Is There a Trade-Off between the Growth of Real GDP and the Degree of Stringency of the COVID-19 Epidemic Control?

by

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Is There a Trade-Off between the Growth of Real GDP and the Degree of Stringency of the COVID-19 Epidemic Control?[§]

Lawrence J. Lau and Yanyan Xiong[1]

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Abstract: The objective of this study is to show how the degree of stringency of the COVID-19 epidemic control policies and measures can affect the level of the cumulative economic loss caused by the epidemic. The epidemic has affected adversely the economic growth of almost every country in the world since 2020. It has also resulted in significant numbers of cumulative infections and deaths in different countries.

More stringent control policies and measures will always result in fewer cumulative infections and deaths from the virus. But will they also result in greater cumulative economic loss, and if so, by how much? We examine the data from the BRICS and Group-of-Seven (G-7) countries, which together account for 69.8 percent of world GDP. The objective is to see whether there is any correlation between the degree of stringency and the level of cumulative economic loss.

To a first approximation, lower cumulative COVID-19 infection and death rates per capita should reflect more stringent epidemic controls; thus, infection and death rates can be used as proxy variables for the degree of stringency. The cumulative economic loss due to COVID-19 of a country may be estimated as the reduction in the cumulative rate of growth of its real GDP between the ten quarters before and after 1 January 2020, when the COVID-19 epidemic began. These estimated cumulative economic losses are then compared with the cumulative COVID-19 deaths per million persons as of 30 June 2022 in these respective countries to see whether a higher reduction in the cumulative rate of growth of real GDP is associated with a lower cumulative COVID-19 death rate.

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1. Introduction

The objective of this study is to show how the degree of stringency of the COVID-19 epidemic control policies and measures can affect the level of the cumulative economic loss caused by the epidemic. The epidemic has affected adversely the economic growth of almost every country in the world since 2020. It has also resulted in significant numbers of cumulative infections and deaths in different countries. In response, different countries have adopted different policies and measures to try to control the epidemic. These range in degrees of stringency from the "dynamic zero" policy of Mainland China to the "living with the virus" and even "herd immunity" policies of some developed Western countries.

More stringent control policies and measures will always result in fewer cumulative infections and deaths from the virus. But will they also result in greater cumulative economic loss, and if so, by how much? This is the question that we try to answer. We examine the data from the BRICS (Brazil, Russia, India, China and South Africa) and Group-of-Seven (G-7: Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) countries, which together account for 69.8 percent of world GDP. The objective is to see whether there is any correlation between the degree of stringency of epidemic control and the level of cumulative economic loss.

It is difficult to devise internationally comparable measures of the degree of stringency of epidemic controls because of their many dimensions. However, to a first approximation, lower cumulative COVID-19 infection and death rates per capita should reflect more stringent controls; thus, infection and death rates can be used as proxy variables for the degree of stringency. The cumulative economic loss due to the COVID-19 epidemic of a country may be estimated as the reduction in the cumulative rate of growth of its real GDP between the ten quarters before and after 1 January 2020, when the COVID-19 epidemic reportedly began. The assumption is that in the absence of the COVID-19 epidemic, the cumulative rate of growth of the country would have remained essentially the same in the two periods, which may not have been entirely true. These estimated cumulative economic losses are then compared with the cumulative COVID-19 deaths per million persons as of 30 June 2022 in these respective countries to see whether there is any correlation between the magnitude of the cumulative economic loss and the degree of stringency; in particular, whether a higher reduction in the

