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A "Ballpark" Assessment of Efficiency in Social Distancing in Early Fights against the COVID-19 Pandemic

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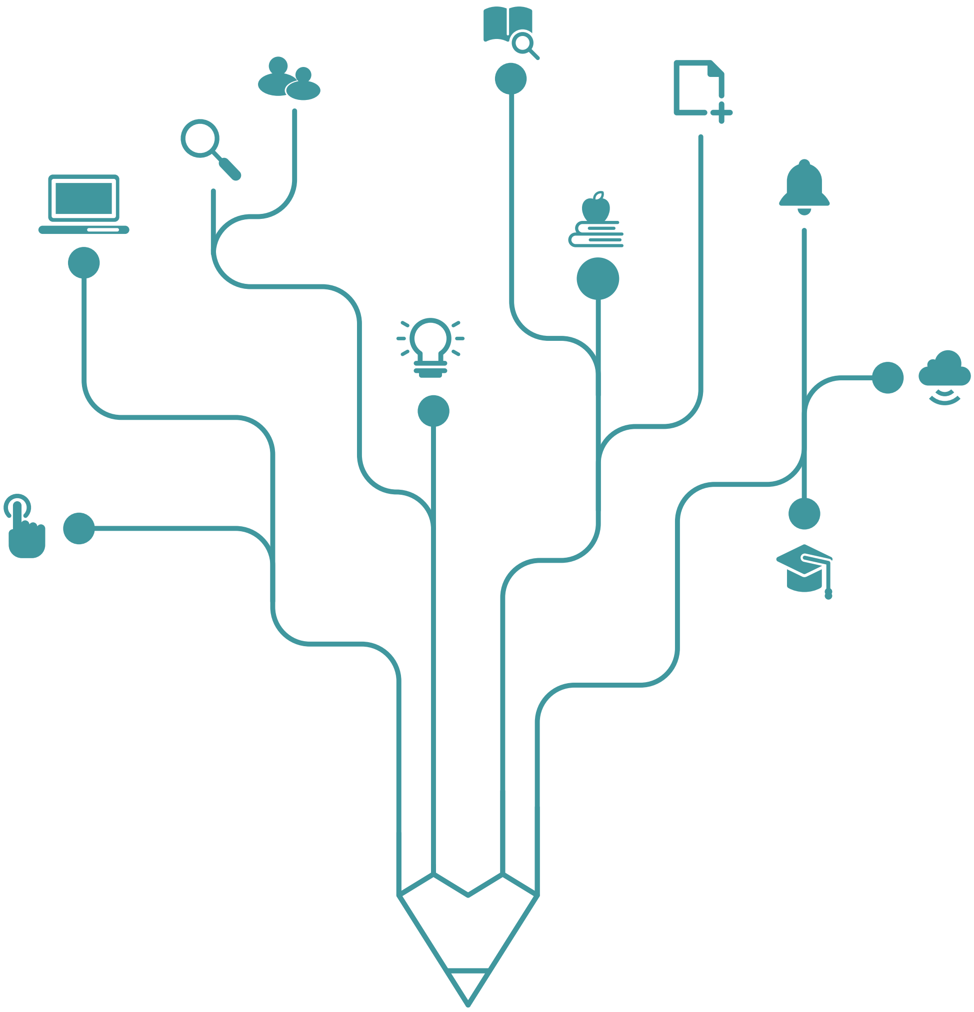

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A "Ballpark" Assessment of Efficiency in Social Distancing in Early Fights against the COVID-19 Pandemic

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Abstract

This paper presents results from assessment of efficiency in social distancing in international responses to the COVID-19 pandemic in 2020. The simple framework adopted for the assessment recognizes two kinds of costs that a society may bear in a pandemic. The first is costs due to infection (infection costs); the second costs resulting from slowdown in economic transactions (economic costs). Efficient social distancing should minimize the sum of these costs. Infection costs are likely to decrease with social distancing at a decreasing rate as intensified social distancing eases pressure on scarce resources for intensive care. Economic costs on the other hand are likely to increase at an increasing rate as extreme slowdown in economic life may entail job losses and business failures. The resulting U-shaped total costs curve implies parity between infection costs and economic costs as a necessary condition for efficiency. In a simplified implementation of the framework, we approximate infection costs by the value of (statistical) lives lost, and economic costs by the gap between the actual gross domestic product in 2020 and the potential GDP as predicted by the within-country growth trend during the preceding decade. The results for 158 countries suggest that the global community perhaps reacted with overly strict social distancing measures whereas high-income countries as a group were more successful in maintaining the parity between infection and economic costs.

