Global Mortality Benefits of COVID-19 Action

Yoo, Sunbin and Managi, Shusuke

Kyushu University

June 2020

Online at https://mpra.ub.uni-muenchen.de/102040/
MPRA Paper No. 102040, posted 09 Aug 2020 15:10 UTC
Global Mortality Benefits of COVID-19 Action

Sunbin Yoo†, Shunsuke Managi*†

Affiliations:
1 Urban Institute & School of Engineering, Kyushu University, Japan

*Correspondence to: Sunbin Yoo, yoo.sunbin.277@m.kyushu-u.ac.jp

† These authors contributed equally to this work.

Abstract: The rapid spread of COVID-19 motivated countries worldwide to mitigate mortality through actions including social distancing, home quarantine, school closures, and case isolation. We estimate the global mortality benefits of these actions. We use county-level data on COVID-19 from January 2020, project the number of mortalities until September 2020, and calculate the global mortality benefits using the age- and country-specific value of a statistical life (VSL). Implementing all four types of actions above would save approximately 40.76 trillion USD globally, with social distancing accounting for 55% of the benefits. The monetary benefit would be the largest in the US, Japan and China. Our findings indicate that global actions during COVID-19 have substantial economic benefits and must be implemented in response to COVID-19.

Key words: COVID-19; coronavirus; global mortality benefit; value of a statistical life; epidemic diseases

1. Introduction

1.1. Research Motivation

COVID-19 is a global pandemic that has resulted in 1,484,811 infected cases and 88,538 deaths as of April 9, 2020 (WHO), and researchers predict that global mortality will be massive, as in Ji et al. (2020) and Remuzzi et al. (2020). Countries worldwide have begun to implement actions to mitigate infections and deaths. These actions can be categorized into four types: social distancing, home quarantine, school closures, and case isolation.

However, whether these actions are effective in reducing the number of global cases and mortality remains unanswered, particularly from a global perspective. Investigating the global perspective is crucial, as it would enable countries to collaborate on the next pandemic, as mentioned in Chen (2020), Mendes (2020), Ceylan et al. (2020). In other words, questions remain regarding how these actions affect the total mortality damage of COVID-19 outside of China, the US, or the UK, which will be tremendous. Hence, to better design a set of policies that enables the reduction of cases and mortalities, this question must be addressed.

Thus, this study empirically examines the effectiveness of these actions for mitigating loss of mortality benefits, which is the monetized value of small changes in the number of mortalities aggregated to express the value related to one death in a population (Viscussi and Masterman, 2017). This is a crucial parameter for policy evaluation in the global context. We use county-level mortality data on COVID-19 from January 2020, project the number of mortalities until September 2020, and calculate the global mortality benefits, which is the monetized value of the decreased number of mortalities.
1.2. Theoretical Framework

Our study contributes to two strands of literature. First, it contributes by examining the global monetized benefits of mortality during the COVID-19 pandemic. Because maintaining the lowest mortality possible should be the highest priority for all governments regardless of borders, our results are essential as they provide evidence that global actions during epidemics are essential because they provide substantial economic benefits that enable countries to mitigate inevitable economic downturns. However, we also find that previous works evaluating these actions mainly focused on the US, UK, and China. For example, previous works mentioned that these actions were effective in China in containing the number of mortalities and infected cases, as in Anderson et al. (2020), and reduced peak healthcare demand by 2/3 in the US and UK, as in Ferguson et al. (2020), which could save 7.9 trillion USD in the US (Greenstone and Nigam, 2020). Furthermore, Kraemer et al. (2020) argued that these actions could substantially reduce the number of mortalities in Wuhan, China. Thus, we contribute by incorporating countries other than the US, UK, and China and by providing global estimates and implications. In this sense, our study is closely related to that of Mandel and Veetil (2020), which analyzes the impact of lockdown on the world economy.

Second, our result contributes by calculating the value of lives. Previous research considers diverse perspectives on the impact of COVID-19 in various sectors: (Wang, M., & Flessa, S. (2020). It computes the spread of the disease and simulates the effects of interventions on health using dynamic system models. Govindan et al. (2020) examine how COVID-19 can affect healthcare supply systems. Fernandes (2020) investigates how the global economy is affected by comparing economic conditions during SARS and the 2008-2009 financial crisis. Nakamura and Managi (2020) calculate the overall relative risk of the importation and exportation of COVID-19 from every airport to local municipalities around the world. While it is also essential to recognize the impacts of COVID-19 on diverse sectors, the disease ultimately and closely affects people’s lives. Thus, our essential contribution is that we offer an approach for computing quantitative estimates of the effects of various actions on the value of lives. Therefore, it is relatively easy to understand which actions are more effective in reducing the cases and mortalities.

The remainder of this paper is structured as follows. Section 1 provides background in terms of policy, and Section 2 presents the model and introduces the data used in this study. Section 3 shows the empirical results. Section 4 discusses practical implications, and Section 5 concludes.

2. Methodology

2.1. Scenario Settings

We establish two scenarios before computing the number of mortalities and the global mortality benefits. First, we establish a scenario involving the most aggressive form of social distancing, with all four additional actions included (social distancing, home quarantine, closure of schools, and case isolation), as the Action Scenario. We establish another scenario, the Nonaction Scenario, which does not include any of the actions included in the Action Scenario and depends on a form of “herd immunity.” The Nonaction Scenario does not mean that a country is not taking any actions to mitigate mortalities. Instead, it refers to a hypothetical situation in which countries are not implementing the four actions above.¹ We assume that all measures started in late March and that COVID-19 will persist until late September. Then, we compare the projected number of mortalities

¹ Of course, it is possible to include actions other than the four mentioned in Section 2.1. Nevertheless, if none of the four actions mentioned in Section 2.1. is included, we classify the scenario as a Nonaction Scenario.
and global mortality benefits of the two scenarios to draw implications on the monetized benefits of executing all four actions.

2.2. Empirical Analysis

Computing the global mortality benefits starts with projecting the global number of mortalities. To do so, we refer to the transmission model and health care demand from Ferguson et al. (2020) and Greenstone and Nigam (2020) using basic reproduction numbers with country-level data. We develop a model that predicts the daily number of infected cases and mortalities under simple assumptions. First, we assume that the number of infected cases and mortalities follows the normal distribution, which approximates the growth curves for the epidemic. The center or peak of the distribution, for instance, would correspond to the peak of the daily number of new infected cases. Then, we compute the number of mortalities based on the number of projected infected cases and the infection fatality ratio (IFR) from Verity et al. (2020) To acquire the number of mortalities based on age group, we adjust for the age distribution of each country, referring to World Bank data. We determine nine age groups and their distributions for each country, and we adopt the same distribution for the total number of mortalities. Using the number of mortalities, we calculate the reduction in mortality from the Nonaction Scenario to the Action Scenario and compute the global mortality benefit using age-varying and country-specific estimates of the value of a statistical life (VSL), referring to Greenstone and Nigam (2020), Viscusi and Masterman (2020), Jumbri et al. (2018), and Murphy and Topel (2006).2

Our model calculates direct deaths with a simple model structure instead of directly including intensive care unit (ICU) bed demand overflow. As a result of this simple structure and the many places that are currently replacing the ICU in practice globally, our model is applicable to discussions of important social aspects with a focus on the direct number of mortalities. Ferguson et al. (2020) and Greenstone and Nigam (2020) apply a more complex model by adopting the demand overflow of ICU beds, but this would require more assumptions, and the number of assumptions would increase if we broadened the research scope to include the entire world.