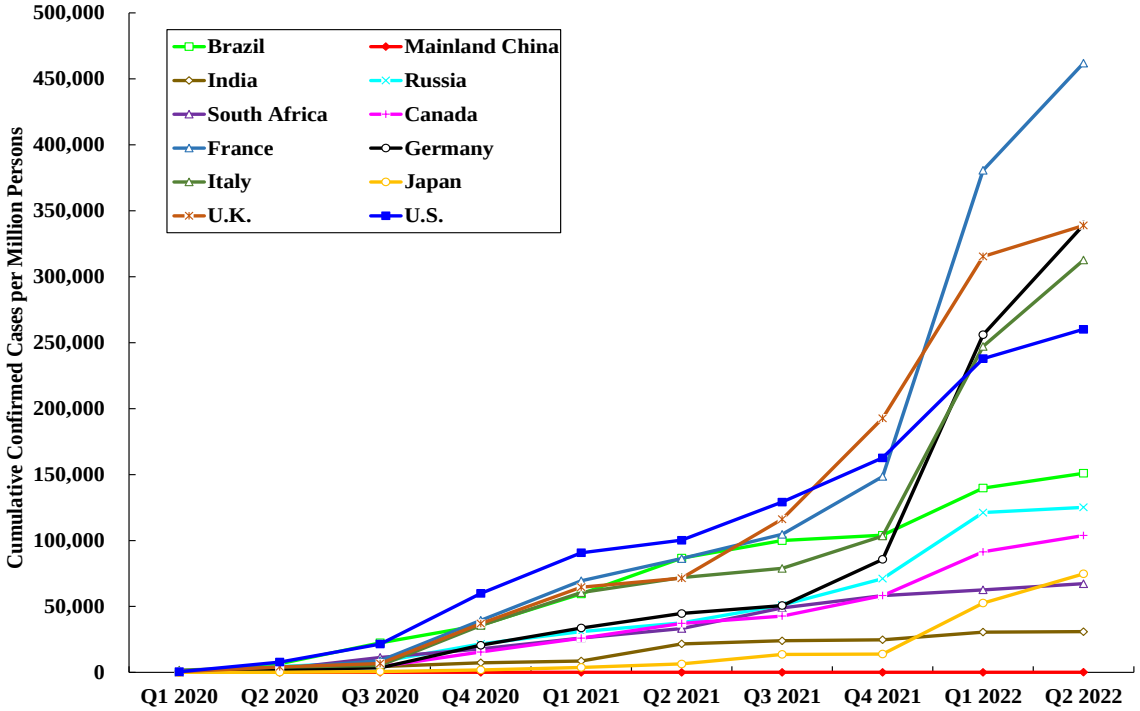
cumulative rate of growth of real GDP is associated with a lower cumulative COVID-19 death rate.

2. The Measurement of the Relative Degree of Stringency

It is not easy to measure the relative degree of stringency ex ante. However, ex post, we can use the resulting outcomes, such as the cumulative COVID-19 infections and/or deaths per million persons as indicators of relative stringency—lower cumulative infections and deaths per capita most likely reflect higher stringency. Of course, it should be recognised that these outcomes may also depend on additional local factors such as the availability of vaccines, the quality of healthcare, the population density, the degree of urbanisation, the climate, and even the "culture" of the country.

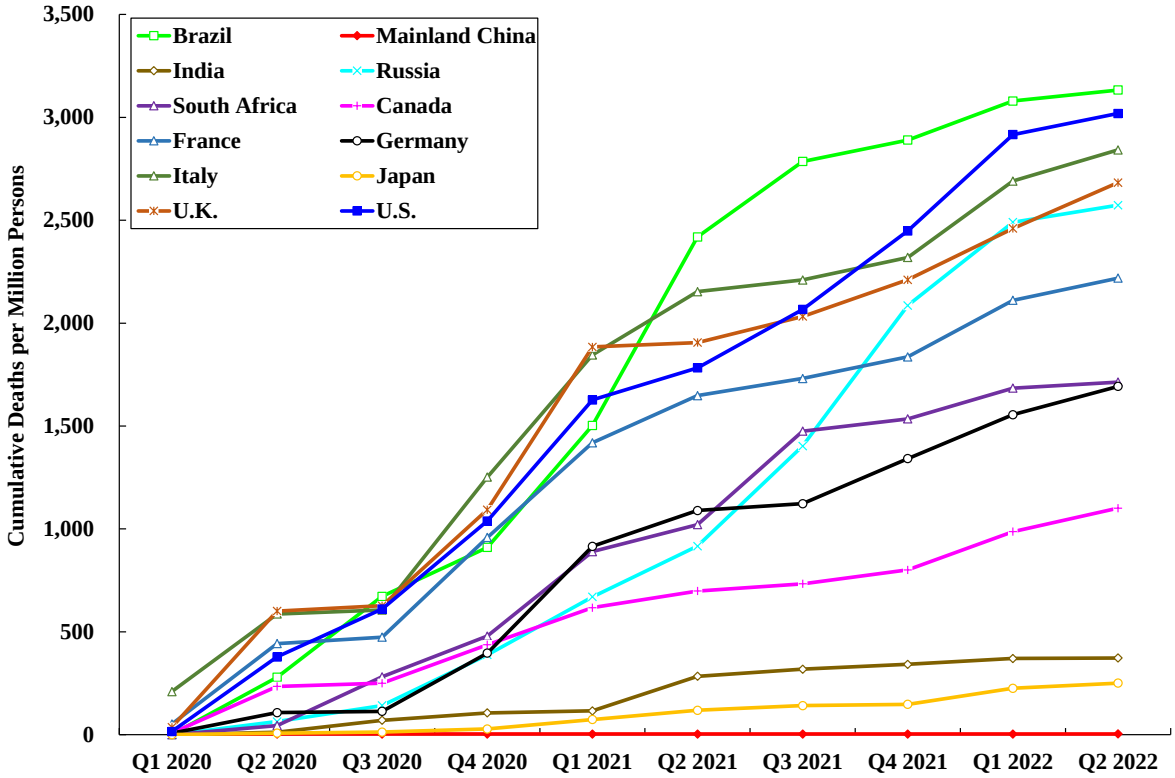
In Figures 1 and 2 below, we present the cumulative COVID-19 infections and deaths per million persons for the twelve countries included in our study on a quarterly basis beginning with 2020Q1. The cumulative deaths per million persons of these countries as of 30 June 2022 are also presented in Table 1 below.

