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Dealing with Covid-19: understanding the policy choices

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Dealing with Covid-19: understanding the policy choices

Key takeaways

- *Containment policies save lives but restrict economic activity. Standard approaches to accounting for the value of human lives lend support to these policies despite their high short-term economic costs.*
- *Integrated epidemic-macroeconomic models provide a coherent framework for quantifying the costs and benefits of containment policies. Part of the benefit comes from limiting externalities that would otherwise arise if social distancing were purely voluntary.*
- *Standard epidemiological and economic parameters suggest that several months of strict containment policies that lead to as much as a 30% decline in GDP for the period of the lockdown could be preferable to alternatives with more casualties and a less severe recession.*

Introduction

The world has never been required to pay such a high price – effectively shutting down the global economy – to tackle a health crisis. Understanding the costs and benefits of these decisions is an important economic question, given its immense economic consequences. Although many aspects of Covid-19 remain unknown, most epidemiological studies suggest that, until a vaccine or an effective treatment becomes available, limits on social interactions are necessary to prevent the spread of infections from overwhelming the capacity of public health systems (eg Ferguson et al (2020)). In many countries, imposing these restrictions has involved shutting down large parts of the economy, creating an apparent trade-off between safeguarding public health and maintaining economic activity.

Economists have sought to evaluate this trade-off in two ways. One is to convert health and economic outcomes into a common unit of analysis so that costs and benefits can be compared. Typically, this involves putting a monetary value on the lives lost to the virus, which, though controversial philosophically, has been adopted in public policy evaluations whenever there has been a need to directly compare health benefits and economic costs.[1] The second approach is to simulate the joint evolution of health and economic outcomes within a single analytical framework, taking into account policies to contain the epidemic. This allows for counterfactual analysis and sheds light on principles that could guide an optimal policy response. This Bulletin reviews these complementary approaches, drawing on selected works that have proved influential in the recent debate.

Valuing lives saved

The first approach to evaluating the policy choices for dealing with the virus involves quantifying the lives saved under alternative containment policies. A standard tool for this exercise is the Value of a Statistical Life (VSL). The VSL measures how much a typical person would be willing to pay for a reduction in their

[1] For example, in evaluating environmental or safety regulations.

probability of death.[2] In conjunction with epidemiological projections of the number of lives lost under alternative virus containment policies, VSL allows a dollar value to be assigned to the resulting health outcomes, which can then be weighed up against the economic consequences of those policies.

Greenstone and Nigram (2020) present one such exercise, applied to the United States. They quantify the implications of three to four months of moderate social distancing policies, and compare these with an alternative scenario in which no policy measures are adopted to limit the spread of the virus. They estimate that the more active policies would result in 530,000 fewer deaths per 100 million people in the US.[3] Around two thirds of the decline would occur because fewer people would be infected with the virus, with the remainder being due to less overcrowding of intensive care unit (ICU) facilities. Using detailed age-specific VSLs estimated by US government agencies, they value these lives saved as equivalent to over one third of US annual GDP. Around 90% of these benefits accrue to people aged 50 or older, reflecting their much higher mortality risk from the virus.

These large estimated benefits of social distancing reflect the high value that US government agencies place on human life.[4] Applying the methodology to countries where government agencies assign lower VSLs leads to smaller estimated benefits of containment policies, even though the expected improvements in health outcomes are similar across countries (Graph 1, left-hand panel). Other modelling choices, such as whether to adjust VSL estimates for age or quality of life, can also affect benefit assessments. For example, Thunström et al (2020) find the benefits of social distancing to be more than 50% greater than Greenstone and Nigram (2020), despite the estimated number of lives saved being only two thirds as high, because they assign an equal value to all lives saved instead of assigning lower VSLs to older cohorts.