First, the demand for ICU beds is subject to change. For the Chinese data on ICUs, clinicians noted that only half of the patients seemed to need invasive mechanical ventilators; the others were given pressurized oxygen and may not have needed an ICU bed, as mentioned in Adam (2020). Furthermore, the demand for ICU beds is subject to change according to the efficiency of bed management in hospitals, as in Davie et al. (2005). Second, ICU beds are not available in low-income countries (i.e., Cambodia, Congo, Ethiopia, Kenya, Nepal, and Uganda). These low-income countries lack ICU beds, and more than 50% of these countries lack any published data on ICU capacity, as mentioned in (Murthy et al., 2015). Third, referring to Onuma et al. (2017), as the pandemic persists, countries increase their adaptation capability, which works globally to reduce adverse effects (i.e., mortalities) in general. Increased adaptation capability would reduce ICU bed demand, requiring more complex assumptions, whereas we focus on implications in the simple but global context. Therefore, in this study, we focus on the number of direct deaths and discuss global implications.

3. Results

2 Greenstone’s mortality benefit for the US is 7.9 trillion USD using US VSL; our estimates produce a mortality benefit of 7.22 trillion USD after adopting international VSL.
Our calculated global mortality benefit shows that adopting the most aggressive form of action would save approximately USD 40.76 trillion globally. Considering that the global GDP in 2018 was approximately 85.91 trillion USD (World Bank), our results show a savings of approximately 47.44% of the GDP as a result of taking action. This result indicates that world populations are willing to pay USD 40.76 trillion for mortality risk reductions. Our results also show that social distancing has the most substantial effects of saving USD 14.79 trillion for mortality risk reductions, which is 17.22% of the global GDP.

Panel (A)

Figure 1 Panel (A): Global Distribution of Global Mortality Benefits (in Trillion USD) A higher number (blue color) indicates that the benefits of actions (case isolation, home quarantine, school closure and social distancing) are high. Lower values (green colors) suggest that the estimated mortality benefit is lower. Panel (B): GDP Loss after COVID-19 in the Nonaction Scenario (%). A higher number indicates that the GDP loss is high. Lower values suggest that the estimated GDP loss is low.

Panel (A) in Figure 1 shows the global distribution of global mortality benefits through a map. Our estimates suggest that the US would share the most benefit, approximately 17.71%, at the continent level. At the country level, Japan and China would benefit the most, as they share 12.64% and
11.96%, respectively, of the benefits of avoided damages worldwide. European countries also receive a large portion of the benefits: Germany has the highest savings, with 7.92%, followed by France (5.20%), the UK (5.00%), and Italy (4.37%). On the other hand, countries with the least benefits are mainly those on the African continent, for example, Gambia, Central African Republic, and Rwanda. Panel (B) in Figure 1 indicates the global distribution of GDP loss due to nonaction. We calculate the GDP loss by calculating the global mortality benefit before the COVID-19 outbreak and then subtract it from the global mortality benefit after the COVID-19 outbreak. Then, we divide the difference between the two by the GDP. In Panel (A), our results indicate that the global average of GDP loss would be 35.61%. Global loss due to nonaction was highest in Japan and European countries and low in African countries. One interesting finding here is that, while the US shows a relatively high global mortality benefit in Panel (A), our estimates suggest that the GDP loss after COVID-19 in the US would also be substantial (34.61%).

Figure 2 shows the distribution of global mortality benefits by action. Among all types of actions, social distancing has the most significant benefits. Social distancing accounts for 55% of the benefit (USD 14.71 trillion), followed by home quarantine, school closures, and case isolation, which account for 23% (USD 6.08 trillion), 21% (USD 5.59 trillion), and 2% (USD 0.49 trillion), respectively. Our findings are consistent with Ferguson and Greenstone, who show that the benefits of social distancing are substantial. However, this is not to say that other actions are a futile endeavor; given a choice between nonaction and action, countries worldwide would prefer to take action. Therefore, there is still a need to promote actions that yield lower benefits than social distancing.
Figures 3, 4, and 5 show the portion of global benefits for national GDP by country and scenario, expressed in maps; the projected number of mortalities by country and scenario; and the GDP loss of action scenarios, respectively. Panel (A) shows the result of Action Scenario 1, which includes case isolation, home quarantine, and social distancing; Panel (B) displays the result of Action Scenario 2, which includes school closure, case isolation, and social distancing; Panel (C) presents the result of Action Scenario 3, which includes case isolation, school closure, home quarantine, and social distancing. We further provide the specific rankings for each figure in Appendix Tables A1, A2 and A3.

Regarding age group, the 60- to 69-year-old age group would experience the most benefits, at 21.70%; the 50- to 59-year age group would experience 7.42%; and 40- to 49-year-olds would experience 1.92%. This result shows that the number of cases, the number of deaths and the willingness to pay to reduce risk to life are higher for the 60- to 69-year-old age group than for the other age groups.
Figure 3 The Portion of Global Benefits for National GDP by Country and Scenario, Expressed in Maps.
Figure 4 The Projected Number of Mortalities by Country and Scenario, Expressed in Maps (Projected until Late September).
4. Discussion

The estimates for each country are worth highlighting. First, we find that the overall benefits are focused on developed countries. The top 10 countries with the greatest benefits include the US,
Japan, China, Germany, France, and the UK. The total global mortality of the top 3 countries (the US, Japan, and China) would be 16.78 trillion USD, which is more than 40% of the total global mortality benefits and accounts for approximately 20% of the global GDP for 2018. Such vast benefits cannot be easily derived from policy interventions, which implies that the economic benefits of taking actions are substantial. This result also suggests that the people in these three countries value their lives and are therefore willing to pay a large amount of money to reduce risks.

Second, the bottom ten countries with the least benefits include Gambia, the Central African Republic, Liberia, Rwanda, and Togo (all less than 1%), which are mainly situated on the African continent. This result is due to the small number of cases in Africa until late March. It is questionable whether African countries have fewer cases than Europe or Asia because African countries do not have the medical capability to count confirmed cases. Because of the high volume of air traffic and trade between China and Africa, Africa is at high risk for the introduction and spread of COVID-19, as mentioned in Nkengasong et al. (2020). Martinez-Alvarez et al. (2020) mentioned that once the first cases were confirmed in West Africa, the increase in the number of confirmed cases of COVID-19 was rapid. However, Wang et al. (2020) and Bukhari and Jameel (2020) argue that Africa should be safer from COVID-19 because its high temperature and humidity can reduce the number of cases. If the virus that causes COVID-2019 is weakened by warm temperatures, then the environmental factors of countries with high temperatures and humidity can maximize the benefits of social distancing and can further prevent cases and deaths. However, other strands of research, including Xie et al. (2020) and Breton (2020), argue that temperature is not correlated with the sensitivity of COVID-19.

From a policy perspective, it is necessary to keep the public informed of the benefits of actions in terms of reducing cases and mortalities and maximizing global economic benefits. Actions, including social distancing, home quarantine, school closure and case isolation, are vital not only for global mortality benefits but also for preventing mortality and GDP loss. In this case, to maximize the benefits and mitigate cases and deaths, raising awareness of social distancing is required. Because this is a benefit-of-life value, which is challenging to monetize, there is room for our estimates to be increased if pandemics persist and people place more importance on the value of a life over this time, as in Liu et al. (2005).

In this sense, our estimates are not overestimated; they are likely to represent the lower bound and leave room to increase because we did not consider additional benefits derived from social distancing. For example, Sen-Crowe et al. (2020) argue that social distancing can slow infection and can further reduce cases and improve the quality of medical care for non-COVID-19 symptoms. Our results are not limited to social distancing and highlight the importance of other measures. Measures such as school closure or home quarantine could be more feasible than social distancing measures, as in Fong et al. (2020). Pandemic plans need to consider how to facilitate such efforts because multiple actions would maximize the benefits and save more lives worldwide.