Figure 1: The Cumulative Confirmed COVID Cases per Million Persons, BRICS and G7 Countries



Sources: Our World in Data (covid.ourworldindata.org); National Health Commission of the People's Republic of China (http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml).

Figure 2: The Cumulative COVID Deaths per Million Persons, BRICS and G7 Countries



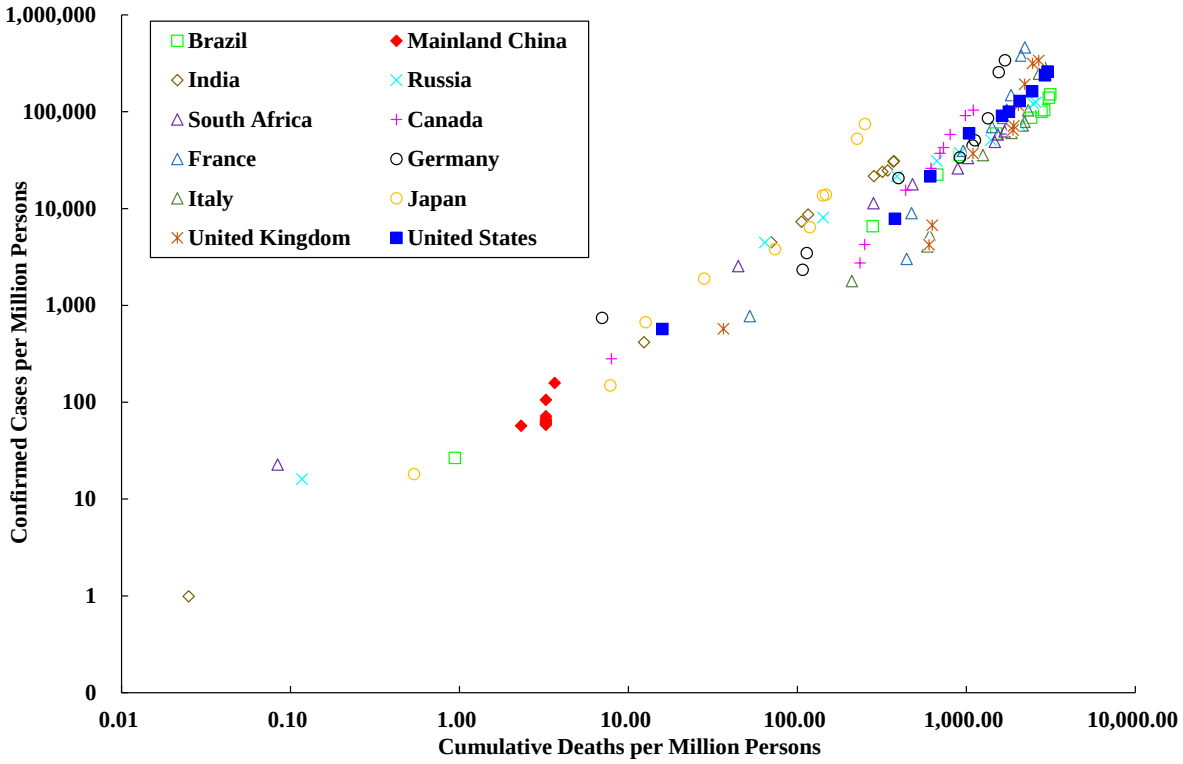
Source: Our World in Data (covid.ourworldindata.org).

