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Stringent government policies are associated with a lower COVID-19 spread rate

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Abstract

The outbreak of COVID-19 has prompted a wide range of policy responses from governments around the world. In this study, we investigate the effect of governmental policies on the spread of the COVID-19 in a cross-country setting using the Oxford COVID-19 Government Response Stringency Index. We find that stringent government policies overall, and the following policies in particular, are associated with a lower spread rate of COVID-19 cases: workplace closing, restrictions on gatherings, close of public transport, stay-at-home order, restrictions on internal movement, and international travel controls; while school closing and public events cancellation are not associated with a lower COVID-19 spread. After including all policies into one single regression and examining their associations simultaneously with the virus spread, we find that the two policies stand out and remain to have a negative association with the COVID-19 spread: close of public transport and restrictions on international travel. Finally, we show that when countries are more oriented toward a tight culture, their governmental strict policies effect on the spread of COVID-19 becomes 1.5 – 3 times stronger than countries more toward a loose culture. Our findings suggest that the governments need to carefully implement policies to cope with the COVID-19 spread in their own social and cultural context.

“...the UK government should promote a sense of collectivism: All messaging should reinforce a sense of community, that ‘we are all in this together.’” – The Scientific Advisory Group for Emergencies (SAGE) of the United Kingdom¹

SARS-CoV-2, the coronavirus strain responsible for COVID-19, the infectious respiratory disease initially discovered in Wuhan, China in December 2019, has spread rapidly across the world. As of September 25, 2020, COVID-19 has been responsible for more than 22.4 million cases and a total of 786,664 deaths worldwide². Its outbreak has prompted a wide range of responses from governments around the world, including closure and containment policies such as school and workplace closings, travel restrictions, and stay-at-home orders to try to break the chain of infection³. It is reported that some countries (i.e., South Korea, Japan, and Singapore) are effective in lowering the spread of the disease and reducing deaths^{4,5} while some other countries have been badly hit and witnessed a rampant spread of the virus^{6,7}. Given the vast difference in the spread and prevalence of COVID-19 among countries and regions across the world⁸, a couple of natural questions to ask are: what are the important factors associated with COVID-19 spread? Can government response policies effectively slow down the spread of the virus?

A number of scientific studies have investigated various factors, including social factors such as travel quarantine and international travel restrictions⁹, face mask wearing¹⁰, and intervention of quarantining and workplace distancing¹¹ and environment factors such as temperature, humidity, wind speed, and pollutions^{12,13}. However, there is not much research focusing on the different governmental policy responses that influence the COVID-19 spread. Government responses to COVID-19 pandemic vary dramatically from one country to another, from China’s full-scale lockdown of Wuhan to Sweden’s “never-went-into-lockdown”, and from South Korea’s centralized control and communication⁴ to UK’s “based on the science”¹⁴. Like any policy interventions, the effect of these policy responses is highly contingent on local political and social context³. In this study, we seek to fill the void by analyzing the stringency of government policies on the effect of the spread of the COVID-19 in a cross-country setting.

We use the Oxford COVID-19 Government Response Stringency Index to measure the stringency level of various government policies in response to COVID-19 spread. The index consists of four types of governmental policies with a total of 17 indicators: (1) containment and closure policies, (2) economic policies, (3) health system policies, and (4) miscellaneous policies. In particular, containment and closure policies include eight indicators: school closing, workplace closing, cancel public events, restrictions on gathering, close public transport, stay at home order, restrictions on internal movement, and international travel controls. As governments are taking a wide range of measures in response to the COVID-19 outbreak, the index aims to track and compare policy responses around the world, rigorously and consistently^{3,15}. We collect daily COVID-19 cases data for 210 countries in the world from Our World in

Data website¹⁶. After excluding the data that have no new cases reported on certain days and that have missing control variables in the regression analysis (as specified below), we obtain a final sample of 6,684 observations for 210 countries with reported daily counts of COVID-19 cases from January 1, 2020 to May 22, 2020. Two key variables are (1) COVID-19 daily new case growth rate or *CASES_GROW*; and (2) government response stringency index or *STRINGENCY*. Considering the potential lagged effect of the government policies on the new case growth, we also use a 1-14 day lagged index for the robustness check¹⁷. Supplementary materials summarize the definitions of main variables and reports the descriptive statistics of the main variables used in the study.