The appropriate stringency of containment policy depends on how the estimated value of lives saved compares against the economic cost of imposing social distancing. A rough estimate of the latter can be obtained by comparing GDP projections for 2020 made before and after the global lockdown. The IMF April and January forecasts of 2020 GDP growth in advanced economies are –6% and 2%, and for emerging markets –1% and 4%, respectively, suggesting an output loss of about 5–8% due to the lockdown (Graph 1, centre panel). Some private sector output loss estimates are closer to 10% (Boissay and Rungcharoenkitkul (2020)). On the one hand, these revisions could overstate the costs of containment policies, as some reduction in economic activity is likely to have occurred even in the absence of these policies (Graph 1, right-hand panel). On the other hand, the overall economic costs of containment policies could also be larger and more persistent than suggested by these forecasts, particularly if supply chains and labour market relationships are disrupted. Furthermore, recessions can lead to their own adverse health outcomes for individuals who lose their jobs. But if the value of lives saved is as high as suggested by VSL-based estimates, these additional costs would need to be quite substantial, ie in excess of 15–20% of annual GDP, for current containment policies to be counterproductive.

Modelling pandemic-macroeconomic interactions

The second approach to evaluating the appropriate policy response to the virus takes account of epidemic and macroeconomic interactions using coherent structural models. A key building block derives from a classic mathematical model of epidemics dating back to the 1920s, the Susceptible-Infected-Removed

2 In principle, the VSL is intended to capture the full benefits of preserving an individual life. VSLs are estimated in several ways, including by measuring the premium that consumers are willing to pay for products, like airbags in motor vehicles, that reduce the probability of death, as well as through surveys.

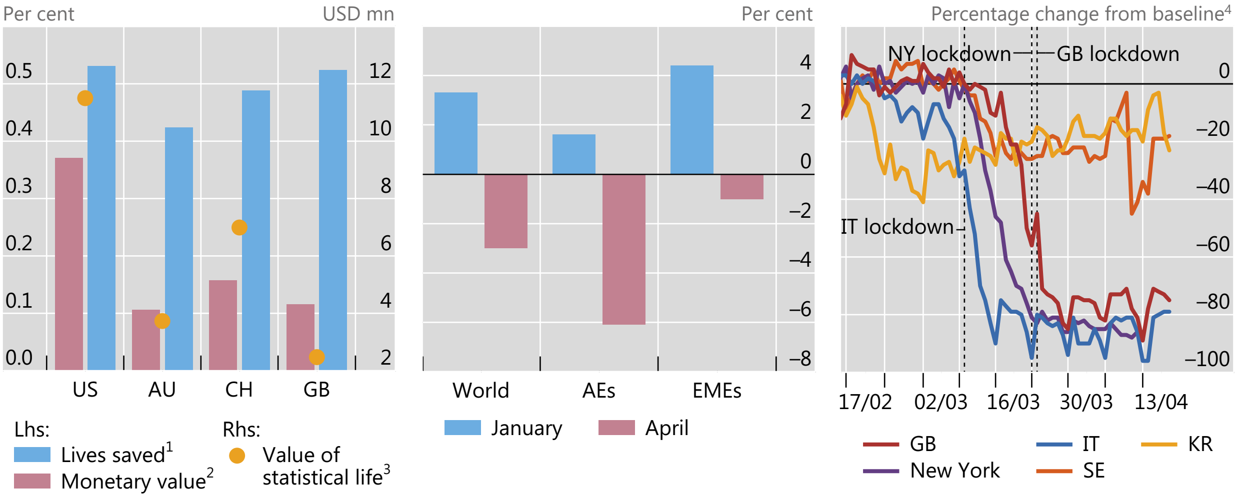
3 The definition of moderate social distancing is taken from Ferguson et al (2020), and includes seven-day isolation for those showing symptoms, 14-day voluntary quarantine for their households, and significant social distancing by those above 70 years of age. This "mitigation" policy is milder than the "suppression" variant that Ferguson et al (2020) recommend for the United Kingdom, but is one that Greenstone and Nigram (2020) argue is closer to the actual set of policies implemented in the United States.

4 The VSL estimates used in Greenstone and Nigram (2020) vary across age cohorts, ranging from USD 14.7 million for a child to USD 1.5 million for someone over 80.

(SIR) model.[5] The SIR model describes the evolution of a typical epidemic in a homogeneous "well mixed" population. When a new infectious disease breaks out, most of the population are "susceptible" to the disease, so that new infections grow rapidly. As more people become infected, they either die or recover and develop immunity, hence are "removed" from the susceptible population. This lowers the chance of new infections, slowing the spread of the disease. When the number of susceptible individuals becomes sufficiently small, the disease can no longer spread – the population has achieved herd immunity. The SIR model can be adjusted to fit the infectiousness of the disease, the rate at which infected individuals recover or die, and the extent of interactions between infected and susceptible individuals.