Figures 1 and 2 show clearly that Mainland China has had the lowest cumulative infections (158 as of 30 June 2022) and deaths (3.7 as of 30 June 2022) per million persons, consistent with it having supposedly the most stringent control measures. In contrast, France (462,000) and Germany (339,000) had the highest and second highest cumulative infections per million persons as of 30 June 2022, with almost half and more than one-third of their respective populations infected. India (30,883) had the second lowest cumulative infections per million persons. Brazil (3,133) and the United States (3,019) had the highest and second highest cumulative deaths per million persons, respectively. Japan (251) and India (373) had the second and third lowest cumulative deaths per million persons, respectively. By way of comparison, for the entire rest of the world ex Mainland China, the cumulative infections and deaths per million persons were 84,458 and 977 respectively as of 30 June 2022. The contrasts between Mainland China and the rest of the countries of the world are most striking. Based on the cumulative infections and deaths per million persons, China must be considered one of the most successful countries in terms of controlling the COVID-19 epidemic.

In Figure 3 we present a scatter diagram between the natural logarithms of the cumulative infections and deaths per million persons at the end of each quarter since 2020. It

is clear that there is a strong and positive correlation and an approximately linear relationship between the two variables. While both the infection and the death rates are subject to under-counting and under-reporting, we believe the data on deaths are more reliable and shall therefore use only the natural logarithm of the cumulative death per million persons as a proxy variable for the degree of stringency of epidemic controls.

Figure 3: Cumulative Confirmed Infections per Million Persons vs. Cumulative Deaths per Million Persons: BRICS and G7 Countries



Source: Our World in Data (covid.ourworldindata.org); National Health Commission of the People's Republic of China (http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml).

3. The Measurement of the Economic Loss

The COVID-19 epidemic has reduced the level of real GDP and hence also its cumulative rate of growth in every country in our study except Japan. The economic loss actually consists of two parts: the loss of GDP due directly to the epidemic itself, and the loss due indirectly to the control measures. We estimate the magnitude of the economic loss by the reduction in the cumulative rate of growth of real GDP by comparing the pre-epidemic and post-epidemic rates of growth. The pre-epidemic rate of growth is taken to be the cumulative real rate of growth in the ten quarters between the beginning of 2017Q3 and the end of 2019Q4. The post-epidemic rate of growth is taken to be the cumulative real rate of growth in the ten

quarters between the beginning of 2020Q1 and the end of 2022Q2. [2] The reduction is then the difference between the pre-epidemic and post-epidemic cumulative rates of growth. To monetise the estimated reductions, they are multiplied by the 2020 GDP (in 2021 US$) of the respective countries. These figures are presented in Table 1 below.

Table 1: Cumulative Deaths per Million Persons, the Reductions of the Cumulative Rates of Growth of Real GDP and Their Monetised Values, BRICS and G7 Countries

	Canada	France	Germany	Italy	Japan	United Kingdom	United States	Brazil	Mainland China	India	Russia	South Africa
Cumulative Death Rate as of 30 June 2022	1,101.0	2,218.9	1,692.7	2,841.9	251.0	2,682.9	3,019.1	3,132.7	3.7	373.1	2,573.4	1,713.4
Cumulative Growth Rate, Q3 2017 - Q4 2019, %	5.466	4.064	2.688	0.992	-1.420	3.833	6.698	3.456	16.281	13.727	4.358	2.034
Cumulative Growth Rate, Q1 2020 - Q2 2022, %	0.919	0.363	-1.016	0.001	-0.622	0.801	2.496	1.776	8.812	6.562	2.479	0.527
Reduction in Cumulative Growth Rate, %	4.548	3.700	3.704	0.991	-0.798	3.032	4.202	1.680	7.468	7.164	1.880	1.507
2020 GDP, billion 2021 US$	1,903.9	2,746.2	4,104.4	1,969.1	4,858.7	2,966.1	21,762.0	1,537.9	17,938.0	2,912.8	1,694.1	400.3
Reduction in GDP, billion 2021 US$	86.6	101.6	152.0	19.5	-38.8	89.9	914.4	25.8	1,339.6	208.7	31.8	6.0

Sources: OECD.Stat (https://stats.oecd.org/#); WDI Database; National Bureau of Statistics of China; and U.S. Bureau of Economic Analysis.

