

The Benefits and Costs of Social Distancing in Rich and Poor Countries

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Abstract

Social distancing and widespread lockdowns of everyday activity have been the primary policy prescription through the first stage of the COVID-19 pandemic. Despite their uniformity across many countries, these policy measures may inherently be differentially valuable for different countries. We estimate the value of disease avoidance using an epidemiological model to project the spread of COVID-19 in poor and rich countries. In high-income countries social distancing measures that “flatten the curve” of the disease to bring demand within the capacity of healthcare systems are predicted to save many lives, such that practically the economic cost of lockdowns are worth bearing. These same social distancing policies however, are estimated to be less effective in poor countries that have younger populations, which are less vulnerable to COVID-19. Equally importantly, social distancing mandates a tradeoff between disease risk and economic activity. Poorer people are less willing to make those economic sacrifices: they place relatively greater value on their livelihood concerns compared to contracting COVID-19. Not only are the epidemiological and economic benefits of social distancing much smaller in poorer countries, such policies may exact a heavy toll on the poorest and most vulnerable. Workers in the informal sector lack the resources and social protections to isolate themselves and sacrifice economic opportunities until the virus passes. By limiting their ability to earn a living, social distancing can lead to an increase in hunger, deprivation, and related mortality and morbidity. Rather than a blanket adoption of social distancing measures, we advocate for alternative harm-reduction strategies, including universal mask adoption and increased hygiene measures.

The COVID-19 pandemic has generated furious debate about what public health measures might prove most effective at managing the spread of the disease. Without a vaccine for the novel coronavirus, governments across the world have implemented social distancing and lockdown measures designed to “flatten the curve” of the pandemic. The goal of shutting down a country is to minimize transmission rates for a sufficient duration so as to allow more targeted testing and tracking measures to be effective in slowing the spread of the virus and minimizing pressure on healthcare systems. In parallel to the implementation of these public health measures, a conversation has emerged about the economic consequences of lockdown and suppression, especially

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within low-income countries. With social distancing having become the universal strategy against COVID-19, a question emerges: was shuttering the economy for months a reasonable cost to pay?

The answer for the United States and other high-income countries with significant mortality risk from the coronavirus appears to be yes. By assigning an economic value to the mortality risk of COVID-19, it becomes clear that the cost of *not* intervening in rich countries would be enormous. In other words, according to any reasonable benefit-cost metric, social distancing interventions and aggressive suppression are overwhelmingly justified.

The purpose of this paper is to quantitatively explore the value of varying suppression strategies in low- and middle-income countries. There are a number of demographic and infrastructural reasons why the benefits of lockdowns to suppress COVID-19 may co-vary with the income level of a country. Lower income countries have relatively younger populations, and the predicted mortality of COVID-19 increases sharply with age (Verity et al. 2020). Therefore the majority of the population in poor countries is predicted to face a relatively low mortality risk from the coronavirus. It remains possible that comorbidities and endemic disease more common in poor countries, such as malnutrition and tuberculosis, may negatively interact with COVID-19 infection to produce higher mortality rates; this is currently a topic of active research (Clark et al. 2020). However, the limited infrastructure of the healthcare systems in poor countries means that they are comparatively less capable of absorbing a rapid influx of COVID-19 patients, such that it may be infeasible to flatten the curve of the disease to fall within capacity without more significant lockdown or mitigation efforts.

The economic welfare value of reducing mortality risk from COVID-19 may also be lower in poorer countries as their population is less willing to trade off their economic livelihood. By definition, the poorest individuals and households live close to subsistence levels. As a result they are necessarily willing to accept higher risks to earn a living than richer people who may enjoy savings or social welfare systems to sustain them through a prolonged lockdown. Many more workers in poor countries are self-employed or in the informal sector and depend on daily wages to feed their families. In the absence of strong social protection and insurance, the cost imposed by social and economic distancing may be large in terms of immediate deprivation and hunger. This difference in risk valuation reflects a necessary determination by people who are unwilling to trade their livelihoods for a reduction in probabilistic risk. Poorer households may not be able to comply

with lockdown orders, and countries with relatively weak enforcement capacity may end up with the worst of both worlds: a shuttered formal economy, but continued informal economic activity leading to the continued spread of COVID-19.