5. Conclusion

The COVID-19 outbreak indicates the need to evaluate the actions that governments worldwide are implementing to mitigate the number of mortalities and cases. The impact of these actions on the worldwide economy is estimated to be substantial. Our estimates suggest that at least 40.76 trillion USD can be saved globally. Economic loss due to reduced demand and supply as a result of COVID-19 has been discussed, but we show that reducing the loss of humans would be more significant because the total saved loss would be approximately 47.28% of the global annual GDP.
Social distancing accounts for more than half of the estimates and would save 14.49 trillion USD globally. This amount is larger than the Chinese GDP and equivalent to approximately 2/3 of the US GDP. Our results show that these actions can produce substantial benefits worldwide.

Unfortunately, predicting the global mortality benefits a few months after the outbreak of COVID-19 does include the problem of uncertainty. However, we believe this research will provide guidelines and insights for researchers and policymakers by providing humble policy advice. Estimating more robust estimates with more data and over a longer period would boost the numerical precision of this research and should be a focus of future research.

Appendix

In this section, we provide the results tables for Figures 3, 4 and 5.

Table A1.

Table A1. Portion of Global Benefits to National GDP by Country and Scenario. (A): A list of the countries included in this study (alphabetical order). (B-a): The portion of benefits to the national GDP by country for Action Scenario 1, which includes case isolation, home quarantine, and social distancing. (B-b): The portion of benefits to the national GDP by country for Action Scenario 2, which includes school closure, case isolation, and social distancing. (B-c): The portion of benefits to the national GDP by country for Action Scenario 3, which includes case isolation, school closure, home quarantine, and social distancing.

| (A) Countries      | (B) Benefits from Actions (% to National GDP) |
|--------------------|---------------------------------------------|
|                    | (B-a) Action Scenario 1 | (B-b) Action Scenario 2 | (B-c) Action Scenario 3 |
| Afghanistan        | 11.40%                       | 13.30%                       | 13.40%                       |
| Albania            | 38.10%                       | 44.20%                       | 44.80%                       |
| Algeria            | 27.20%                       | 31.60%                       | 32.00%                       |
| Angola             | 10.60%                       | 12.30%                       | 12.40%                       |
| Antigua and Barbuda| 27.90%                       | 32.40%                       | 32.80%                       |
| Argentina          | 39.20%                       | 45.50%                       | 46.00%                       |
| Armenia            | 37.60%                       | 43.60%                       | 44.20%                       |
| Australia          | 54.40%                       | 63.10%                       | 63.90%                       |
| Austria            | 58.40%                       | 67.80%                       | 68.60%                       |
| Azerbaijan         | 35.30%                       | 41.00%                       | 41.50%                       |
| Bahamas            | 17.10%                       | 19.90%                       | 20.10%                       |
| Bahrain            | 10.80%                       | 12.50%                       | 12.70%                       |
| Bangladesh         | 13.80%                       | 16.10%                       | 16.30%                       |
| Barbados           | 44.30%                       | 51.40%                       | 52.10%                       |
| Belarus            | 51.70%                       | 60.00%                       | 60.80%                       |
| Belgium            | 58.50%                       | 67.90%                       | 68.70%                       |
| Belize             | 16.40%                       | 19.10%                       | 19.30%                       |
| Benin              | 11.00%                       | 12.80%                       | 12.90%                       |
| Country                      | 2017  | 2018  | 2019  |
|------------------------------|-------|-------|-------|
| Bhutan                       | 15.90%| 18.50%| 18.70%|
| Bolivia                      | 21.30%| 24.70%| 25.00%|
| Bosnia and Herzegovina       | 42.60%| 49.50%| 50.10%|
| Brazil                       | 33.10%| 38.40%| 38.90%|
| Brunei Darussalam            | 24.20%| 28.10%| 28.50%|
| Bulgaria                     | 52.60%| 61.00%| 61.70%|
| Burkina Faso                 | 8.10% | 9.50% | 9.60% |
| Cambodia                     | 11.90%| 13.80%| 13.90%|
| Cameroon                     | 8.60% | 10.00%| 10.10%|
| Canada                       | 59.20%| 68.80%| 69.60%|
| Central African Republic     | 7.10% | 8.20% | 8.30% |
| Chad                         | 10.90%| 12.60%| 12.80%|
| Chile                        | 35.60%| 41.30%| 41.80%|
| China                        | 30.50%| 35.40%| 35.80%|
| Colombia                     | 32.50%| 37.70%| 38.20%|
| Congo                        | 12.50%| 14.50%| 14.70%|
| Costa Rica                   | 30.00%| 34.80%| 35.30%|
| Côte d’Ivoire                | 8.60% | 10.00%| 10.10%|
| Croatia                      | 56.80%| 66.00%| 66.80%|
| Cyprus                       | 56.90%| 66.10%| 66.90%|
| Czech Republic               | 47.30%| 54.90%| 55.60%|
| Democratic Republic of the Congo | 7.90% | 9.20% | 9.30% |
| Denmark                      | 59.90%| 69.50%| 70.40%|
| Dominican Republic           | 20.10%| 23.40%| 23.70%|
| Ecuador                      | 24.40%| 28.30%| 28.70%|
| Egypt                        | 24.10%| 28.00%| 28.30%|
| El Salvador                  | 27.90%| 32.30%| 32.70%|
| Equatorial Guinea            | 11.70%| 13.60%| 13.80%|
| Estonia                      | 51.00%| 59.20%| 60.00%|
| Ethiopia                     | 9.50% | 11.00%| 11.20%|
| Fiji                         | 15.40%| 17.90%| 18.10%|
| Finland                      | 64.10%| 74.40%| 75.30%|
| France                       | 64.90%| 75.40%| 76.30%|
| Gabon                        | 15.10%| 17.50%| 17.70%|
| Gambia                       | 6.00% | 7.00% | 7.10% |
| Georgia                      | 43.40%| 50.30%| 50.90%|
| Country       | 1960% | 1980% | 2000% |
|--------------|-------|-------|-------|
| Germany      | 69.60%| 80.80%| 81.80%|
| Ghana        | 8.20% | 9.50% | 9.60% |
| Greece       | 74.10%| 86.00%| 87.10%|
| Grenada      | 26.30%| 30.50%| 30.90%|
| Guatemala    | 13.80%| 16.00%| 16.20%|