According to Table 1, Mainland China experienced the highest reduction in the cumulative rate of growth of real GDP, 7.5%, followed by India, with 7.2%. Canada had the third highest reduction, at 4.5%. Japan was an outlier—its cumulative rate of growth actually increased in the post-epidemic period by 0.8%. We believe this is an artifact of its chronically low rate of economic growth and have therefore left Japan out of our subsequent regression analysis. Italy (1.0%) and South Africa (1.5%) had the lowest and second lowest reductions respectively. Mainland China had the lowest cumulative deaths per million persons, at 3.7, as well as the highest reduction in the cumulative rate of growth (and the highest estimated economic loss), at 7.5%, among the twelve countries.

However, it is instructive to compare the experiences of Mainland China and the United States. The cumulative deaths per million persons as of 30 June 2022 were 3.7 and 3,019 in Mainland China and the U.S., respectively. The estimated reductions in the cumulative rate of economic growth of the two countries were respectively 7.5% and 4.2%. If Mainland China were to pursue the same epidemic control policy as the U.S., and hence would have the cumulative death rate as well as the reduction in the cumulative rate of growth of the U.S., the additional number of Chinese cumulative deaths would have been approximately 4.30 million, and the decrease in the reduction would have shrunk the estimated economic loss by US$586

[2] If fewer than ten quarters of data are available for any country for the post-2020 period, the cumulative real rate of growth will be blown up to ten quarters proportionally.

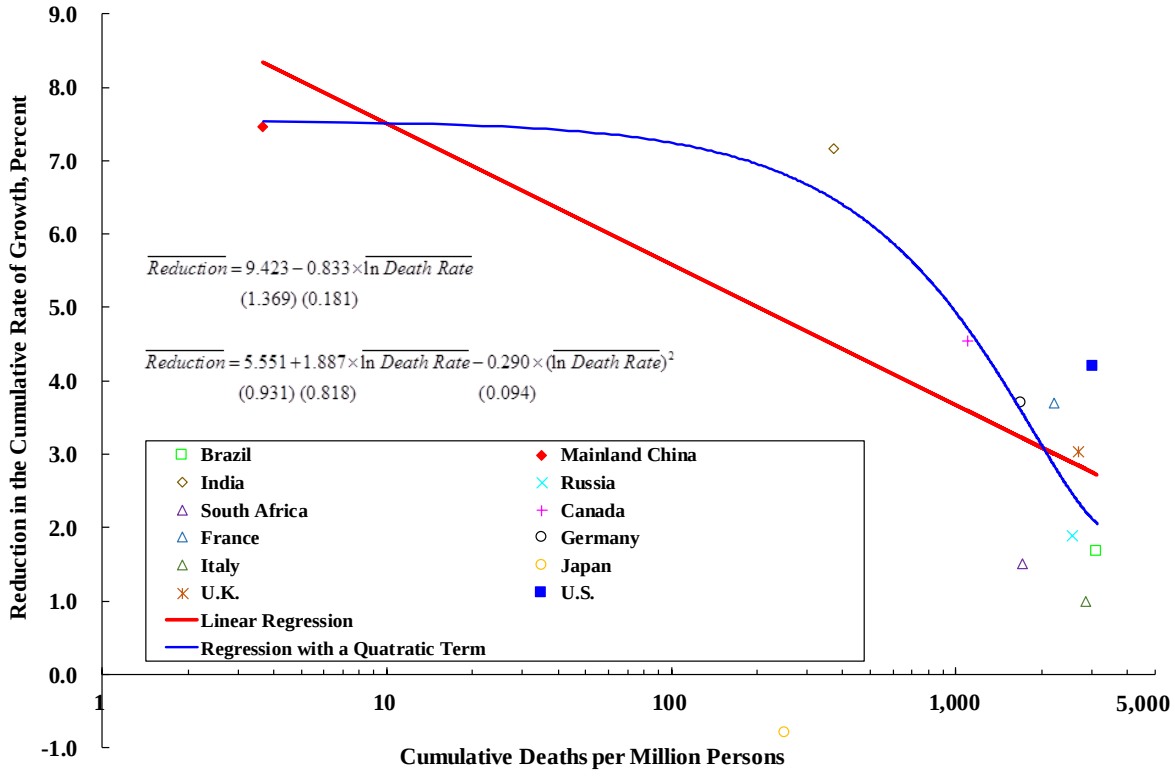
billion to US$754 billion. Thus, one may say that by forgoing 3.3% worth of real GDP (equivalent to US$586 billion), Mainland China averted a possible additional COVID-19 deaths of 4.30 million persons. The social cost per life saved may be estimated at US$136,000.