Benefits and costs of containment policies — Graph 1

Estimated monetary and health benefits of social distancing | GDP forecasts sharply lower since the outbreak of the virus | Retail traffic has fallen everywhere, especially in regions with lockdowns



[1] Lives saved from enhanced social distancing relative to no mitigation as a share of each country's initial population, assuming an initial virus reproduction rate of 2.4. [2] Value of lives saved as a share of 2019 GDP, calculated using country-specific Value of Statistical Life estimates assuming that the age distribution of fatalities matches that described in Greenstone and Nigram (2020). [3] Country-specific estimates in local currency units, converted into US dollars using 2019 average exchange rates. [4] Number of visits to retail and recreational facilities.

Sources: Greenstone and Nigram (2020); IMF, *World Economic Outlook*; Imperial College; national authorities; Google Mobility Trends.

What the classical SIR model does not capture is the feature that the contact rate between infected and susceptible individuals varies over time, depending on how the population reacts to the pandemic. The contribution of the recent economic literature is to fill that gap and embed the SIR model into a conventional macroeconomic model (SIR-macro).[6] By linking infection rates to economic activity, this approach enables a full characterisation of the optimal containment policy that balances health and economic considerations, and lends itself to quantitative analysis. It also allows an explicit modelling of the central externalities associated with a pandemic. A common finding of these models is that individuals' efforts to protect themselves against the virus mean that economic activity will decline even without a policy intervention. But these private responses will be too small if individuals ignore the effect of their behaviour on the spread of the epidemic and the health of others. Containment policy can internalise this externality and raise social welfare by coordinating public social distancing.

Graph 2 shows results from a simple SIR-macro model, to illustrate the general principles of combating a pandemic.[7] The left-hand and centre panels show the evolution of GDP per capita and

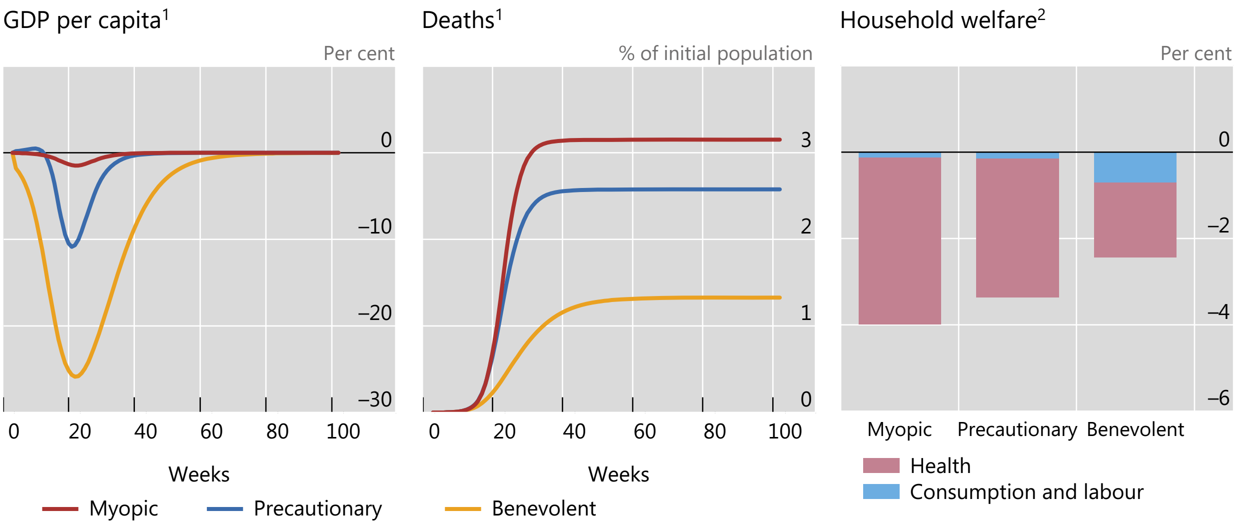
[5] See Hethcote (2000) for an overview of SIR models.

[6] See eg Eichenbaum et al (2020), Jones et al (2020), Bethune and Korinek (2020) and Álvarez et al (2020).