To determine the relative value of suppression strategies in rich versus poor countries, we embed estimates of the country-specific costs of mortality into the influential epidemiological model developed by the the Imperial College London COVID-19 Response Team that predicts cross-country mortality from the spread of the virus (Walker, Watson, et al. 2020; Ferguson, Laydon, Nedjati-Gilani, et al. 2020; Walker, Whittaker, et al. 2020). Greenstone and Nigam (2020) adapt an early version of this model to assign an economic value to COVID-19 mortality in the United States. They predict that social distancing measures will save 1.76 million lives (both directly, and indirectly by reducing hospital overcrowding), with a total welfare value of 7.9 trillion dollars. Widespread social distancing and stay-at-home orders may create economic hardship in the United States, but this leaves no room for debate about the value of this public health intervention. We conduct a similar exercise for all rich and poor countries to explore whether such a policy prescription applies uniformly, or whether more nuanced thinking and analysis is required in the case of low-income countries.

1 Mortality

We generate mortality predictions for SARS-CoV-2 epidemic trajectories across five non-pharmacological intervention scenarios using an age-structured compartmental SEIR model designed by the Imperial College London COVID-19 Response Team (Walker, Watson, et al. 2020). The model simulates the spread of the novel coronavirus in each country and resultant hospitalizations and fatalities, according to that country’s demographic structure and healthcare capacity. We model each country’s population at the start of the pandemic, where everyone is initially susceptible. As the virus spreads, more of the population becomes exposed, then infected, and then recovers. Infected individuals either experience a mild infection or a more severe form that requires some form of hospitalization. Hospitalized cases are further split between those requiring intensive treatment and those requiring routine hospital care. The model assigns an age-specific mortality probability to individuals that receive hospital care, and a higher mortality likelihood to individuals that require but cannot

receive hospital care due to capacity constraints. The speed with which the virus spreads, and the fraction of the population that is ultimately infected, is largely determined by the estimated infectivity (R_0) of the virus. Using a base estimate of the infectivity for COVID-19 of 3.0, we estimate mortality rates under different scenarios where we temporarily modify the infectivity of the virus to represent the implementation of a social distancing policy in each country. We consider five scenarios:

1. The unmitigated spread of COVID-19, where the virus progresses through each country at a high level of infectivity.
2. The implementation of an “individual” distancing policy, similar to the case of a country like Sweden where workplaces, schools, and restaurants mostly remain open but large gatherings are discouraged, reducing infectivity by 20%.
3. A broad social distancing policy, equivalent to the closure of schools and workplaces, that reduces infectivity by 50%.
4. An even more intensive social distancing policy with targeted stay-at-home orders, “social distancing+” that reduces infectivity by 66%.
5. Full lockdown policies designed to entirely suppress social contact, closing transit and stay-at-home orders for the entire population, reducing infectivity by 80%.

In each of these scenarios we allow the policy to remain in effect for a duration of forty days, representing the average duration of most lockdown and social distancing policies around the world, with Google mobility data indicating that mobility was significantly increased after forty days from lockdown.¹ After forty days the simulated policy is lifted and the R_0 of the virus returns to its base level of infectivity, set at 3.0. We have chosen a one-shot policy due to its relative simplicity. While rolling lockdowns have been proposed as an effective way of combating the spread of the coronavirus, we are skeptical as to the capacity of any government being able to repeatedly implement and terminate lockdown orders. In countries with limited state capacity, and the majority of the workforce in the informal sector, there are few policy tools to implement sophisticated partial

1. *COVID-19 Community Mobility Reports*.

lockdowns. Whether the infectivity of the virus should return to its prior level post-lockdown is an open question. Individuals and households may naturally change their behavior, even absent government policy, to reduce the spread of COVID-19. However, if a significant proportion of transmissions to occur through the workplace or on public transportation, unavoidable to most people returning to work after a lockdown, then the infectivity of the virus may necessarily rise.