If the U.S. were to adopt the same epidemic control policy as Mainland China, and hence would have the cumulative death rate as well as the reduction in the cumulative rate of growth of Mainland China, the number of cumulative deaths as of 30 June 2022 would have been reduced to 1,235 from 1,017,421, and the estimated economic loss would have increased by 3.3% of real GDP, or US$711 billion, to US$1,625 billion. Thus, one may say that by forgoing an additional US$711 billion worth of real GDP, the U.S. could have averted a possible cumulative COVID-19 deaths of 1.016 million. The social cost per life potentially saved may be estimated at US$699,000. It turns out that the estimated cost per life to be saved is more than five times in the U.S. than in China.

4. The Correlation between the Economic Loss and the Degree of Stringency

In Figure 4, the reductions in the cumulative rates of economic growth attributable to the COVID-19 epidemic are plotted against the cumulative COVID-19 death rates as of 30 June 2022. We also present in Figure 4 the linear and quadratic regression lines of the reduction in the cumulative rate of growth of real GDP on the natural logarithm of the cumulative COVID-19 death rate per million persons, but without Japan, because its reduction was negative. The regression results are presented in Table 2 below.

Figure 4: The Reductions in the Cumulative Rate of Growth of Real GDP vs. the Cumulative COVID-19 Deaths per Million Persons as of 30 June 2022



Sources: OECD.Stat (https://stats.oecd.org/#); WDI Database; Our World in Data (covid.ourworldindata.org); and National Health Commission of the People's Republic of China (http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml).

Table 2: Regressions of the Reduction in the Cumulative Growth Rates on the Natural Logarithm of the Cumulative Death Rate

Dependent Variable: Reduction in the Cumulative Rates of Growth, Percent	(1)	(2)
Ln (Cumulative Deaths per Million Persons)	-0.833***	1.887*
	(0.181)	(0.818)
Ln (Cumulative Deaths per Million Persons) Squared		-0.290**
		(0.094)
Constant	9.423***	5.551***
	(1.369)	(0.931)
Number of Observations	11	11
Adjusted R^2	0.529	0.678

Notes: Robust standard errors are in the parentheses. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.

Both regression lines show a statistically significant negative relationship between the cumulative reduction in real GDP and the cumulative COVID-19 deaths per million persons--the higher the cumulative death rate is, the lower the cumulative economic loss, indicating a trade-off between cumulative reductions in real GDP and the cumulative COVID-19 deaths per million persons. The quadratic regression line fits the data much better than the linear regression line. We shall therefore focus on only the quadratic regression line and refer to it as the Reduction-Death Curve.

The slope of the Reduction-Death Curve indicates the possible trade-offs between the reduction in the rate of growth and deaths. By differentiating the Reduction-Death Curve with respect to the natural logarithm of the cumulative death rate, we obtain:

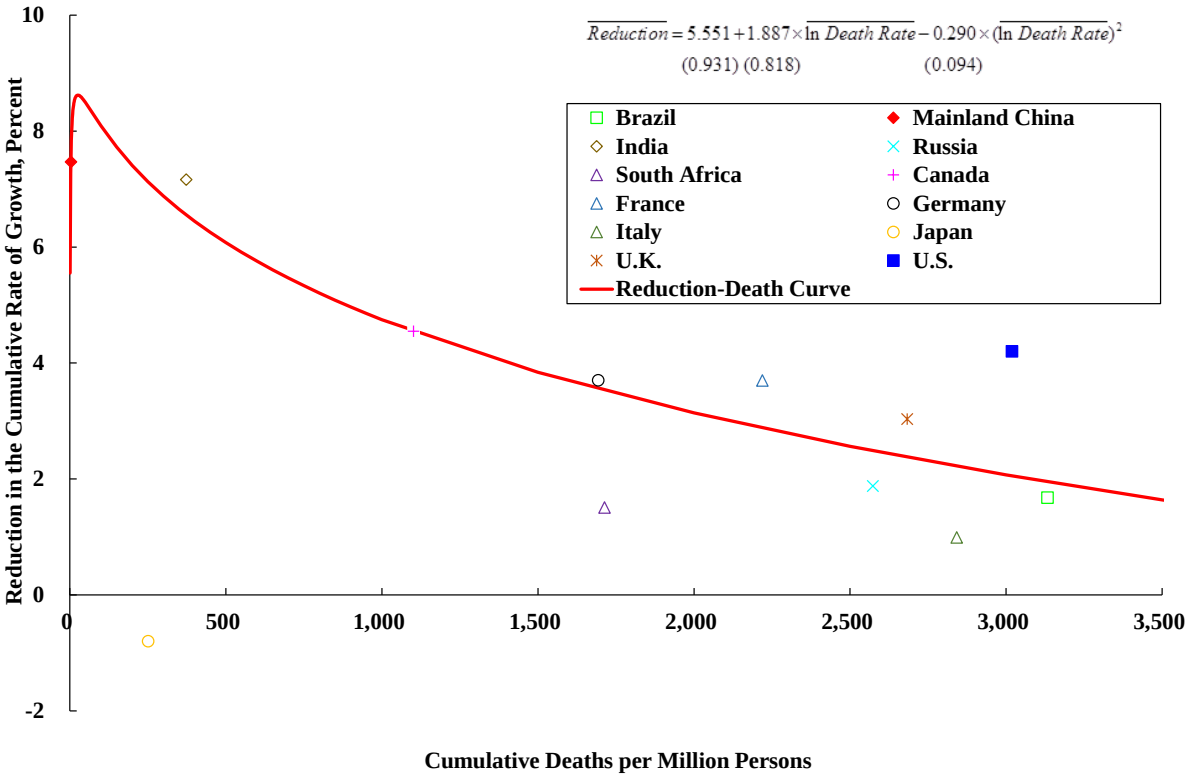
$$\frac{dReduction}{d\ln Death\ Rate} = 1.887 - 0.580 \times \ln Death\ Rate,$$

which is negative when cumulative deaths exceed 26 per million persons. This implies that the reduction in the cumulative rate of growth declines with increases in cumulative deaths when cumulative deaths exceed 26 per million persons. The only country in our study with a cumulative death rate of less than 26 per million persons is China (Mainland).[3]

[3] According to Our World in Data, out of 186 countries and territories in the world, only 14 has cumulative COVID-19 deaths per million persons less than 26 as of 30 June 2022. They include China, North Korea, Tajikistan, and 11 African countries.

However, the quadratic regression line in Figure 4 obscures the direct relationship between the reduction and the cumulative deaths per million persons. We therefore plot the Reduction-Death Curve in Figure 5, with reductions on the vertical axis and the cumulative death rates on the horizontal axis. Figure 5 shows that when the cumulative deaths increase from 1 to 500 per million persons, the reduction increases from 5.55 to 6.08. But when the cumulative deaths increase from 500 to 1,000 per million persons, the reduction decreases from 6.08 to 4.75. And when the cumulative deaths increase from 1,000 to 1,500, the reduction decreases from 4.75 to 3.84. Thus, the rate of reduction is not constant but declines with increasing cumulative deaths. When the cumulative deaths reach 3,500 per million persons, the reduction falls to 1.64.

Figure 5: The Reduction in the Cumulative Rates of Growth vs. Cumulative Deaths per Million Persons



Source: Authors' calculations.

5. Concluding Remarks

We note that there is indeed a trade-off between the degree of stringency of the COVID-19 epidemic controls, as proxied by the cumulative COVID-19 deaths per million persons, and the cumulative economic loss—the more stringent the controls are, the lower the cumulative death rate is, and the higher the cumulative economic loss. China has foregone an estimated US$1,340 billion worth of GDP over the past two and a half years to limit its cumulative COVID-19 deaths to 3.7 per million persons. This is entirely consistent with the Chinese policy of emphasising the quality rather than the quantity of economic growth. Ultimately the degree of stringency of the epidemic controls is a policy choice. However, there is no one universal policy that is right for every country. What is right for one country may not be right for another. It depends on how much reduction in real GDP a country is willing and able to accept to achieve lower deaths—how much a country values human life.