[7] The model is a modified version of Jones et al (2020). We simulate a stylised pandemic, and do not attempt to model the effects of Covid-19 specifically. The calibration of epidemiological and macroeconomic parameters mirrors that in the literature. The cost of one death in an average household is conservatively set at five years' worth of consumption, compared with 10 years implied by the VSL analysis of Greenstone and Nigram (2020). See online appendix for details.

mortality rates during a stylised pandemic. The red lines ("myopic") trace what would occur if households did not realise that they could change behaviour to avoid becoming infected. In this case, a relatively small decline in output occurs largely because some are too sick to work. But infection spreads unchecked, and eventually more than 3% of the population die. Higher mortality partly reflects growing strains on the healthcare system, as the death rate is assumed to grow with the number of infected people. The blue lines ("precautionary") show how the situation changes when households optimally avoid being infected through voluntary social distancing, by working and consuming less around the peak of the epidemic, when the risks of contracting the virus are greatest. These households seek to limit their own risk of infection, but do not internalise the cost inflicted through their own behaviour in spreading the virus to others. Their preventative actions lower GDP, but the number of people who become infected and die also declines. The yellow lines ("benevolent") show the socially optimal policy response, taking account of all externalities. This results in a larger and earlier suppression of economic activity, leading to a slower spread of the virus and an even lower number of infected people and deaths. Given the calibration of the model, social welfare is highest in the "benevolent" case because the gains from better health outcomes outweigh the costs of lower consumption (right-hand panel).

Macroeconomic and health outcomes from a simple macro-SIR model — Graph 2



[1] Deviation from a baseline with no pandemic. [2] Effect of each scenario on household welfare expressed as an equivalent percentage change in household consumption. "Health" consists of three parts: (i) the cost of death valued at the model's VSL, (ii) the cost of being ill and (iii) the present discounted value of forgone consumption.

Source: Authors' calculations.

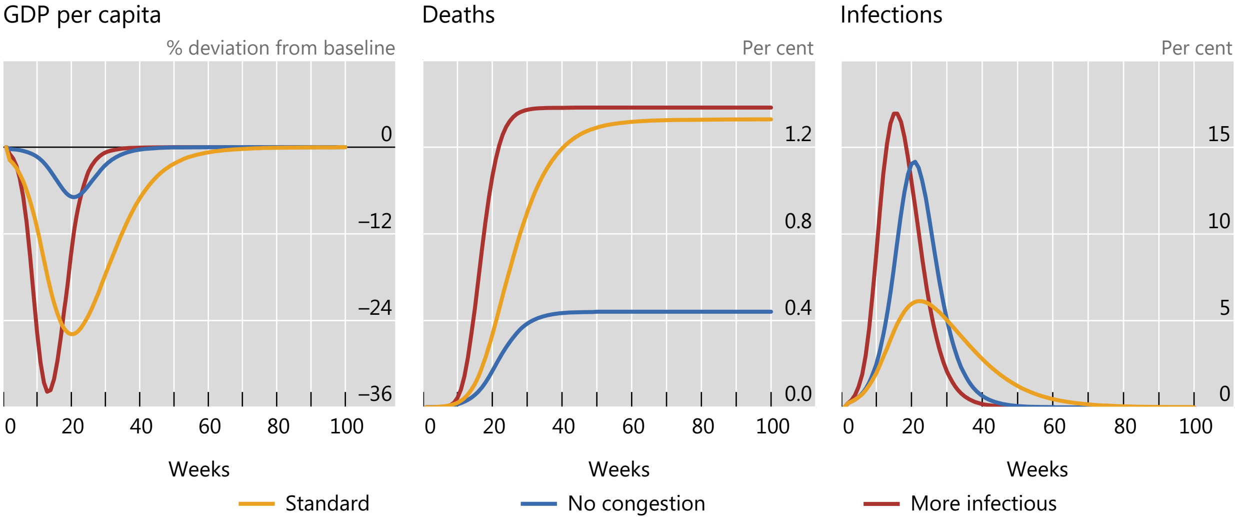
SIR-macro models can be calibrated to match the broad features of Covid-19 in order to provide quantitative guidance to the optimal policy response. These generally conclude that significant shutdowns are likely to be optimal.[8] In Eichenbaum et al (2020), consumption falls more than 20% below its baseline level for several months under optimal containment measures, compared with a 7% decline under voluntary social distancing. This roughly halves the peak infection rate and reduces the death toll from 0.40% to 0.26% of the population. In Jones et al (2020), the optimal reduction in consumption is 25%, while in Álvarez et al (2020) it is optimal to shut down more than half of all economic activity for several weeks at the peak of the pandemic, resulting in an 8% fall in annual GDP. That is, these models recommend similarly sized lockdowns to the VSL-based estimates described above.