Keywords: COVID-19; social distancing; economic and infection costs related to pandemics; efficiency

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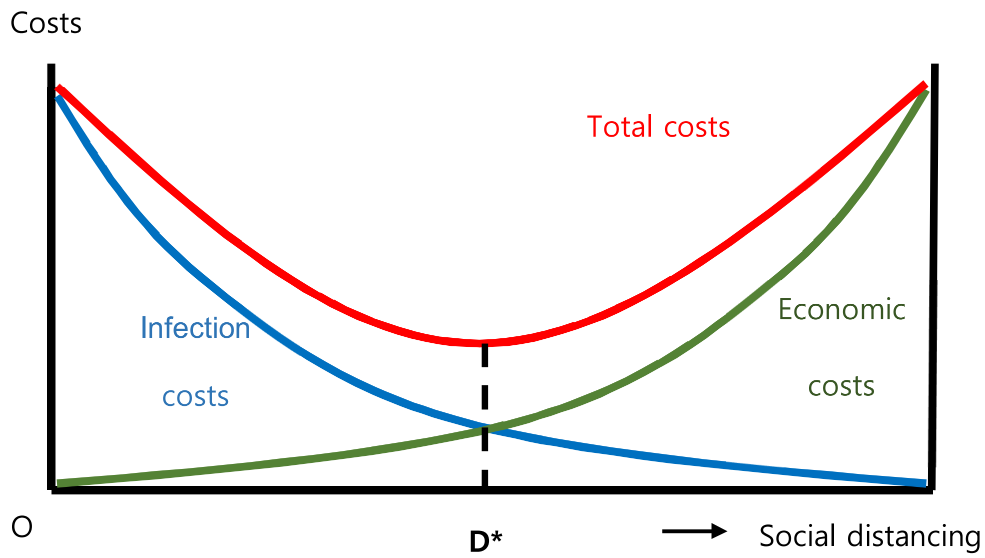
1. Introduction

The COVID-19 pandemic has claimed more than 5.2 million lives as of the end of November, 2021.[3] Economic consequences have been also devastating. The global gross domestic products (GDP) recorded a 3.5% contraction in 2020, and while economic activities have regained some momentum in 2021, the projection for the global GDP in 2021remains below the pre-pandemic levels across the regions (World Bank, 2021). A key component in global responses to the pandemic has been various measures of social distancing. While the remarkably fast development and deployment of vaccines has significantly enhanced the ability of the global community to control the spread of the virus, viral mutations necessitate continued practice of social distancing in emergency situations even in regions with already high vaccination rates. During the first year of the pandemic, social distancing was the mainstay in public health responses to fight the viral spread across the world, and it remains such in a large swathe of developing countries where vaccine supplies are still slow in arriving.

This paper presents a simple and practical conceptual framework for assessing efficiency in the implementation of social distancing across the countries. The framework recognizes that efficient social distancing should minimize the sum of two distinct costs a society may bear in a pandemic: first, costs due to infection by the virus (infection costs), and second, costs due to potential slowdown in economic transactions (economic costs). Social distancing will reduce infection costs, while raising economic costs. Figure 1 provides a visual representation of the framework.

Infection costs are likely to decrease with social distancing at a decreasing rate as intensified social distancing eases pressure on limited resources for intensive care. Economic costs on the other hand are likely to increase at an increasing rate as extreme slowdown in economic life entails job losses and business failures. The resulting U-shaped total costs curve implies parity between infection costs and economic costs as a necessary condition for efficiency. In Figure 1, efficiency is attained at D^*, where infection costs and economic costs match each other, minimizing total costs.



Source: the authors' own conceptualization

<Figure 1> Infection costs, economic costs, and efficient social distancing

3 https://ourworldindata.org/grapher/cumulative-covid-deaths-region.