Results

Government stringent responses and COVID-19 spread

We conduct an ordinary least square (OLS) regression after controlling for country level and weekly fixed effect, whereas the standard errors are clustered at a country level. As reported in the supplementary materials, all four measures of government stringency indexes have a negative and significant coefficient across four specifications, indicating that strict government response policies are associated with a slow spread rate of COVID-19 cases. In particular, the coefficient of *STRINGENCY_INDEX* in Column (1) is negative and significant ($\beta = -0.0043$, $t = -3.22$) after controlling for several factors, implying that for one standard deviation increase of stringency index ($\sigma = 23.8832$, as reported in Table S2), the COVID-19 growth rate decreases by 10.2702%. Given the average daily new case is about 437.3359 in our sample (*reported in the supplementary materials*), this is equivalent to a reduction of 44.9134 new cases on a daily basis.

Containment and closure policies and COVID-19 spread

Our results so far are based on the board government response stringency index, which is constructed by four categories with 17 indicators. In this section, we regress the growth rate of COVID-19 cases against the eight indicators to examine which aspects of board stringency index matter the most for lower spread of COVID-19. The supplementary materials report the results. Of the eight indicators, we find that school closing and cancel public events have no significant effects on reducing COVID-19 spread; while the other six indicators, including workplace closing, restrictions on gatherings, close public transport, stay at home requirements, restrictions on internal movement, and international travel controls are significantly and negatively associated with the lower COVID-19 spread, as indicated by their negative and significant coefficients in Columns (2), and (4) – (8), respectively. In addition to their statistical significance, the economic significance of these indicators is sizable, as discussed in the supplementary materials.

We include all the eight indicators into a single regression in Column (9) and examine their effects simultaneously on the COVID-19 spread. Interestingly, we find that two indicators eventually dominate: close public transport and restrictions on international travel. These results indicate the critically important role of closing public transport and restricting international travel in slowing down the spread of COVID-19.

Cultural tightness vs. looseness, government responses, and COVID-19 spread

Cultural tightness-looseness, according to^{18, 19}, assesses how much a culture adheres to social norms and tolerates deviance. A tight culture is restrictive and takes strict disciplinary actions for the violation of norms, while a loose culture has relaxed social norms and high tolerance for deviant behaviors. As a tight culture tends to allow people to coordinate more effectively to survive threats and natural disasters^{18, 19} and is associated with increased government control and constraints in daily life²⁰, we expect the effect of government stringent policies on COVID-19 spread to be stronger in countries and regions that are more oriented toward cultural tightness.

We obtain the cultural tightness score for 33 countries from¹⁹ and merge the scores with the COVID-19 data. We use 35% and 60% quantile, corresponding to the tight score of 5.4 and 7, respectively as a cutoff to classify a country as tight- vs. loose-oriented. In particular, countries with a score equal to or less than 5.4 are classified as LOOSE group while countries with a score equal to or above 7 as TIGHT group²¹. We then conduct the original regression using these two subsamples, and report the results in the supplementary materials. The estimated coefficient of *STRINGENCY_INDEX* in the LOOSE subsample is -0.0038 ($t = -1.48$), and -0.0105 in the TIGHT subsample ($t = -2.95$). We obtain similar and consistent results when using other alternative measures of government stringent policy indexes, as shown in Columns (3) – (8). The differences in the coefficient magnitude is sizable – the coefficients of government stringency indexes in the TIGHT group are approximately 1.5 – 3 times those in the LOOSE group. The results show that when a country is more toward a tight culture, its governmental strict policies in response to the COVID-19 becomes 1.5 – 3 times effective in slowing down the spread of COVID-19 than a country more toward a loose culture²².

