COVID-19 and Government Responses^{*}

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Abstract

The coronavirus disease (COVID-19), the worst pandemic since the Spanish flu, has spread rapidly across the world. This study investigates this pandemic from the perspective of government responses. The analyses are not limited to the effect of non-pharmaceutical interventions (NPIs) on deaths, but also cover the effect of confirmed COVID-19 cases and deaths on NPIs using daily cross-national data. This paper also shows the precise timing in which NPIs have a reduced effect on deaths. The results indicate that confirmed cases are more positively correlated with NPIs than deaths, and NPIs show a strong positive correlation with deaths in the short run and a negative correlation in the long run. The turnaround time is about 25 days. This means that NPIs take about one month to reduce the number of deaths.

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Introduction

The coronavirus disease (COVID-19), the worst pandemic since the Spanish flu, has spread rapidly across the world. Initially, China reported many deaths but after a short time, European and North and South American countries became the major battlefields of COVID-19 infections. Scholars have debated the factors behind this huge difference between these countries. This study investigates this pandemic from the perspective of government responses and analyzes the relationship between confirmed COVID-19 cases or deaths and government responses.

Using daily cross-national data, scholars have reported that governments' strict measures to prevent the spread of pandemics, called non-pharmaceutical interventions (NPIs), can effectively reduce the growth rate of confirmed COVID-19 cases and deaths (Hsiang et al. 2020; Dergiades et al. 2020; Hale et al. 2020c)¹. Case studies in China also reached a similar conclusion, that the lockdown of the city of Wuhan effectively prevented the disease from spreading throughout the country (Fang et al. 2020; Lai et al. 2020; Wang et al. 2020). A study in Scandinavian countries reported that stricter lockdown policies are associated with fewer COVID-19 deaths (Conyon et al. 2020). Other studies in the United States also argued that the social distancing ordered by the

¹ One of them reveals that the effectiveness of lockdown policies is conditioned by a country's socio-economic and demographic factors (Castex et al. 2020).

government lowered the growth rate of confirmed COVID-19 cases and deaths (Courtemanche et al. 2020; Lyu et al. 2020)².

Most aforementioned studies reported the reduction effect of NPIs on confirmed COVID-19 cases and deaths. However, the causality between these variables was not necessarily taken into consideration. The government usually takes strong measures after confirmed cases start to increase. This response is likely to affect the numbers of confirmed cases and deaths. If the causal direction between confirmed cases or deaths from COVID-19 and government response is disregarded, the effects of NPIs on confirmed cases and deaths may be inaccurately estimated. For example, Hale et al. (2020c) provided one of the most comprehensive studies using cross-national data of 170 countries. However, the authors only considered the effect of NPIs on the number of deaths from COVID-19. On the other hand, the current study considers bidirectional causality to understand the dynamic relationship between the variables.

Figure 1 shows the trends of the confirmed cases, deaths, and NPIs in Japan, which have puzzled Western countries because of the success in preventing the disease from spreading throughout the country. Figure 1 helps us understand the causality. In the

² A historical study on Spanish flu in the United States also shows the stringent non-pharmaceutical interventions was able to reduce disease transmission without a lasting economic damage (Correia et al. 2020).

beginning, COVID-19 cases were reported, and NPIs were conducted by the Japanese government immediately after reporting. After sometime, deaths from the disease began to be reported. This clearly suggests that the government took measures to combat the pandemic, paying special attention to confirmed cases. However, once confirmed cases increase, successive deaths cannot be avoided. Thus, COVID-19 deaths would naturally increase even after the government takes measures, irrespective of whether they are smoothly and successfully introduced. This may lead to spurious correlations between NPIs and COVID-19 deaths, even if there may not have a direct relationship. It is for this reason that this study takes into account this potential problem in the analysis.

Figure 1. Trends in the number of confirmed COVID-19 cases and deaths and NPIs

Statistical Analysis

The effect of confirmed COVID-19 cases and deaths on NPIs

First, this study analyzes the effect of confirmed COVID-19 cases and deaths on NPIs using Ordinary Least Squares (OLS) regression. The number of confirmed COVID-19 cases and deaths are obtained from the Center for Systems Science and Engineering at Johns Hopkins University³. Hale et al. (2020c) operationalizes government NPIs by

³ COVID-19 Data Repository by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Available at <https://github.com/CSSEGISandD>

creating NPI scores. They measure a composite Stringency Index (SI). It is composed of nine relevant policy response indicators each of which range from 0-100. It averages these nine scores (Hale et al. 2020c: 6). The data is extracted from Hale et al.'s (2020c) study, on which Hale et al.'s (2020a) research is based⁴. The data cover 151 countries in which at least one death was reported between January 22, 2020 and July 9, 2020. The first analysis uses NPIs as the dependent variable and confirmed cases and deaths as the independent variables. The independent variables are transformed into a five-day moving average⁵. This study takes the first difference in logs of the confirmed cases and deaths to capture the growth rate of infections based on Hsiang et al. (2020) and Hale et al. (2020c) and the first difference of the NPIs. The number of days since the first confirmed case was reported in a country is included in the analysis to control for the linear time trend. The study takes lags from day 0 to -70, with five-day intervals of the independent variable to consider the lagged effects of the variable⁶.