| Guinea       | 5.50% | 6.40% | 6.50% |
| Guyana       | 20.20%| 23.50%| 23.80%|
| Haiti        | 16.50%| 19.20%| 19.40%|
| Honduras     | 16.20%| 18.80%| 19.00%|
| Hungary      | 48.70%| 56.50%| 57.20%|
| Iceland      | 33.40%| 38.80%| 39.30%|
| India        | 2.50% | 3.00% | 3.00% |
| Indonesia    | 19.70%| 22.80%| 23.10%|
| Iran         | 27.00%| 31.30%| 31.70%|
| Iraq         | 12.10%| 14.10%| 14.20%|
| Ireland      | 30.60%| 35.60%| 36.00%|
| Israel       | 33.40%| 38.80%| 39.30%|
| Italy        | 72.80%| 84.50%| 85.50%|
| Jamaica      | 29.20%| 33.80%| 34.30%|
| Japan        | 88.20%| 102.40%| 103.70%|
| Jordan       | 16.40%| 19.00%| 19.20%|
| Kazakhstan   | 31.50%| 36.60%| 37.10%|
| Kenya        | 7.70% | 8.90% | 9.00% |
| Kuwait       | 19.20%| 22.30%| 22.60%|
| Kyrgyzstan   | 16.30%| 18.90%| 19.10%|
| Laos         | 10.40%| 12.10%| 12.30%|
| Laos         | 55.20%| 64.00%| 64.80%|
| Lebanon      | 24.20%| 28.10%| 28.50%|
| Liberia      | 6.70% | 7.80% | 7.90% |
| Lithuania    | 52.60%| 61.00%| 61.80%|
| Luxembourg   | 31.80%| 36.90%| 37.40%|
| Madagascar   | 9.10% | 10.50%| 10.70%|
| Malaysia     | 22.70%| 26.30%| 26.60%|
| Maldives     | 9.80% | 11.40%| 11.60%|
| Mali         | 7.60% | 8.80% | 8.90% |
| Malta        | 53.00%| 61.50%| 62.20%|
| Country                        | 2010  | 2011  | 2012  |
|-------------------------------|-------|-------|-------|
| Mauritania                    | 13.70%| 15.90%| 16.10%|
| Mauritius                     | 34.70%| 40.20%| 40.70%|
| Mexico                        | 26.30%| 30.50%| 30.90%|
| Mongolia                      | 15.90%| 18.50%| 18.70%|
| Montenegro                    | 39.90%| 46.30%| 46.80%|
| Morocco                       | 23.60%| 27.50%| 27.80%|
| Mozambique                    | 12.10%| 14.10%| 14.20%|
| Myanmar                       | 18.80%| 21.80%| 22.10%|
| Namibia                       | 11.60%| 13.40%| 13.60%|
| Nepal                         | 13.70%| 15.90%| 16.10%|
| Netherlands                   | 58.00%| 67.30%| 68.10%|
| New Zealand                   | 49.60%| 57.60%| 58.30%|
| Nicaragua                     | 19.20%| 22.20%| 22.50%|
| Niger                         | 8.60% | 10.00%| 10.10%|
| Nigeria                       | 13.90%| 16.10%| 16.30%|
| Norway                        | 63.60%| 73.90%| 74.80%|
| Oman                          | 11.90%| 13.80%| 13.90%|
| Pakistan                      | 15.20%| 17.60%| 17.80%|
| Panama                        | 22.40%| 26.00%| 26.30%|
| Papua New Guinea              | 10.70%| 12.40%| 12.50%|
| Paraguay                      | 16.30%| 18.90%| 19.10%|
| Peru                          | 25.70%| 29.90%| 30.20%|
| Philippines                   | 22.10%| 25.60%| 25.90%|
| Poland                        | 50.70%| 58.80%| 59.50%|
| Portugal                      | 64.00%| 74.30%| 75.20%|
| Puerto Rico                   | 40.60%| 47.10%| 47.70%|
| Qatar                         | 12.50%| 14.50%| 14.60%|
| Republic of Korea             | 46.10%| 53.50%| 54.10%|
| Romania                       | 46.30%| 53.80%| 54.40%|
| Russian Federation            | 50.10%| 58.10%| 58.80%|
| Rwanda                        | 10.30%| 12.00%| 12.10%|
| Saint Lucia                   | 23.60%| 27.40%| 27.80%|
| Saint Vincent and the Grenadines| 29.50%| 34.30%| 34.70%|
| Saudi Arabia                  | 14.90%| 17.20%| 17.50%|
| Senegal                       | 7.10% | 8.30% | 8.40% |
| Serbia                        | 43.30%| 50.20%| 50.80%|
| Country         | (B-a) Nonaction | (B-b) Action Scenario 1 | (B-c) Action Scenario 2 | (B-d) Action Scenario 3 |
|-----------------|-----------------|-------------------------|-------------------------|-------------------------|
| Seychelles      | 26.20%          | 30.40%                  | 30.80%                  |                         |
| Singapore       | 34.80%          | 40.40%                  | 40.90%                  |                         |
| Slovakia        | 46.30%          | 53.70%                  | 54.40%                  |                         |
| Slovenia        | 55.30%          | 64.20%                  | 64.90%                  |                         |
| South Africa    | 18.10%          | 21.00%                  | 21.20%                  |                         |
| Spain           | 62.60%          | 72.60%                  | 73.50%                  |                         |
| Sri Lanka       | 32.80%          | 38.10%                  | 38.50%                  |                         |
| Sudan           | 25.50%          | 29.60%                  | 30.00%                  |                         |
| Suriname        | 37.40%          | 43.40%                  | 44.00%                  |                         |
| Sweden          | 67.70%          | 78.60%                  | 79.50%                  |                         |
| Switzerland     | 63.80%          | 74.10%                  | 75.00%                  |                         |
| Thailand        | 34.00%          | 39.50%                  | 40.00%                  |                         |
| Timor Leste     | 16.00%          | 18.60%                  | 18.80%                  |                         |
| Togo            | 8.50%           | 9.90%                   | 10.00%                  |                         |
| Trinidad and Tobago | 38.10%      | 44.30%                  | 44.80%                  |                         |
| Tunisia         | 34.50%          | 40.10%                  | 40.60%                  |                         |
| Turkey          | 31.80%          | 36.90%                  | 37.30%                  |                         |
| Uganda          | 8.40%           | 9.70%                   | 9.80%                   |                         |
| Ukraine         | 48.50%          | 56.30%                  | 57.00%                  |                         |
| United Arab Emirates | 9.50%    | 11.10%                  | 11.20%                  |                         |
| United Kingdom  | 60.70%          | 70.50%                  | 71.30%                  |                         |
| United States of America | 28.00% | 32.50%                  | 32.90%                  |                         |
| Uruguay         | 45.30%          | 52.60%                  | 53.20%                  |                         |
| Uzbekistan      | 25.50%          | 29.60%                  | 30.00%                  |                         |
| Vietnam         | 22.10%          | 25.60%                  | 25.90%                  |                         |
| Zambia          | 8.10%           | 9.40%                   | 9.50%                   |                         |
| Zimbabwe        | 4.40%           | 5.10%                   | 5.10%                   |                         |