Rigorous measurement of infection and economic costs is not an easy task. In this paper, we attempt a simplified operationalization by approximating infection costs by the value of (statistical) lives lost, and economic costs by the gap between the actual gross domestic product in 2020 and the potential GDP as predicted by the within-country growth trend during the preceding decade. These approximations are both likely to understate the true costs, as they leave out obvious items: infection costs should also include costs for treatment for the infected (Baker et al., 2020), value of labor lost while the infected go through treatment and recovery (Baker et al., 2020), and long-term adverse health effects of infection known as “long COVID” (Yelin et al., 2020) whereas economic costs should include welfare loss due to negligence in the care of other diseases (Wright et al., 2020), loss in psychological wellbeing due to imposed loneliness (Groarke et al., 2020), and disruptions in human capital investment, among other things (Neidhoefer et al., 2021).

Our motivation for choosing the simplifying approximations is chiefly practical, as we have no clear methods to estimate the omitted items in a credible and comparable manner across the countries in the world. In the case of the infection costs, however, we believe that our approximation is likely to capture more or less satisfactorily the true extent of the costs, as value of lives lost will dwarf the other items. We concede that the extent of the underestimation is likely to be more substantial in the approximation we propose for the economic costs. We will discuss the implication of this observation in the discussion of the results.

We follow the recommendation by Masterman and Viscusi (2017) to estimate 2020 values of a statistical life (VSL) in different countries, and multiplied these by the number of cumulative deaths due to COVID-19 by the end of year 2020 provided by the World Health Organization (WHO) to estimate country-by-country infection costs. We sourced GDP data for 2020 and the preceding decade from the World Bank.

The resulting ratio of infection costs over economic costs spans a wide range with values spread on both sides of unity. For our sample of 158 countries, both the mean and the median of the ratios is significantly below 1, suggesting that the vast majority of countries in the global community practiced overly restrictive social distancing. For 34 countries in the sample with per capita income over USD 20,000, however, we cannot reject the null hypothesis that the mean or the median is equal to 1.

The rest of the paper proceeds as follows. Section 2 will discuss approximations we use to estimate both infection costs and economic costs. Section 3 will present results from the comparison of infection and economic costs across the countries in the sample, including results from statistical tests. Section 4 will discuss the findings and their implications and present some concluding remarks.

2. Estimation of infection costs and economic costs

Infection costs comprise costs for medical treatment, value of labor lost by the infected during treatment and recovery, reduction in welfare due to long COVID, and most importantly, value of lives lost. Our “ballpark” estimation focuses on the value of lives lost, ignoring the remaining items. This decision was chiefly forced by the difficulty in estimation for a large number of countries, but may be justified in that the value of lives lost most probably dominate the remaining items by an order of magnitude.

To measure value of lives lost to the pandemic, we rely on the concept of the value of a statistical life (VSL). The VSL is a measure of life’s value derived from the tradeoff rate between fatality risk and money, often observed through choices in product and labor market contexts (Kniesner and Viscusi, 2019). Since the 1980s, the VSL has played an increasing role in cost benefit analyses for regulatory changes affecting mortality risks in the US and other countries. As most estimates of the VSL are concentrated in a relatively small number of mostly high-income countries, mortality valuation in a global context has to estimate the VSL figures for countries through extrapolation from a base country. (Robinson et al., 2019) The extrapolation relies on the following formula.

$$VSL_{target} = VSL_{base} * (Income_{target}/Income_{base})^{elasticity}. \quad (1)$$

In the equation, *elasticity* is a positive parameter capturing the empirical pattern among existing VSL estimates showing higher VSL values for more affluent societies. Following the recommendation by Viscusi and Masterman (2017), we take 2015 US as the base, with the VSL estimated to be $9.6 million and the base income of $55,980. *Elasticity* is assumed to be 1.0 with countries with per capita income less than $8,809 and 0.85 for countries with higher income.