Figure 2 indicates the effects of confirmed cases and deaths on NPIs from day 0 to

ata/COVID-19, accessed on July 17, 2020.

⁴ Hale et al. (2020a) Oxford COVID-19 Government Response Tracker, Blavatnik School of Government. Data use policy: Creative Commons Attribution CC BY standard. Available at <https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker#data>, accessed on July 17, 2020.

⁵ The inclusion or exclusion of the moving average does not affect the results much.

⁶ The study runs regressions 15 times according to different lags and does not include all the lagged independent variables at one regression. But the results do not significantly change if all the lagged independent variables are included in one regression.

day -70. The same color indicates that the same days lagged two independent variables.

Figure 2 shows confirmed cases (the right bars of the pair variables) are consistently more likely to affect NPIs than deaths (the left bars of the pair variables). The result implies that the government usually takes measures to stop pandemic and pays special attention to confirmed cases before reported deaths start to increase. This result is highly intuitive. The bar on the extreme right (0 confirmed) shows that many countries respond immediately after confirmed cases increase (see Figure 2). This positive relationship at the time between confirmed cases and NPIs, however, seems too strong. This may be because the government sometimes predicts the upsurge of cases in the near future and takes preventive measures beforehand. Even if the estimation result in Figure 2 captures this exaggerated effect, it does not matter for the relatively stronger effect of confirmed cases on NPIs than deaths.

Figure 2. The effect of confirmed COVID-19 cases and deaths on NPIs

The effect of NPIs on COVID-19 deaths

The study further analyzes the effect of NPIs on COVID-19 deaths. The regression models are basically the same as in the above analysis. The following are just Slightly different points: In this analysis (see Figure 3), the study calculates deaths from COVID-19 per 100,000 people to estimate the real effect⁷. The confirmed cases are excluded from

⁷ Population data are obtained from World Development Indicators. Available at <https://databank.worldbank.org/source/world-development-indicators> accessed on July 20, 2020.

the analysis. Figure 3 shows the regression results.

Figure 3. The effect of NPIs on COVID-19 deaths per 100,000 people

Figure 3 illustrates a strong positive correlation between NPIs and deaths in the short run (15 days before). However, the positive sign of the coefficient suddenly changes in the other direction. After 25 days, the two variables were negatively correlated. At first glance, the results seem quite odd because NPIs have an increasing effect on COVID-19 deaths. Here, refer to Figure 1 for the Japanese case, which may be helpful in resolving

this discrepancy. The Japanese government took measures to combat the pandemic immediately after COVID-19 cases began to be reported. However, regardless of whether the government took immediate appropriate measures, the number of deaths without a “silver bullet” or vaccine inevitably increased once confirmed cases began to rise. The strong positive effect in the short run within 20 days is likely to capture spurious correlations, as mentioned above⁸. NPIs taken more 20 days before can have a reducing effect on the number of deaths. This means that NPIs take about one month to reduce the number of deaths.

This finding is consistent with Hale et al.’s (2020c), who took six-week lags of the NPI variable rather arbitrarily and reported that NPIs reduce COVID-19 deaths. However, their study analyzed the effect of NPIs on COVID-19 deaths and took the pinpoint lag only. On the other hand, this study explores the effects of confirmed COVID-19 cases and deaths on NPIs and of NPIs on deaths. This study also takes different lags to obtain a comprehensive understanding of the relationship between the variables. These two points are the main contributions of this study to past research.

⁸ NPIs are such stringent measures. The idea may not be totally rejected that NPIs confuse the society, which lead to the growing number of deaths.

Conclusion

This study explores the relationship between confirmed COVID-19 cases and deaths and government measures to combat the pandemic. The analyses are not limited to the effect of NPIs on deaths, but also cover the effect of confirmed COVID-19 cases and deaths on NPIs using daily cross-national data. This paper also shows the precise timing in which NPIs have a reduced effect on deaths. The results indicate that confirmed cases are more positively related to NPIs than deaths, and NPIs have a strong positive correlation with deaths in the short run and a negative correlation in the long run. The turning point is about 25 days. This means that NPIs take about one month to reduce the number of deaths. To the best of our knowledge, this study is the first to report such findings.

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