**Table A2**

**Projected Number of Mortality by Country and Scenario (Projected until Late September).**

(A): A list of the countries included in this study (alphabetical order). (B-a): The number of projected mortalities in the Nonaction scenario until late September. (B-b): The number of projected mortalities in Action Scenario 1, which includes case isolation, school closure, and social distancing. (B-c): The number of projected mortalities in Action Scenario 2, which includes school closure, case isolation, and social distancing. (B-d): The number of projected mortalities in Action Scenario 3, which includes case isolation, school closure, home quarantine, and social distancing.
| Country                  | Land | Navy | Airforce | Total |
|-------------------------|------|------|----------|-------|
| Afghanistan             | 25,353 | 4,325 | 943 | 646   |
| Albania                 | 9,423 | 1,608 | 351 | 240   |
| Algeria                 | 67,963 | 11,595 | 2,528 | 1,732 |
| Angola                  | 18,650 | 3,182 | 694 | 475   |
| Antigua and Barbuda     | 238 | 41 | 9 | 6     |
| Argentina               | 114,454 | 19,526 | 4,258 | 2,917 |
| Armenia                 | 8,434 | 1,439 | 314 | 215   |
| Australia               | 90,968 | 15,519 | 3,384 | 2,319 |
| Austria                 | 39,271 | 6,700 | 1,461 | 1,001 |
| Azerbaijan              | 17,680 | 3,016 | 658 | 451   |
| Bahamas                 | 718 | 122 | 27 | 18    |
| Bahrain                 | 1,436 | 245 | 53 | 37    |
| Bangladesh              | 222,920 | 38,030 | 8,293 | 5,682 |
| Barbados                | 1,101 | 188 | 41 | 28    |
| Belarus                 | 33,471 | 5,710 | 1,245 | 853   |
| Belgium                 | 50,242 | 8,571 | 1,869 | 1,281 |
| Belize                  | 479 | 82 | 18 | 12    |
| Benin                   | 9,448 | 1,612 | 351 | 241   |
| Bhutan                  | 1,148 | 196 | 43 | 29    |
| Bolivia                 | 20,024 | 3,416 | 745 | 510   |
| Bosnia and Herzegovina  | 12,899 | 2,201 | 480 | 329   |
| Brazil                  | 446,933 | 76,247 | 16,626 | 11,392 |
| Brunei Darussalam       | 606 | 103 | 23 | 15    |
| Bulgaria                | 32,061 | 5,470 | 1,193 | 817   |
| Burkina Faso            | 12,577 | 2,146 | 468 | 321   |
| Cambodia                | 19,059 | 3,252 | 709 | 486   |
| Cameroon                | 17,617 | 3,006 | 655 | 449   |
| Canada                  | 149,584 | 25,519 | 5,565 | 3,813 |
| Central African Republic | 3,311 | 565 | 123 | 84    |
| Chad                    | 9,756 | 1,664 | 363 | 249   |
| Chile                   | 52,720 | 8,994 | 1,961 | 1,344 |
| China                   | 3,666,538 | 625,511 | 136,395 | 93,460 |
| Colombia                | 105,512 | 18,000 | 3,925 | 2,690 |
| Congo                   | 3,884 | 663 | 144 | 99    |
| Costa Rica              | 12,155 | 2,074 | 452 | 310   |
| Country                          | Code  | Population | GDP   | CPI   |
|---------------------------------|-------|------------|-------|-------|
| Côte d'Ivoire                   | 18,308| 3,123      | 681   | 467   |
| Croatia                         | 19,121| 3,262      | 711   | 487   |
| Cyprus                          | 3,830 | 653        | 142   | 98    |
| Czech Republic                  | 44,795| 7,642      | 1,666 | 1,142 |
| Democratic Republic of the Congo| 63,435| 10,822     | 2,360 | 1,617 |
| Denmark                         | 25,489| 4,348      | 948   | 650   |
| Dominican Republic              | 19,333| 3,298      | 719   | 493   |
| Ecuador                         | 30,740| 5,244      | 1,144 | 784   |
| Egypt                           | 126,645| 21,606     | 4,711 | 3,228 |
| El Salvador                     | 12,901| 2,201      | 480   | 329   |
| Equatorial Guinea               | 858   | 146        | 32    | 22    |
| Estonia                         | 5,984 | 1,021      | 223   | 153   |
| Ethiopia                        | 94,512| 16,124     | 3,516 | 2,409 |
| Fiji                            | 1,239 | 211        | 46    | 32    |
| Finland                         | 26,691| 4,554      | 993   | 680   |
| France                          | 311,641| 53,166     | 11,593| 7,944 |
| Gabon                           | 1,928 | 329        | 72    | 49    |
| Gambia                          | 1,493 | 255        | 56    | 38    |
| Georgia                         | 12,844| 2,191      | 478   | 327   |
| Germany                         | 419,026| 71,486     | 15,588| 10,681|
| Ghana                           | 25,223| 4,303      | 938   | 643   |
| Greece                          | 55,712| 9,504      | 2,072 | 1,420 |
| Grenada                         | 252   | 43         | 9     | 6     |
| Guatemala                       | 21,047| 3,591      | 783   | 536   |
| Guinea                          | 8,957 | 1,528      | 333   | 228   |
| Guyana                          | 1,342 | 229        | 50    | 34    |
| Haiti                           | 13,848| 2,362      | 515   | 353   |
| Honduras                        | 11,931| 2,035      | 444   | 304   |
| Hungary                         | 41,499| 7,080      | 1,544 | 1,058 |
| Iceland                         | 1,208 | 206        | 45    | 31    |
| India                           | 308,140| 52,569     | 11,463| 7,854 |
| Indonesia                       | 417,010| 71,142     | 15,513| 10,630|
| Iran                            | 132,261| 22,564     | 4,920 | 3,371 |
| Iraq                            | 32,632| 5,567      | 1,214 | 832   |
| Ireland                         | 15,618| 2,664      | 581   | 398   |
| Country         | Population | Malaria Cases | Malaria Deaths | Malaria Incidence |
|-----------------|------------|---------------|----------------|-------------------|
| Israel          | 24,261     | 4,139         | 903            | 618               |
| Italy           | 323,881    | 55,254        | 12,048         | 8,256             |
| Jamaica         | 6,354      | 1,084         | 236            | 162               |
| Japan           | 791,482    | 135,027       | 29,443         | 20,175            |
| Jordan          | 10,346     | 1,765         | 385            | 264               |
| Kazakhstan      | 34,781     | 5,934         | 1,294          | 887               |
| Kenya           | 35,100     | 5,988         | 1,306          | 895               |
| Kuwait          | 4,494      | 767           | 167            | 115               |
| Kyrgyzstan      | 7,902      | 1,348         | 294            | 201               |
| Laos            | 7,545      | 1,287         | 281            | 192               |
| Latvia          | 8,879      | 1,515         | 330            | 226               |
| Lebanon         | 12,464     | 2,126         | 464            | 318               |
| Liberia         | 4,050      | 691           | 151            | 103               |
| Lithuania       | 13,174     | 2,248         | 490            | 336               |
| Luxembourg      | 2,052      | 350           | 76             | 52                |
| Madagascar      | 21,000     | 3,583         | 781            | 535               |
| Malaysia        | 53,815     | 9,181         | 2,002          | 1,372             |
| Maldives        | 528        | 90            | 20             | 13                |
| Mali            | 11,902     | 2,030         | 443            | 303               |
| Malta           | 2,257      | 385           | 84             | 58                |
| Mauritania      | 3,665      | 625           | 136            | 93                |
| Mauritius       | 3,529      | 602           | 131            | 90                |
| Mexico          | 231,554    | 39,503        | 8,614          | 5,902             |
| Mongolia        | 3,763      | 642           | 140            | 96                |
| Montenegro      | 2,129      | 363           | 79             | 54                |
| Morocco         | 64,494     | 11,003        | 2,399          | 1,644             |
| Mozambique      | 20,997     | 3,582         | 781            | 535               |
| Myanmar         | 80,548     | 13,742        | 2,996          | 2,053             |
| Namibia         | 2,261      | 386           | 84             | 58                |
| Nepal           | 38,071     | 6,495         | 1,416          | 970               |
| Netherlands     | 75,977     | 12,962        | 2,826          | 1,937             |
| New Zealand     | 17,789     | 3,035         | 662            | 453               |
| Nicaragua       | 9,066      | 1,547         | 337            | 231               |
| Niger           | 14,348     | 2,448         | 534            | 366               |
| Nigeria         | 137,381    | 23,437        | 5,111          | 3,502             |
| Norway          | 20,650     | 3,523         | 768            | 526               |
| Country               | Number 1 | Number 2 | Number 3 | Number 4 |
|-----------------------|-----------|-----------|-----------|-----------|
| Oman                  | 3,890     | 664       | 145       | 99        |
| Pakistan              | 231,799   | 39,545    | 8,623     | 5,909     |
| Panama                | 8,577     | 1,463     | 319       | 219       |
| Papua New Guinea      | 7,845     | 1,338     | 292       | 200       |
| Paraguay              | 11,021    | 1,880     | 410       | 281       |
| Peru                  | 65,248    | 11,131    | 2,427     | 1,663     |
| Philippines           | 143,944   | 24,557    | 5,355     | 3,669     |
| Poland                | 155,862   | 26,590    | 5,798     | 3,973     |
| Portugal              | 52,588    | 8,972     | 1,956     | 1,340     |
| Puerto Rico           | 14,894    | 2,541     | 554       | 380       |
| Qatar                 | 1,988     | 339       | 74        | 51        |
| Republic of Korea     | 190,499   | 32,499    | 7,087     | 4,856     |
| Romania               | 81,846    | 13,963    | 3,045     | 2,086     |
| Russian Federation    | 507,695   | 86,613    | 18,886    | 12,941    |
| Rwanda                | 9,843     | 1,679     | 366       | 251       |
| Saint Lucia           | 433       | 74        | 16        | 11        |
| Saint Vincent and the Grenadines | 253 | 43 | 9 | 6 |
| Saudi Arabia          | 34,737    | 5,926     | 1,292     | 885       |
| Senegal               | 12,267    | 2,093     | 456       | 313       |
| Serbia                | 27,688    | 4,724     | 1,030     | 706       |
| Seychelles            | 198       | 34        | 7         | 5         |
| Singapore             | 17,034    | 2,906     | 634       | 434       |
| Slovakia              | 19,537    | 3,333     | 727       | 498       |
| Slovenia              | 9,427     | 1,608     | 351       | 240       |
| South Africa          | 76,677    | 13,081    | 2,852     | 1,954     |
| Spain                 | 218,112   | 37,210    | 8,114     | 5,560     |
| Sri Lanka             | 53,721    | 9,165     | 1,998     | 1,369     |
| Sudan                 | 37,994    | 6,482     | 1,413     | 968       |
| Suriname              | 1,005     | 172       | 37        | 26        |
| Sweden                | 45,528    | 7,767     | 1,694     | 1,161     |
| Switzerland           | 37,248    | 6,355     | 1,386     | 949       |
| Thailand              | 210,553   | 35,920    | 7,833     | 5,367     |
| Timor Leste           | 1,326     | 226       | 49        | 34        |
| Togo                  | 5,890     | 1,005     | 219       | 150       |
| Trinidad and Tobago   | 3,605     | 615       | 134       | 92        |
Tunisia & 24,208 & 4,130 & 901 & 617 \\
Turkey & 172,502 & 29,429 & 6,417 & 4,397 \\
Uganda & 23,034 & 3,930 & 857 & 587 \\
Ukraine & 168,541 & 28,753 & 6,270 & 4,296 \\
United Arab Emirates & 6,416 & 1,095 & 239 & 164 \\
United Kingdom & 279,866 & 47,745 & 10,411 & 7,134 \\
United States of America & 731,068 & 124,720 & 27,196 & 18,635 \\
Uruguay & 12,033 & 2,053 & 448 & 307 \\
Uzbekistan & 41,694 & 7,113 & 1,551 & 1,063 \\
Vietnam & 190,620 & 32,520 & 7,091 & 4,859 \\
Zambia & 10,107 & 1,724 & 376 & 258 \\
Zimbabwe & 11,004 & 1,877 & 409 & 280 \\