Our analysis includes 178 countries, which we aggregate according to their 2020 World Bank income classification: high-, upper-middle, lower-middle, and low-income economies (“World Bank Country and Lending Groups” 2020). Data on life expectancy for each age group is given by the World Health Organization Global Health Observatory (Organization 2020). We run a grid search at a 3-day resolution to find the most optimal timing for each social distancing and lockdown policy in each country. In this way we only consider the impact of optimally timed policies, as though a government could have the foresight over the exact date on which to implement a policy, and as such these represent a best-case scenario for policies designed to suppress COVID-19.

Figure 1: What is mortality risk from COVID-19 by country?

Figure 1 shows predicted mortality from the spread of COVID-19 for a set of countries. For richer countries like the United Kingdom and the United States the model predicts that the unmitigated spread of COVID-19 would lead to more than 1.2% dying. In the same scenario in poorer countries, such as Nigeria, Pakistan, and Bangladesh, predicted mortality is approximately half that. Moreover, while mortality falls sharply in the United States and the United Kingdom when social distancing measures are imposed, the change in mortality is far less responsive in lower-income countries. We aggregate total predicted mortality under each scenario by total population across all four income groups in Figure 2, finding that expected mortality is lower in poorer countries despite their comparatively more limited health care systems.²

2. The global mortality predicted from the unmitigated spread of COVID-19 is over 135 million. For context, the H1N1 Spanish influenza of 1918 is estimated to have killed between 50 to 100 million people, somewhere between .95% and 5.4% of the world population at the time. See: Johnson and Mueller (2002) and Taubenberger and Morens (2006).

Figure 2: Percentage of Population Lost by Income Group and Intervention

1.1 Demographic risk profiles

The primary cause of the divergent mortality risk between countries of higher and lower income levels from COVID-19 is their demographic structure. High-income countries tend to have lower fertility rates and older populations; low-income countries tend to have higher fertility rates and younger populations. This is important because the mortality risk of COVID-19 varies considerably by age. Younger people appear to face relatively low mortality risk from the virus, and the mortality rate increases sharply among the elderly. Age-specific mortality parameter estimates are given in Figure 3. The proportion of cases requiring hospitalization increases with age, up to nearly 20% of the elderly, those age 75 and above. Of the patients hospitalized, a subset will require critical care, such as mechanical ventilation. We set a mortality rate of 50% across all ages for those requiring and receiving critical care, and a mortality rate of 95% for those requiring but not receiving critical care. For patients hospitalized but not requiring critical care, the mortality rate is low for those under the age of 60, reaching nearly 60% among the elderly. For people that would require but cannot receive hospital care due to capacity constraints, their likelihood of dying doubles, up to a maximum of 90% (Verity et al. 2020; Walker, Watson, et al. 2020).

A question that we cannot fully answer at this time is the likelihood of death for an infection that would require but does not receive hospital care. As there are currently no effective treatments for COVID-19 it is unclear whether non-critical cases are receiving lifesaving care in hospitals, or whether the support they receive only increases their comfort without significantly modifying their likelihood of dying.³ We consider a range of parameters for excess mortality in Section 2. A second concern is that the epidemiological model does not account for the higher burden of infectious diseases and chronic illness in low-income countries, particularly in children. If these factors negatively interact with COVID-19 this could lead to an under-estimate of mortality in low-income countries (Walker, Whittaker, et al. 2020; Walker, Watson, et al. 2020).

In Figure 4 we show the distribution of age groups in each population across countries that are

3. We discussed this question extensively with doctors working in hospitals in the United States, who discussed the difficulty of even defining which cases needed to be hospitalized, as well as the difficulty of understanding how hospital treatment improved survival.

Figure 3: Estimated Risks of COVID-19 by Age Group

Figure 4: Population distribution of high and low income countries

classified as either high- or low-income. Each point represents the fraction of the population within that age range in a country. Where the population structure in higher income countries is more evenly distributed across the entire age range, the population in lower-income countries is heavily skewed younger. This skewness means that lower income countries have a much smaller fraction of their population that is predicted to be hospitalized or die from COVID-19 if they contract the virus.