Estimating economic costs poses an even greater challenge. We estimate economic costs through the difference between the actual 2020 GDP and the predicted 2020 GDP estimated using the average annual growth rate during the previous decade. We are aware that this approximation clearly understates the true value, as it ignores welfare loss due to negligence in the care of other diseases; loss in psychological wellbeing due to imposed isolation; and adverse consequences for disruption in the investment for human capital. While we lack a credible method to estimate the value of the omitted items across a large number of countries, country case studies indicate that the welfare reduction implied by these items is substantial indeed. (Wright et al., 2020; Groarke et al., 2020; Neidhoefer et al., 2021) This realization is the main reason why we think of our assessment as a "ballpark" exercise. We will discuss the implication of the relatively more severe underestimation of economic costs vis-à-vis infection costs later, and note briefly here that a more accurate measurement of both the costs should strengthen our case that social distancing was overly restrictive during the first year of the pandemic.

3. Results

Using data on GDP and COVID-19 deaths sourced, respectively, from the World Bank and the World Health Organization, we have calculated infection costs and economic costs per capita. The summary statistics for these and other related variables are presented in Table 1. From the table, we note that both the mean and, in particular, the median are larger for economic costs than their counterparts for the infection costs.

Variable	Obs.	Mean	Std. Dev.	Median	Min.	Max.
Infection costs per capita	158	1,244	2,486	138	0.005	13,150
Economic costs per capita	159	1,601	1,836	1,071	-5,114[4]	8,852
VSL	159	2,411,469	3,325,592	931,999	33,672	1.67e+07
GDP per capita	159	14025	19,631	5,434	196	107,028

<Table 1> Summary statistics (in USD, 2015 PPP)

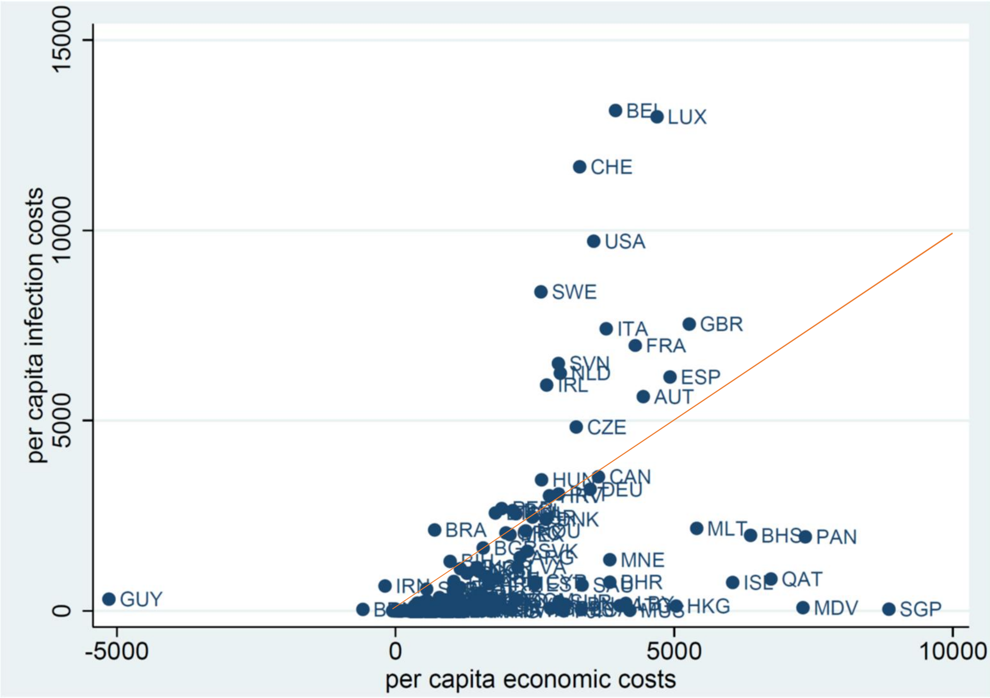
[4] We count six countries in our sample where the actual 2020 GDP was higher than the predicted: Iran, Brunei Darussalam, Guyana, Guinea, Central African Republic, and Comoros.