Table A3.

Table A3. GDP Loss of Action Scenarios by Countries and Scenarios Expressed in Table. (A): A list of countries included in this study (alphabetical order). (B-a): The GDP loss from the Nonaction Scenario. (B-b): The GDP loss of Action Scenario 1, which includes case isolation, home quarantine, and social distancing. (B-c): The GDP loss of Action Scenario 2, which includes school closure, case isolation, and social distancing. (B-d): the GDP loss of Action Scenario 3, which includes case isolation, school closure, home quarantine, and social distancing.

| (A) Countries       | (B) GDP Loss (% of National GDP) | (B-a) Nonaction | (B-b) Action Scenario 1 | (B-c) Action Scenario 2 | (B-d) Action Scenario 3 |
|---------------------|---------------------------------|-----------------|-------------------------|-------------------------|-------------------------|
| Afghanistan         | 13.787%                         | 2.350%          | 0.514%                  | 0.351%                  |
| Albania             | 45.936%                         | 7.836%          | 1.710%                  | 1.172%                  |
| Algeria             | 32.807%                         | 5.596%          | 1.220%                  | 0.836%                  |
| Angola              | 12.726%                         | 2.171%          | 0.473%                  | 0.325%                  |
| Antigua and Barbuda | 33.689%                         | 5.747%          | 1.252%                  | 0.859%                  |
| Argentina           | 47.221%                         | 8.056%          | 1.756%                  | 1.203%                  |
| Armenia             | 45.327%                         | 7.733%          | 1.687%                  | 1.156%                  |
| Australia           | 65.582%                         | 11.190%         | 2.441%                  | 1.672%                  |
| Austria             | 70.370%                         | 12.005%         | 2.618%                  | 1.794%                  |
| Azerbaijan          | 42.550%                         | 7.258%          | 1.583%                  | 1.084%                  |
| Bahamas             | 20.625%                         | 3.519%          | 0.768%                  | 0.526%                  |
| Bahrain             | 12.992%                         | 2.217%          | 0.483%                  | 0.331%                  |
| Bangladesh          | 16.690%                         | 2.846%          | 0.620%                  | 0.425%                  |
| Barbados            | 53.432%                         | 9.116%          | 1.987%                  | 1.361%                  |
| Belarus             | 62.342%                         | 10.635%         | 2.320%                  | 1.589%                  |
| Country                      | Population   | Public Admin | Private Admin | Revenue Admin | Other Dev |
|------------------------------|--------------|--------------|---------------|---------------|-----------|
| Belgium                      | 70.484%      | 12.024%      | 2.622%        | 1.797%        |
| Belize                       | 19.795%      | 3.377%       | 0.735%        | 0.503%        |
| Benin                        | 13.263%      | 2.262%       | 0.493%        | 0.338%        |
| Bhutan                       | 19.212%      | 3.277%       | 0.714%        | 0.489%        |
| Bolivia                      | 25.665%      | 4.379%       | 0.956%        | 0.654%        |
| Bosnia and Herzegovina       | 51.383%      | 8.767%       | 1.912%        | 1.309%        |
| Brazil                       | 40.658%      | 6.936%       | 1.512%        | 1.036%        |
| Brunei Darussalam            | 29.215%      | 4.984%       | 1.087%        | 0.744%        |
| Bulgaria                     | 63.361%      | 10.810%      | 2.358%        | 1.615%        |
| Burkina Faso                 | 9.825%       | 1.676%       | 0.365%        | 0.250%        |
| Cambodia                     | 14.306%      | 2.441%       | 0.532%        | 0.365%        |
| Cameroon                     | 10.368%      | 1.769%       | 0.385%        | 0.264%        |
| Canada                       | 71.421%      | 12.185%      | 2.658%        | 1.821%        |
| Central African Republic     | 8.527%       | 1.454%       | 0.317%        | 0.218%        |
| Chad                         | 13.113%      | 2.235%       | 0.486%        | 0.333%        |
| Chile                        | 42.898%      | 7.318%       | 1.595%        | 1.093%        |
| China                        | 36.763%      | 6.272%       | 1.368%        | 0.937%        |
| Colombia                     | 39.158%      | 6.679%       | 1.457%        | 0.998%        |
| Congo                        | 15.108%      | 2.577%       | 0.562%        | 0.386%        |
| Costa Rica                   | 36.178%      | 6.172%       | 1.345%        | 0.921%        |
| Côte d'Ivoire                | 10.415%      | 1.778%       | 0.388%        | 0.266%        |
| Croatia                      | 68.530%      | 11.691%      | 2.549%        | 1.747%        |
| Cyprus                       | 68.618%      | 11.708%      | 2.554%        | 1.751%        |
| Czech Republic               | 57.020%      | 9.728%       | 2.120%        | 1.453%        |
| Democratic Republic of the Congo | 9.564%    | 1.631%       | 0.356%        | 0.244%        |
| Denmark                      | 72.198%      | 12.318%      | 2.687%        | 1.841%        |
| Dominican Republic           | 24.286%      | 4.144%       | 0.904%        | 0.619%        |
| Ecuador                      | 29.427%      | 5.020%       | 1.094%        | 0.749%        |
| Egypt                        | 29.061%      | 4.958%       | 1.081%        | 0.740%        |
| El Salvador                  | 33.588%      | 5.732%       | 1.251%        | 0.858%        |
| Equatorial Guinea            | 14.132%      | 2.410%       | 0.525%        | 0.359%        |
| Estonia                      | 61.522%      | 10.496%      | 2.289%        | 1.568%        |
| Ethiopia                     | 11.452%      | 1.954%       | 0.426%        | 0.292%        |
| Fiji                         | 18.610%      | 3.175%       | 0.692%        | 0.474%        |
| Finland                      | 77.256%      | 13.179%      | 2.873%        | 1.969%        |
| Country       | Value 1   | Value 2   | Value 3   | Value 4   |
|--------------|-----------|-----------|-----------|-----------|
| France       | 78.273%   | 13.354%   | 2.911%    | 1.995%    |
| Gabon        | 18.150%   | 3.097%    | 0.676%    | 0.466%    |