1.2 Medical system capacity

The spread of COVID-19 has threatened to overwhelm the medical system of many countries. One benefit to social distancing policies that reduce infectivity, flattening the curve of the disease's trajectory, is to spread the number of infections across a longer period of time, allowing more patients to be accommodated by existing infrastructure. In poorer countries with more limited healthcare capacity—proxied by the number of hospital and ICU beds—it may be impossible to sufficiently flatten the curve of COVID-19 sufficiently so that patient demand can be met.

In Figure 5 we plot the estimated demand for healthcare under two scenarios as a percentage of existing capacity in a high- and low-income country, Bangladesh and the United States, respectively. The first scenario involves the unmitigated spread of COVID-19 in both countries, and the second involves the suppression scenario: intensive social distancing that reduces the virus infectivity by $\frac{4}{5}$ for a period of thirty-five days. Assuming identically implemented and effective policies in both countries, suppression is effective at allowing existing U.S. healthcare infrastructure to accommodate demand, while the healthcare infrastructure in Bangladesh is overwhelmed in either case. In Bangladesh the unmitigated spread of COVID-19 leads to excess demand that peaks at approximately 250% of hospital bed capacity; under an intensive social distancing policy excess demand peaks at approximately 220%. In the United States an identical policy would drop peak demand from 134% of capacity to approximately 105%. It is feasible to imagine policies to increase

Figure 5: Hospital and ICU demand in Bangladesh and the U.S.

capacity by five percentage points in the case of the United States, it seems less likely that the number of hospital beds could increase by 200% in any country over a month.

2 Differences in the Economic Value of Non-Pharmaceutical Interventions in Rich and Poor Countries

Increasing social distancing measures save an increasing number of lives. We are interested in determining the relative value of distancing and lockdown measures in different countries. To do so we embed country-specific estimates of the welfare value of risk reduction, the value of a statistical life (VSL) and the value of a statistical life-year (VSLY), into our mortality predictions (Viscusi and Masterman 2017; Robinson, Hammitt, and O’Keeffe 2019).⁴ This allows us to translate between the change in predicted mortality and the social welfare benefit this would provide each country.

It is important to emphasize that social distancing policies are a form of risk reduction. We can predict in expectation how many lives each policy may save, but we cannot know exactly which person will benefit. The spread of COVID-19 is not eliminated under any feasible form of social distancing, but the likelihood of mortality can be reduced. To provide a valuation for this probabilistic reduction we use the VSL, a metric of the economic value of risk. The VSL is derived from studies of how individuals accept mortality risks, whether as a result of their occupation or from external environmental sources or disease, on a regular basis when appropriately compensated. Adding up the value that people assign to small changes in probabilistic risk provides an estimate of the monetary welfare value that people assign to saving one such *statistical* life. The VSL is in no way a measurement of the economic productivity that a person provides, but rather is based on how individuals themselves assign value to the risks they face.⁵

Figure 6 displays the estimated dollar value of total losses from deaths under each intervention scenario when the Viscusi and Masterman (2017) VSL estimates are embedded in the mortality

4. We use the country-adjusted VSL from Viscusi and Masterman (2017). Alternative VSL estimates from Robinson, Hammitt, and O’Keeffe (2019) are used as a robustness check.

5. One way of understanding the VSL is through a recent strike by Instacart workers in the United States during this pandemic, who are demanding an additional \$5 in hazard pay per order as compensation for their increased exposure to the disease (Olson and Anderson 2020).

Figure 6: What is the estimated VSL lost for each country?

predictions. The cost of leaving COVID-19 uncontrolled in the United States is unambiguously large. This is due to higher predicted mortality rates in the United States relative to other countries and the higher base VSL. In comparison to U.S. losses, the dollar costs of uncontrolled COVID-19 in large countries such as Pakistan or Nigeria look minuscule. A more relevant question for any country-specific policy is the total cost of COVID-19 mortality under each scenario relative to that country's own GDP.

Figure 7: What is the relative VSL lost for each country?

Figure 7 shows a comparison of the VSL lost by scenario and country as a fraction of GDP, with the United States benchmarking losses in high-income countries. Without mitigation efforts COVID-19 imposes a large relative welfare cost in high-income countries—approximately 200% of the GDP of the United States. In contrast, in the unmitigated scenario the losses in India, Bangladesh, Pakistan, Nigeria, Nepal are approximately half that, when scaled against their own GDP.

