main manuscript, the spillover effect of COVID-19 on disapproval deceases more steeply with few rebounds.