| Gambia       | 7.245%    | 1.236%    | 0.270%    | 0.186%    |
| Georgia      | 52.269%   | 8.918%    | 1.945%    | 1.332%    |
| Germany      | 83.908%   | 14.314%   | 3.121%    | 2.138%    |
| Ghana        | 9.831%    | 1.678%    | 0.366%    | 0.252%    |
| Greece       | 89.341%   | 15.242%   | 3.324%    | 2.277%    |
| Gambia       | 31.663%   | 5.402%    | 1.178%    | 0.808%    |
| Guatemala    | 16.598%   | 2.832%    | 0.618%    | 0.423%    |
| Guinea       | 6.670%    | 1.138%    | 0.249%    | 0.170%    |
| Guyana       | 24.379%   | 4.159%    | 0.907%    | 0.622%    |
| Haiti        | 19.951%   | 3.402%    | 0.742%    | 0.509%    |
| Honduras     | 19.535%   | 3.333%    | 0.728%    | 0.499%    |
| Hungary      | 58.702%   | 10.015%   | 2.184%    | 1.496%    |
| Iceland      | 40.280%   | 6.872%    | 1.498%    | 1.027%    |
| India        | 3.127%    | 0.533%    | 0.117%    | 0.080%    |
| Indonesia    | 23.706%   | 4.044%    | 0.881%    | 0.603%    |
| Iran         | 32.534%   | 5.550%    | 1.211%    | 0.831%    |
| Iraq         | 14.598%   | 2.490%    | 0.544%    | 0.373%    |
| Ireland      | 36.949%   | 6.304%    | 1.374%    | 0.941%    |
| Israel       | 40.308%   | 6.877%    | 1.499%    | 1.028%    |
| Italy        | 87.745%   | 14.969%   | 3.263%    | 2.236%    |
| Jamaica      | 35.157%   | 5.998%    | 1.308%    | 0.896%    |
| Japan        | 106.392%  | 18.150%   | 3.957%    | 2.711%    |
| Jordan       | 19.748%   | 3.370%    | 0.734%    | 0.502%    |
| Kazakhstan   | 38.039%   | 6.490%    | 1.416%    | 0.970%    |
| Kenya        | 9.247%    | 1.578%    | 0.345%    | 0.237%    |
| Kuwait       | 23.190%   | 3.956%    | 0.862%    | 0.592%    |
| Kyrgyzstan   | 19.650%   | 3.352%    | 0.732%    | 0.500%    |
| Laos         | 12.584%   | 2.147%    | 0.469%    | 0.322%    |
| Latvia       | 66.508%   | 11.347%   | 2.475%    | 1.696%    |
| Lebanon      | 29.199%   | 4.982%    | 1.088%    | 0.745%    |
| Liberia      | 8.083%    | 1.379%    | 0.301%    | 0.206%    |
| Lithuania    | 63.380%   | 10.812%   | 2.357%    | 1.615%    |
| Luxembourg   | 38.362%   | 6.544%    | 1.426%    | 0.978%    |
| Madagascar   | 10.940%   | 1.866%    | 0.406%    | 0.280%    |
| Country               | %1  | %2  | %3  | %4  |
|-----------------------|-----|-----|-----|-----|
| Malaysia              | 27.315% | 4.659% | 1.015% | 0.695% |
| Maldives              | 11.872% | 2.026% | 0.442% | 0.303% |
| Mali                  | 9.117% | 1.556% | 0.339% | 0.232% |
| Malta                 | 63.846% | 10.893% | 2.376% | 1.628% |
| Mauritania            | 16.562% | 2.825% | 0.616% | 0.423% |
| Mauritius             | 41.780% | 7.127% | 1.554% | 1.065% |
| Mexico                | 31.717% | 5.411% | 1.181% | 0.809% |
| Mongolia              | 19.201% | 3.275% | 0.716% | 0.490% |
| Montenegro            | 48.062% | 8.199% | 1.788% | 1.225% |
| Morocco               | 28.514% | 4.864% | 1.060% | 0.728% |
| Mozambique            | 14.593% | 2.489% | 0.542% | 0.370% |
| Myanmar               | 22.639% | 3.863% | 0.843% | 0.579% |
| Namibia               | 13.931% | 2.377% | 0.520% | 0.356% |
| Nepal                 | 16.534% | 2.820% | 0.615% | 0.422% |
| Netherlands           | 69.913% | 11.927% | 2.602% | 1.783% |
| New Zealand           | 59.780% | 10.199% | 2.223% | 1.524% |
| Nicaragua             | 23.104% | 3.941% | 0.860% | 0.589% |
| Niger                 | 10.385% | 1.772% | 0.386% | 0.264% |
| Nigeria               | 16.821% | 2.870% | 0.626% | 0.429% |
| Norway                | 76.721% | 13.088% | 2.854% | 1.957% |
| Oman                  | 14.295% | 2.440% | 0.532% | 0.365% |
| Pakistan              | 18.299% | 3.122% | 0.680% | 0.465% |
| Panama                | 26.965% | 4.601% | 1.004% | 0.689% |
| Papua New Guinea      | 12.876% | 2.196% | 0.479% | 0.328% |
| Paraguay              | 19.639% | 3.351% | 0.731% | 0.501% |
| Peru                  | 31.019% | 5.293% | 1.155% | 0.791% |
| Philippines           | 26.605% | 4.540% | 0.991% | 0.679% |
| Poland                | 61.086% | 10.421% | 2.272% | 1.556% |
| Portugal              | 77.183% | 13.168% | 2.870% | 1.968% |
| Puerto Rico           | 48.958% | 8.353% | 1.821% | 1.248% |
| Qatar                 | 15.025% | 2.563% | 0.558% | 0.383% |
| Republic of Korea     | 55.566% | 9.480% | 2.067% | 1.417% |
| Romania               | 55.837% | 9.526% | 2.077% | 1.424% |
| Russian Federation    | 60.353% | 10.296% | 2.245% | 1.539% |
| Rwanda                | 12.450% | 2.124% | 0.464% | 0.318% |
| Saint Lucia           | 28.497% | 4.861% | 1.060% | 0.726% |
| Country                  | Saint Vincent and the Grenadines | Saudi Arabia | Senegal | Serbia | Seychelles | Singapore | Slovakia | Slovenia | South Africa | Spain | Sri Lanka | Sudan | Suriname | Sweden | Switzerland | Thailand | Timor Leste | Germany | Togo | Trinidad and Tobago | Tunisia | Turkey | Uganda | Ukraine | United Arab Emirates | United Kingdom | United States of America | Uruguay | Uzbekistan | Vietnam | Zambia | Zimbabwe |
|-------------------------|----------------------------------|-------------|---------|--------|------------|-----------|----------|----------|-------------|-------|-----------|-------|----------|--------|-------------|---------|------------|--------|------|----------------------|---------|--------|--------|---------|---------------------|---------------|----------------------------|--------|-----------|---------|-------|---------|
|                         | 35.610%                          | 17.916%     | 8.614%  | 52.158%| 31.571%    | 41.928%   | 55.778%  | 66.649%  | 21.798%     | 75.447%| 39.536%   | 30.755%| 45.109%  | 81.599%| 76.923%     | 41.037%  | 19.297%    | 10.248%| 45.967%| 41.612%                          | 38.306% | 10.105%| 58.496%| 11.495%| 73.183%                          | 34.365%| 54.630%| 30.747%| 26.600%| 9.717%                          | 5.267%| 6.076%| 3.058%| 8.898%| 5.387%| 7.153%| 9.516%| 11.371%| 3.719%| 12.871%| 6.745%| 5.248%| 7.697%| 13.920%| 13.124%| 7.002%| 3.291%| 1.748%| 7.842%| 7.098%| 6.534%| 1.722%| 9.979%| 1.962%| 12.485%| 5.863%| 9.319%| 5.246%| 4.538%| 1.660%| 0.898%| 1.325%| 0.667%| 1.940%| 1.175%| 2.075%| 2.479%| 0.810%| 2.806%| 1.470%| 1.146%| 1.681%| 3.036%| 2.861%| 1.527%| 0.717%| 0.381%| 1.710%| 1.547%| 1.425%| 0.375%| 2.175%| 0.429%| 2.721%| 1.277%| 2.032%| 1.145%| 0.990%| 0.363%| 0.196%| 0.909%| 0.458%| 1.329%| 0.804%| 1.069%| 1.422%| 1.700%| 0.556%| 1.924%| 1.007%| 0.788%| 1.152%| 2.080%| 1.960%| 1.047%| 0.492%| 0.261%| 1.172%| 1.061%| 0.975%| 0.257%| 1.492%| 0.294%| 1.865%| 0.875%| 1.391%| 0.786%| 0.679%| 0.249%| 0.135%|