Figure 8: Estimated Value of COVID-19 Intervention by Income Group

The other lesson from Figure 7 is that moving from a policy of doing nothing to imposing social distancing yields a large welfare improvement in rich countries. We show the estimated marginal value of an increasing social distancing policy in Table 1. The marginal value of imposing even minor individual distancing measures in high-income countries is large, approximately 43% and 33% in the United Kingdom and the United States, respectively. An identical policy in Mexico only yields a welfare benefit of approximately 19% of its GDP, and 6% of GDP in Bangladesh. Moving from a policy of individual distancing to one of full social distancing policy, decreasing the infectivity of COVID-19 to 50% of its base value for a period of 40 days, yields a welfare value increase equivalent to 66% of the UK's annual GDP and 46% in the United States. The same increase in policy stance in India yields a welfare increase equivalent to 8% of its GDP, and and in Bangladesh 6% of its GDP. Increasing social distancing measures yield significant welfare improvement in richer countries, in

Table 1: Marginal Value of COVID-19 Interventions (Δ VSL/GDP)

Strategy	Income Group								
	High		Upper-Middle		Lower-Middle				Low
	UK	US	Mexico	S. Africa	India	Bangladesh	Pakistan	Nigeria	Nepal
Unmitigated	—	—	—	—	—	—	—	—	—
Individual distancing	21.7	18.6	9.8	7.5	4.6	4.5	2.7	4.2	3.7
Social distancing	42.9	34.8	19.0	13.0	10.0	8.6	6.6	8.4	7.9
Social distancing+	39.8	30.1	18.3	7.9	8.1	7.0	6.5	6.0	7.0
Suppression	28.3	13.0	4.9	2.1	5.2	0.7	4.1	0.2	1.5

Figure 9: Population Averaged Life Expectancy by Income Group Classification

poorer countries this value declines quickly. The non-monotonicity in welfare improvement for some countries moving from social distancing+ to suppression is due to a larger second wave of the virus: reducing transmission by too much too quickly can lead to even more deaths than a less stringent policy.

2.1 Value of Statistical Life-Years

The VSL is most appropriately used to assign value to mortality risk reduction when the benefits are spread across a population. In the case of COVID-19 however, the majority of risk reduction is concentrated among the elderly. As shown in Figure 3, the risk of hospitalization and dying from the coronavirus increase sharply with age. If social distancing and lockdown policies reduce mortality risk differentially across age groups, we may wish to account for the number of expected life *years* saved under any policy. This is not to privilege saving young versus old lives, but rather to provide a more granular metric by which to estimate the welfare value of risk reduction.

The value of a statistical life year (VSLY) is derived by dividing the country specific population-averaged VSL by the life expectancy of a working-age person, someone between the ages of 20-64 (Robinson, Hammitt, and O’Keeffe 2019). Population averaged life expectancy for each income group is shown in Figure 9, with working ages of 20-64 shaded in gray. We see that life expectancy declines linearly with age, and a clear separation in life expectancy at all ages between income groups.

Table 2: Marginal Value of COVID-19 Interventions (Δ VSLY/GDP)

Strategy	Income Group								
	High		Upper-Middle		Lower-Middle				Low
	UK	US	Mexico	S. Africa	India	Bangladesh	Pakistan	Nigeria	Nepal
Unmitigated	—	—	—	—	—	—	—	—	—
Individual distancing	6.7	6.6	4.2	3.4	2.1	2.1	1.2	2.4	1.6
Social distancing	14.3	12.8	8.3	6.1	4.5	4.2	3.1	4.4	3.3
Social distancing+	13.9	11.4	7.5	3.5	3.4	3.1	3.1	2.8	2.9
Suppression	9.7	5.8	2.7	1.6	2.8	0.0	1.5	0.7	0.7

In Figure 10 we reproduce our analysis from Section 2 using VSLY. Continuing to use the United States as the benchmark for high-income countries, we see that the value of social distancing remains significantly higher in richer countries. However there is a pronounced level shift in the welfare value of social distancing between Figures 7 and 10. Accounting for the risk profile of COVID-19—where the majority of risk reduction is accrued by the elderly—means that there are relatively few years saved in expectation by lockdown and suppression policies. Accordingly, the welfare value of these interventions is less than a static valuation of welfare.