Country	COVID-19 deaths	VSL	Infection costs in mil. USD (A)	Economic costs in mil. USD (B)	Ratio A/B
China	4,634	1,399,381	6,485	1,134,762	0.0057
South Korea	917	5,428,300	4,978	85,729	0.0581
Australia	909	9,615,503	8,740	36,833	0.2373
Germany	33,791	7,903,049	267,974	292,941	0.9148
United States	352,001	9,192,503	3,235,770	1,183,774	2.7334
Belgium	19,528	7,833,682	152,976	45,918	3.3314

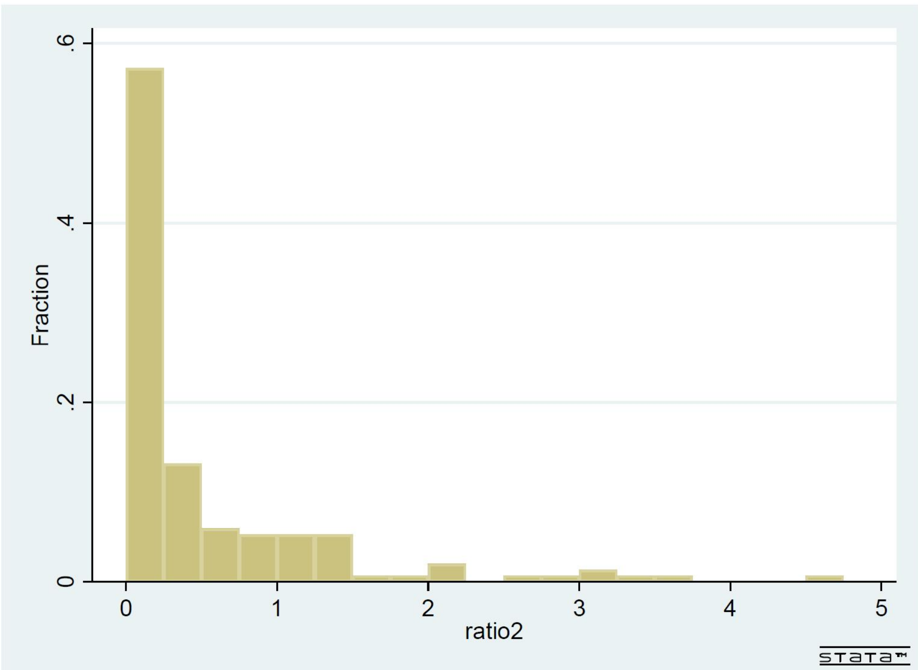
<Table 2> COVID-19 deaths, VSL, infection costs, and economic costs in 2020 for selected countries

In Table 2, we present the costs and related data for six selected countries. COVID-19 deaths are the number of cumulative deaths by the end of year 2020, and VSL our estimates of the VSL based on extrapolation from the 2015 US base. Infection costs in the third column are found by multiplying the number of deaths by VSL. Note that the figures in the table are not normalized for population. Infection costs in countries on top three rows (China, South Korea, and Australia) are relatively small, measured in billions, mainly reflecting fewer deaths registered in these countries. Infection costs are much higher for Germany, the US, and Belgium in the table, and in the US in particular, the infection costs were beyond 3 trillion dollars. Economic costs are also substantial, and in the countries in top three rows, they are larger than infection costs. In the US and Belgium, we see that while economic costs are large, they are smaller than even larger infection costs these two countries incurred in 2020. China is notable with the economic costs over 1 trillion dollars, much larger than infection costs. Reflecting these cross-country variations, the last column reports a fairly wide range of values for the ratio of infection costs over economic costs. For the six countries in consideration, the ratio varies from 0.0057 for China (overly strict social distancing) to 3.3314 for Belgium (overly lax social distancing).