**Acknowledgments**

This research is supported by the following Grant in Aid from the Ministry of Education, Culture, Sports, Science and Technology in Japan (MEXT): Grant in Aid (20H00648), Ministry of
Environment, Japan (JPMERF20201001). Any opinions, findings, and conclusions expressed in this material are those of the authors and do not necessarily reflect the views of the agencies.
References

1. A. Atkeson, (2020). What will be the economic impact of covid-19 in the us? rough estimates of disease scenarios (No. w26867). National Bureau of Economic Research.

2. A. Mandel, V. Veetil, The Economic Cost of COVID Lockdowns: An Out-of-Equilibrium Analysis. EconDisCliCha (2020). https://doi.org/10.1007/s41885-020-00066-z

3. A. Remuzzi et al., COVID-19 and Italy: what next? The Lancet, 395, 10231, 1225 – 1228 (2020).

4. B. Sen-Crowe et al., Social distancing during the COVID-19 pandemic: Staying home save lives. The American Journal of Emergency Medicine, 0, 0, (2020).

5. D. Adam, Special report: The simulations driving the world’s response to COVID-19, How epidemiologists rushed to model the coronavirus pandemic, Nature Special Report (2020).

6. D. Davis et al., Hospital Bed Surge Capacity in the Event of a Mass-Casualty Incident, Prehospital and Disaster Medicine, 20, 3, 169-176 (2005).

7. H. Nakamura, S. Managi, Airport risk of importation and exportation of the COVID-19 pandemic, Transport Policy 96: 40-47. (2020)

8. H. Onuma et al., Reduction of future disaster damages by learning from disaster experiences, Natural Hazards, 87, 1435–1452 (2017).

9. I. Jumbri et al., Heterogeneous global health stock and growth: quantitative evidence from 140 countries, 1990–2100. Arch Public Health 76, 81. (2018).

10. J. Bukhari, Y. Jameel, Will Coronavirus Pandemic Diminish by Summer? (2020).

11. J. Liu et al., Valuation of the risk of SARS in Taiwan. Health Econ., 14, 83-91 (2005).

12. J. Nkengasong et al., Looming threat of COVID-19 infection in Africa: act collectively, and fast. The Lancet, 395, 10227, 841 – 842 (2020).

13. J. Nkengasong, China’s response to a novel coronavirus stands in stark contrast to the 2002 SARS outbreak response, Nature Medicine, 26, 310-311 (2020).

14. J. Wang et al., High Temperature and High Humidity Reduce the Transmission of COVID-19 (2020).

15. J. Xie, Y. Zhu, Association between ambient temperature and COVID-19 infection in 122 cities from China, Science of The Total Environment, 724, 138201. (2020)

16. K.Govindan, H. Mina, B. Alavi, A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). Transportation Research Part E: Logistics and Transportation Review, 101967 (2020).

17. K.M. Murphy, R.H. Topel, The value of health and longevity, Journal of Political Economy, 114, 5 871–904 (2006).

18. M. Fong et al., Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings-Social Distancing Measures. Emerging Infectious Diseases, 26, 5 (2020).
19. M. Greenstone, V. Nigam, Does Social Distancing Matter? University of Chicago, Becker Friedman Institute for Economics Working Paper No. 2020-26 (2020).

20. M. Kraemer et al., The effect of human mobility and control measures on the COVID-19 epidemic in China, Science, 25, eabb4218 (2020).

21. M. Martinez-Alvarez et al., COVID-19 pandemic in west Africa, The Lancet Global Health, Volume 0, 0 (2020).

22. M. Wang, S. Flessa, Modelling Covid-19 under uncertainty: what can we expect?. The European Journal of Health Economics, 1. (2020).

23. N. Fernandes, Economic effects of coronavirus outbreak (COVID-19) on the world economy. Available at SSRN 3557504 (2020).

24. N. Ferguson et al., Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand, Imperial College COVID-19 Response Team, London. (2020).

25. R. Anderson et al., How will country-based mitigation measures influence the course of the COVID-19 epidemic? The Lancet, 395, 10228, 931 – 934 (2020).

26. R.F. Ceylan, B. Ozkan, E. Mulazimogullari, Historical evidence for economic effects of COVID-19. The European Journal of Health Economics, 1. (2020).

27. R. Verity et al., Estimates of the severity of COVID-19 disease. (2020).

28. S. Murthy et al., Intensive Care Unit Capacity in Low-Income Countries: A Systematic Review, Plos One, 10, 1, e0116949 (2015).

29. T. Breton, The Effect of Temperature on the Spread of the Coronavirus in the U.S. Through March 2020 (2020).

30. T., Mendes, L. Carvalho, Shifting Geographies of Knowledge Production: The Coronavirus Effect. Tijdschrift voor economische en sociale geografie (2020).

31. W. K. Viscusi, C. Masterman, Income Elasticity and the Global Value of a Statistical Life. Journal of Benefit-Cost Analysis, 8, 2, 226–250 (2017).

32. Y. Ji et al., Potential association between COVID-19 mortality and health-care resource availability. The Lancet Global Health, 8, 4, e480 (2020).

33. Z. Chen, COVID-19: A revelation-A reply to Ian Mitroff. Technological Forecasting and Social Change, 120072 (2020).