Figure 10: What is the value of social distancing for each country?

The marginal value of an increasing policy stance remains small in poorer countries. Where we estimate social distancing to provide a welfare value equivalent more than 30% of GDP in countries like the United Kingdom and the United States, an identical policy produces a welfare gain of less than 10% in lower-middle and low-income countries as shown in Figure 11. Using the VSLY instead of the VSL corroborates our conclusion that the value of social distancing and other measures to suppress COVID-19 is unequally distributed between rich and poor countries.

Beyond the level shift when evaluating the value of social distancing policies in rich and poor countries, our conclusion about the relative value of these interventions remain the same. There is a steep welfare gradient for rich countries implementing increasingly suppressive measures. We estimate a much smaller marginal value to each intervention for poorer countries, where lower life expectancies means that identical measures save fewer years.

Figure 11: VSLY by income group

2.1.1 Limitations of the VSL

A concern with using the VSL and the VSLY to provide estimates of the welfare value of COVID-19 interventions is the degree to which they are determined by the income level of people in each country. Willingness to accept compensation for increased risks is decreasing as income rises. That people in poor countries accept greater risks for lower compensation, leading to a lower estimate of their VSL, is due to necessity rather than some idiosyncratic tolerance for risk. That people must choose between accepting mortality risk from disease and mortality risk from not working or being able to generate an income is terrible, but it is a choice that individuals must make.

Another concern with using the VSL to estimate the social welfare value of changes in mortality risk reduction, is that the VSL is estimated using very small changes in the relative risk of dying. Individuals typically choose to accept changes in mortality risk on the order of an increase of 1 in 10,000. The different COVID-19 mitigation scenarios under consideration shift estimated mortality rates more drastically: two to three orders of magnitude larger. It is unclear how accurately we can extrapolate the VSL to capture the welfare value of large shifts in risk reduction under different COVID-19 suppression policies.

3 Differences in the Cost and Efficacy of Interventions in Rich and Poor Countries

Underpinning the relatively modest estimated value of mitigation and suppression policies in poorer countries are three critical factors. First, in poor countries there are fewer old people to who can benefit from targeted distancing. The elderly also more frequently reside in multigenerational households, so their contact rates with others can only be reduced so far. Second, the relatively low hospital and ICU capacity at baseline in poorer countries means that flattening the mortality curve is unlikely to be sufficient to prevent hospitals from being overwhelmed. Third, the economic opportunity cost of social distancing is larger in poorer countries, and the VSL is therefore lower. Simply put, rich people can more easily meet their basic needs while social distancing, while a poor

Figure 12: Distribution of self- or informally employed workforce by income group

person may need to prioritize income-generating opportunities to put food on their family's table.

Beyond the much smaller benefits of COVID-19 mitigation in poorer countries, workers in these countries are also more vulnerable to the disruption of the economy. They are more likely to rely on a daily cash wage, their work is hands-on and cannot be done while social distancing. Figure 12 shows the distribution of the percentage of workers either self- or informally-employed. Such workers do not always appear in government and bureaucratic records. So even if a social insurance policy were implemented in these countries, it is uncertain how quickly such people could be located, if at all, to deliver relief benefits to them.

The social distancing and suppression interventions pioneered in Wuhan, China, and enacted throughout Europe and the United States, have relied on government support systems. Many workers throughout Europe received their salaries, and U.S. taxpayers will receive a stimulus check. By contrast, efforts by the Indian government to impose a lock-down appear to have had significant negative consequences for the most vulnerable members of its population. Interviews with workers from the informal sector tell a story of impending poverty, evictions, and hunger, as their incomes and work opportunities have been curtailed. Migrant laborers in India's largest cities, now without access to employment, are without food or shelter. Many are in the process of literally walking back to their homes, with deaths along the journey already being reported.⁶ The mortality consequences to macroeconomic economic shocks are not straightforward, but cross-country results find that a 1% decrease in GDP can lead to an increase in infant mortality between 0.24 and 0.40 per 1,000 children born (Baird, Friedman, and Schady 2011).⁷

6. See: Abi-Habib and Yasir (2020a, 2020b), BBC (2020), and Tewari (2020). Abi-Habib and Yasir (2020b) quote one migrant laborer saying: "You fear the disease, living on the streets. But I fear hunger more, not corona." Another migrant construction worker is quoted saying "I earn 600 rupees every day and I have five people to feed. We will run out of food in a few days. I know the risk of coronavirus, but I can't see my children hungry" (BBC 2020).