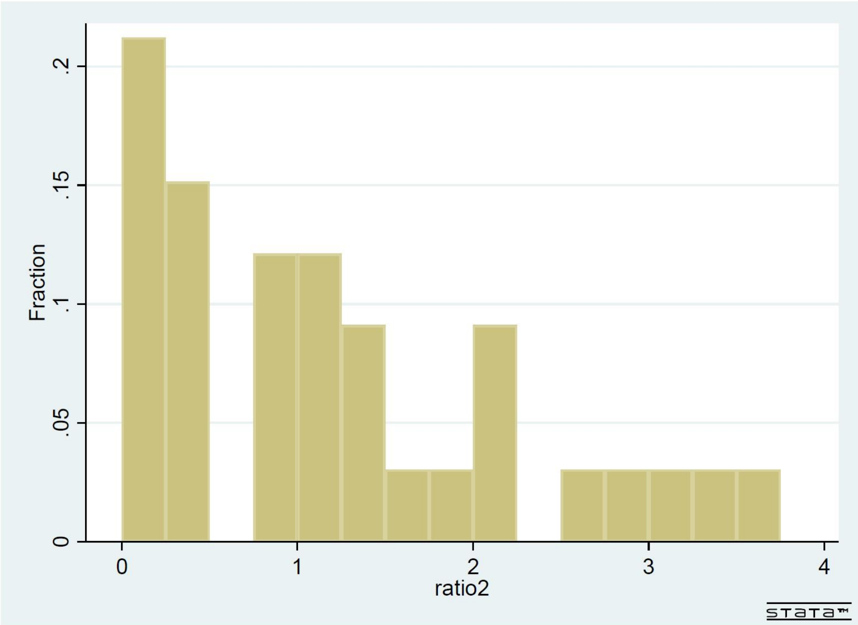
Figure 2 presents a scatterplot juxtaposing economic costs against infection costs in international comparison. Each dot in the plot represents one of 158 countries for which we have been able to estimate these costs. The red straight line superimposed on the plot is the 45-degree line, signifying parity between economic costs and infection costs. The countries above the line suffered infection costs higher than economic costs. Had they been able to be more strict in social distancing, they should have been able to cope with the pandemic with lower total costs. The vast number of countries located below the line incurred economic costs larger than infection costs, meaning that they could have relaxed their measures of social distancing and reduce the total costs.



<Figure 2> Economic costs *vs.* infection costs: international comparison (in USD)



<Figure 3> The frequency distribution of the ratio infection costs/economic costs: whole sample (158 countries)



<Figure 4> The frequency distribution of the ratio infection costs/economic costs: high income countries (with per capita GDP over USD 20,000; 34 countries)

Figures 3 and 4 are histograms, showing the frequency distributions of the ratio of infection costs over economic costs, for the whole sample (Figure 3) and for the high-income subsample (Figure 4), respectively. The high-income subsample has 34 countries with per capita GDP over USD 20,000. Figure 3 demonstrates vividly that the global community in general has overreacted to the pandemic scare in terms of social distancing. In a one-sample *t* test, we very strongly reject the null hypothesis that the mean value of the ratios is 1. See Table 3 for detailed results. In Figure 4, the frequency distribution is more closely concentrated around the value of 1 for high-income countries, even though there is no bunching around the value. The results from the one-sample *t* test for the high-income subsample are also presented in Table 3, and do not reject the null hypothesis that the mean ratio is one.

4. Discussion and concluding remarks

We have applied a simple framework with fairly light data requirements and assessed efficiency in the global practice of social distancing, and found that the intensity in social distancing was overly strict in a majority of countries during the first year of the pandemic. We used the annual time frame to compare

Sample	Obs.	Mean	Std. Err.	Std. Dev.	*T*	Lower B. (95% CI)	Upper B. (95% CI)
Whole sample	158	0.4661	0.0680	0.8549	-7.8495	0.3317	0.6004
High-income	34	1.1785	0.1816	1.0591	0.9828	0.8089	1.5480

<Table 3> Results from one-sample *t* tests against the null hypothesis of parity between two costs

infection and economic costs. In countries where GDP estimates are expediently made available in a higher frequency, it might be possible to put the paper's framework to a practical, "ballpark"-style assessment of the social distancing practice, for instance on a quarterly basis.

An ideal and more rigorous assessment of efficiency in social distancing as a response to the COVID-19 pandemic would require a set of elaborate models and a range of reliable data. For instance, Thunström and others (Thunström et al., 2020) used an SIR (Susceptible Infectious Recovered) epidemiological model to estimate expected numbers of deaths and used macroeconomic forecasts from the global consulting firm McKinsey under different scenarios of social distancing to "flatten out" the curve in the initial phase of the pandemic. An obvious drawback of rigorous approaches for a practical global assessment is the unavailability of parameter estimates and other data required for a large number of countries. Striking the appropriate balance between saving lives and keeping the economy afloat is an urgent challenge across the world. Our hope is that the simple conceptual framework and the economy in data requirements in our "ballpark" efficiency assessment might provide a practically useful data point for desperate policymakers in the developing world.