Discussion

Based on a sample of 6,684 observations for 210 countries with reported daily counts of COVID-19 cases from January 1, 2020 to May 22, 2020, we conduct ordinary least squares regression analysis of the association between government stringency index and the COVID-19 spread after controlling for country level and weekly fixed effect. We find that strict government response policies are associated with a slow spread rate of COVID-19 cases. In particular, for one standard deviation increase of stringency index, the COVID-19 growth rate decreases by 10.2702%. Given the average daily new case is

about 437.3359 in our sample, this is equivalent to a reduction of 44.9134 new cases on a daily basis. We obtain consistent results when using alternative measures of stringency index. Furthermore, considering the potential lagged effect of the government policies on the new case growth, we use a 1-14 day lagged index in the regression analysis. A negative association between the stringency index and COVID-19 growth rate remains to exist. Interestingly, we show that government response policies become the most effective in reducing the COVID-19 spread one week after these policies have been implemented. This finding appears to be consistent with the SARS-CoV-2 transmission pattern overall time course for the disease.

To shed more light on the effects of governmental policies on the COVID-19 spread, we regress the growth rate of COVID-19 cases against the eight indicators in index to examine which aspects of board stringency index matter the most for lower spread of COVID-19. Our regression analysis shows that among several government policies, workplace closing, restrictions on gatherings, close public transport, stay at home requirements, restrictions on internal movement and international travel controls are associated with a lower spread rate of COVID-19 cases; while school closing and cancel public events are not. After including all policies into one single regression and examining their effects simultaneously on the COVID-19 spread, we find that the two policies dominate and remain to have a negative association with the COVID-19 spread: close public transport and restrictions on international travel. These findings have important policies implications and indicate that to slow down the spread of COVID-10, the governments need to carefully consider their containment and closure policies.

Finally, we further our study by considering an important aspect of cultures: tightness-looseness on the association between government policy stringency and the spread of COVID-19. A country's culture is oriented toward tightness if it has many strong norms and low tolerance of deviant behaviors. In contrast, a country's culture is considered loose if it has weak social norms and high tolerance for deviant behavior^{18, 19}. The results show that when a country is more toward a tight culture, its governmental strict policies in response to the COVID-19 becomes 1.5 – 3 times effective in slowing down the spread of COVID-19 than a country more toward a loose culture.

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15. Refer to the Codebook for the Oxford Covid-19 Government Response Tracker for detailed information (<https://github.com/OxCGRT/covid-policy-tracker/blob/master/documentation/codebook.md#codebook-changelog>). The index should not be interpreted as measuring the appropriateness or effectiveness of a country's responses (Hale *et al.*, 2020).
16. According to Our World in Data website (<https://ourworldindata.org/>), the goal is to make the knowledge on the big problems accessible and understandable. The COVID-19 data can be downloaded from <https://github.com/owid/covid-19-data/tree/master/public/data>.
17. There may be a time lag between government policies and its effect on the growth rate of COVID-19 cases. That is, when a government adopts strict prevention and control measures to deal with COVID-19, it may take some time before the growth rate of new cases starts to decrease.
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21. The LOOSE group includes Australia, Brazil, Estonia, Greece, Hungary, Israel, Netherlands, Spain, Ukraine, New Zealand, United States. The TIGHT group includes China, Germany, India, Japan, Malaysia, Mexico, Norway, Pakistan, Portugal, Singapore, Turkey, South Korea.
22. Martin and Yoon (2020) report that South Korean was about twice as effective as the U.S. and U.K. at preventing infected individuals from spreading the disease to others, according to a recent report from a United Nations-affiliated research network.

Data availability

All the data are publicly available, as indicated by the websites from which we collected the data.

Code availability

All codes necessary to replicate the analyses and tables in this paper and the Supplementary Information are available from the authors. Stata (versions 15) was used for data analysis.

Author contributions J. Zhang and T. Zhang collected the COVID-19 data and cultural tightness scores, initiated the research idea, and wrote the manuscript; Z. Xiu, P. Feng, and J. Yin performed and reviewed the statistical analysis, and tabulated the results.

Competing interests The authors declare no competing interests

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [GovernmentStringencyMarch192021NatureScientificReportsSupplementary.pdf](#)