7. See: Paxson and Schady (2005), Cutler et al. (2002), and Bhalotra (2010) for country-level studies on the effect of economic shocks on health outcomes.

4 Policy Discussion

The COVID-19 pandemic represents a serious threat in every country. A policy response is necessary, the benefits to each policy must be carefully weighed against the economic cost and risks imposed on that society. The most widely-cited model of COVID-19 transmission and mortality shows that we should expect fewer deaths in poor countries, and that social distancing policies in these countries produce smaller benefits. Much of this result is based on differences in the age distribution across countries, because our present understanding is that COVID-19 mortality risk increases dramatically with age. It is uncertain whether this relationship will remain robust in poorer countries where younger people have higher rates of chronic illness and endemic disease. Given the later start date of epidemics in lower income countries, extensive data characterising such comorbidities is lacking, however, early reports from a population cohort analysis in the Western Cape province of South Africa suggests that people with HIV have an increased risk of COVID-19 death (Davies and Boule 2020). Yet even permitting an overestimate of deaths in rich countries and an underestimate in poor countries, the differences in imputed welfare benefit remain vast. Given the deeper concerns about the risks that economic shutdowns pose on the most vulnerable members of low-income societies (Saleh and Cash 2020), it remains unclear whether the value of the most stringent suppression policies in poor countries outweighs the uncertain economic costs.

We know that workers in low-income countries are younger and less likely to develop a severe infection due to COVID-19. We know that workers are also more vulnerable to economic disruption, and may be unable to adhere to lockdown orders. Various government and non-governmental organizations are currently playing an important role to avert outright starvation during the pandemic by providing free meals, food supplies, and fuel to poor households. Supply chains within countries have been disrupted by lockdown measures, making it increasingly difficult to deliver food (Purohit 2020). Ray and Subramanian (2020) suggest permitting people under the age of 40 to work during lockdown as a way of mitigating the economic costs to COVID-19 suppression. Indeed, the recent example of India demonstrates our concern about the capacity of states to enforce suppression strategies, and where imperfect compliance may lead to an increase in transmission to other vulnerable populations (Agrawal 2020). Ravallion (2020) highlights the tradeoff inherent to COVID-19 mitigation strategies between the risks of the disease, and the deprivation and hunger

that will result from prolonged economic disruption. Early analyses of the effect size of reductions in population mobility due to lockdowns indicates that suppression strategies have been less effective at reducing the effective reproduction number below 1 in lower income settings (Nouvellet, Bhatia, Cori, et al. 2020). Consequently, although the implemented suppression strategies have undoubtedly slowed epidemic progression, affording lower income countries invaluable time to prepare, it seems likely that COVID-19 will continue to spread within these countries and alternative intervention approaches will need to be explored.

The social distancing policies implemented in European countries and the United States may well be entirely applicable to other parts of the world. Nevertheless, a serious assessment is urgently required to determine what other measures could effectively preserve lives and aggregate welfare. Efforts now are needed to apply individual based models, such as the Imperial College model used for forecasting the impact of non-pharmaceutical interventions, to lower income settings to explore the sensitivity of benefit estimates to changes in assumptions about compliance with distancing guidelines, enforcement capacity, and other behavioral adjustments. It is worth noting, however, that this application will require considerable understanding of how people's movement and behaviour has changed to date, with models needing to be calibrated to subregional trends before the effect size of alternative interventions can be estimated reliably. This effort is complicated by inadequate reporting systems in many countries, obfuscating the early dynamics of the epidemic in many countries. However, this approach will allow for the benefits of alternative policies to social distancing to be quantitatively explored. These include harm-reduction measures that may allow people in low income countries to minimize their risk from COVID-19 while preserving their ability to put food on the table:

- Increasing access to clean water and handwashing are likely to provide significant mortality risk reduction.⁸
- Universal mask wearing when outside, even with home-made cloth masks.⁹
- Targeted social isolation of the elderly and other at-risk groups will save lives while permitting individuals with lower risk profiles to continue to work.¹⁰

8. Glassman, Chalkidou, and Sullivan 2020.

9. Abaluck et al. 2020.

10. *COVID-19 control in low-income settings and displaced populations: what can realistically be done?* 2020; Favas

- If widespread social distancing is pursued, then efforts must be made to get food, fuel, and cash into the hands of the people most at risk of hunger and deprivation.

A Robustness checks

A.1 Alternative estimates of the VSL

We re-estimate the relative value of lockdowns and social distancing interventions using the VSL for low- and middle-income countries provided in Robinson, Hammitt, and OKeeffe (2019), which uses a higher income elasticity for mortality risk valuation.¹¹ In Figure 13 we show estimates of the relative VSL lost for each country under each intervention. The shaded points represent estimates using the VSL from Robinson, Hammitt, and OKeeffe (2019), the triangles represent estimates from our primary analysis using the estimates from Viscusi and Masterman (2017). In Botswana, India, and Indonesia the relative value of intervention increases; in Bangladesh and Nigeria the relative value falls.

Figure 13: Alternative VSL

We show the difference between the relative value of each policy between our primary specification and using the VSL estimates in Robinson, Hammitt, and OKeeffe (2019) for middle- and low-income countries in Figure 14. On average our preferred specification estimates the relative value of interventions to be 13% higher than if we used the alternative VSL estimates.

Figure 14: Difference in Relative Value of Interventions Using Preferred and Alternative VSL Estimates

Figure 15: Difference in VSL estimates for low- and middle-income countries

11. Robinson, Hammitt, and OKeeffe (2019) use an income elasticity of 1.5, while Viscusi and Masterman (2017) use an income elasticity of 1.

A.2 Alternative excess mortality demand parameters

The epidemiological model distinguishes between COVID-19 cases that are severe—requiring hospitalization—and those that are critical—requiring intensive care. An open question is the likelihood of death for people who require but cannot access hospital or ICU care. In our primary specification we set the age-specific excess mortality parameter to be 100% that of people receiving hospital care, up to a mortality rate of 90%. For example, where the likelihood of a severe cases leading to death is 1.3% for a patient ages 0 to 39, we set the probability of death to 2.6% for patients in this same range that cannot access a hospital bed. Similarly a hospitalized patient age 80 and above dies 58% of the time, and without a hospital bed they die 90% of the time in our preferred specification (Verity et al. 2020; Walker, Watson, et al. 2020).

As there is presently no effective treatment for COVID-19, much of what is provided to patients in hospitals is considered supportive care. Supplemental oxygen provides relief to patients, but it is unclear whether it leads to a higher survival rate. Of course, if COVID-19 leads to other complications, hospitals are effective at treating those, which can dramatically reduce mortality.

We re-estimate mortality in our model across the same five scenarios using alternative excess mortality rates for severe non-hospitalized cases of four, six, and ten times that of hospitalized cases. We show these excess mortality rates by age group relative to the baseline rate of hospitalized severe cases (x1) in Figure 16. The relative value of social distancing in each scenario by excess mortality parameter is shown for a set of countries in Figure 17. The value of social distancing increases in the likelihood of death without hospital care. The peak of COVID-19 becomes proportionally more deadly when a patient requires but cannot access a hospital bed, increasing the value of “flattening the curve.” Figure 18 shows the distribution of the relative value of social distancing by income group, suppression strategy, and excess mortality parameter. Our estimate of the relative value of social distancing is the most sensitive to this parameter in countries that are high and lower middle income. In these countries the efficacy of hospital treatment, or the lack thereof, is a hugely important factor on which to condition the implementation of social distancing policies.

Figure 16: Alternative Parameters for Excess Mortality Rates by Age

Figure 17: Change in Relative Value of VSL by Excess Mortality Measures

Figure 18: Relative Value of Social Distancing by Income Group and Excess Mortality Parameter

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