For the whole sample, it was obvious that the vast majority of countries in the world were erring on the overly strict side of the balance, that is, on the right-hand side of the optimal distancing level D^* in Figure 1. We have already noted that both infection costs and economic costs are likely to be underestimated in our approximations. In the ratio of infection costs over economic costs, the extent of underestimation is most probably the larger for the denominator, that is, the economic costs. This implies that in the absence of measurement errors the distribution of the values of the ratio of infection costs over economic costs should tilt further to the left, rendering the ratios for countries even further away from unity and closer to zero.

Assuming no measurement error, parity between infection costs and economic costs should be desired in the normative sense, as a society struggles to cope with the pandemic at lowest possible costs. We surmise at the same time that there might also be a positive tendency for the ratio to converge to one over time. This would be the case, for instance, if the political processes in a given society are successful in incorporating diverse interests and voices among the public in an efficient manner. This observation suggests two natural extensions to the study this paper reports. When the GDP data become available for 2021, we should be able to check whether countries do migrate closer to the 45-degree line in a chart like Figure 2. As well, we could investigate what political, social, or cultural factors correlate with the distance between their infection costs/economic costs ratios and unity.

References

Baker, T., Schell, C. O., Petersen, D. B., Sawe, H., Khalid, K., Mndolo, S., ... & Molyneux, E. (2020). Essential care of critical illness must not be forgotten in the COVID-19 pandemic. *The Lancet*, *395*(10232), 1253-1254.

Groarke, J. M., Berry, E., Graham-Wisener, L., McKenna-Plumley, P. E., McGlinchey, E., & Armour, C. (2020). Loneliness in the UK during the COVID-19 pandemic: Cross-sectional results from the COVID-19 Psychological Wellbeing Study. *PloS one*, *15*(9), e0239698.

Kniesner, Thomas J., and Viscusi, W. (2019). The Value of a Statistical Life, *Oxford Research Encyclopedia, Economics and Finance.* Oxford University Press.

Neidhöfer, G., Lustig, N., & Tommasi, M. (2021). Intergenerational transmission of lockdown consequences: prognosis of the longer-run persistence of COVID-19 in Latin America. *The Journal of*

Economic Inequality, *19*(3), 571-598.

Robinson, A. Lisa., Hammit, James K., and O'Keeffe, Lucy. (2019). Valuing Mortality Risk Reductions in Global Benefit-Cost Analysis, *Journal of Benefit-Cost Analysis, 10(S1):15-50.* doi:10.1017/bca.2018.26.

Thunström, L., Newbold, Stephen C., Finnoff, D., Ashworth M., and Shogren Jason F. (2020), The Benefits and Costs of Using Social Distancing to Flatten the Curve for COVID-19. *Journal of Benefit-Cost Analysis 11(2):*179-195. doi:10.1017/bca/2020.12.

Viscusi, W., & Masterman, C. (2017). Income Elasticities and Global Values of a Statistical Life. *Journal of Benefit-Cost Analysis, 8(2), 226-250.* doi:10.1017/bca.2017.12.

von Wachter, T. (2020). Lost generations: long-term effects of the COVID-19 crisis on job losers and labour market entrants, and options for policy. *Fiscal Studies*, *41*(3), 549-590.

Wright, A., Salazar, A., Mirica, M., Volk, L. A., & Schiff, G. D. (2020). The invisible epidemic: neglected chronic disease management during COVID-19. *Journal of general internal medicine*, *35*(9), 2816-2817.

World Bank. (2021). *Global Economic Prospects*, June 2021.

Yelin, D., Wirtheim, E., Vetter, P., Kalil, A. C., Bruchfeld, J., Runold, M., ... & Leibovici, L. (2020). Long-term consequences of COVID-19: research needs. *The Lancet Infectious Diseases*, *20*(10), 1115-1117.