[8] Calibrations of SIR-macro models generally make similar epidemiological assumptions, drawing on recent expert estimates. By considering a representative household perspective, the age-specific mortality is reflected in the household's average fatality.

A critical assessment of the VSL and SIR-macro approaches

VSL-based and SIR-macro models have helped to inform policy decisions in the early stages of the Covid-19 pandemic. However, the existing models are subject to a number of caveats, particularly relating to the uncertainty of their underlying epidemiological projections and stylised economic foundations.

Economic and health outcomes under different assumptions — Graph 3



Source: Authors' calculations.

In the context of a new virus, the epidemiological projections are subject to considerable uncertainty. Many characteristics of Covid-19, including its contagiousness, incubation time and fatality rate remain subject to wide margins of uncertainty. For example, given that many Covid-19 cases are asymptomatic, one issue of recent debate among experts is how much of the population has already been exposed to the virus and acquired immunity.[9] To illustrate the sensitivity of model conclusions to epidemiological assumptions, Graph 3 shows optimal containment policies and health outcomes in the simple SIR-macro model for three scenarios. The yellow lines replicate the optimal policy response in Graph 2. The blue lines show the outcomes with ample healthcare capacity, where mortality rates do not increase as infections rise. The red lines show optimal policy when the virus is more infectious but less deadly than in the baseline case. The optimal containment policy – as proxied by the path of GDP per capita – varies markedly between the three scenarios. When the disease is more contagious, a deeper recession is entailed (left-hand panel) to prevent a rapid increase in infections from overwhelming the health system. In contrast, when the health system has ample spare capacity, there is less reason to restrain economic activity, as a given number of infections will result in fewer deaths. Yet, in the early stages of the epidemic, the numbers of deaths in the scenarios are similar (centre panel). This highlights the challenges involved in crafting an appropriate policy response in real time, and cautions against placing too much weight on the precise numerical recommendations of any individual model.

Another important shortcoming of the VSL-based and SIR-macro approaches is that the underlying epidemic models are highly stylised and rest on many simplifying assumptions – eg a uniform and constant contact rate between susceptible and infected populations – that are clearly violated in practice. State-of-the-art epidemic models are somewhat more realistic because they incorporate detailed information

9 At one end of the spectrum, Lourenço et al (2020) argue that almost 70% of the UK population may have acquired immunity by mid-March 2020, and Fernández-Villaverde and Jones (2020) suggest that almost two thirds of the population of New York City could have been infected by late April. If accurate, these estimates would imply a fast-diminishing infection rate, and much lower benefits from containment policies. This view that "herd immunity" can be achieved so quickly remains contentious, however. According to the World Health Organization, no more than 2–3% of population may have been infected even in heavily affected areas.

about social interactions and demographics at micro-geographical levels (eg Ferguson et al (2020), Acemoğlu et al (2020)). But these more realistic models have yet to be incorporated into a coherent economic framework to inform the potential trade-offs between public health and economic activity.

The way the economic costs of epidemics have been assessed within the VSL-based and SIR-macro approaches is also subject to caveats. On the one hand, they do not take into consideration that macroeconomic stabilisation policies may mitigate the economic cost of the epidemic. Guerrieri et al (2020) argue that, under certain circumstances, fiscal policy and social transfers may help mitigate the economic effects, making it less costly for a government to impose more stringent containment. On the other hand, existing analyses of the health versus economic activity trade-off do not take into account the possibly highly persistent and non-linear economic consequences of prolonged shutdowns. The destruction of organisational and human capital, which bankruptcies and layoffs typically induce, may cause long-lasting damage to the economy and social fabric. Reducing firm mortality and averting a protracted slump is a key element in the overall evaluation of containment policies.

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