



# BIS Working Papers No 959

Macroeconomic effects of Covid-19: a mid-term review

by Phurichai Rungcharoenkitkul

## Monetary and Economic Department

August 2021

JEL classification: E00, I18.

Keywords: Covid-19 pandemic, health-economic tradeoffs

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The papers are on subjects of topical interest and are technical in character. The views expressed in them are those of their authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).

© Bank for International Settlements 2021. All rights reserved. Brief excerpts may be reproduced or translated provided the source is stated.

ISSN 1020-0959 (print) ISSN 1682-7678 (online)

## Macroeconomic effects of Covid-19: a mid-term review<sup>\*</sup>

Phurichai Rungcharoenkitkul<sup>†</sup>

### August 10, 2021

### Forthcoming in the Pacific Economic Review

#### Abstract

This article provides an interim assessment of the macroeconomic consequences of the Covid-19 pandemic. Estimates suggest a median output loss of about 6.5 percent in 2020, a gap that is expected to narrow to around 4 percent of the pre-pandemic trend by the end of 2021. There is however a high dispersion of economic losses across economies, reflecting varying exposures to the pandemic and societies' responses. High-frequency indicators and epidemiological models provide some insights into the interactions between the pandemic evolution and societies' strategies of combating it, including the role of vaccination. The article draws lessons from experiences thus far and discusses challenges ahead.

JEL Classification: E00, I18 Keywords: Covid-19 pandemic, health-economic tradeoffs

<sup>\*</sup>I am grateful to Frederic Boissay, a joint work with whom lays the basis for some materials being used here. I thank Claudio Borio, Benoit Mojon, Daniel Rees, Hyun Song Shin, Christian Upper, and colleagues at the BIS for helpful discussion and comments. I also thank the editor Tai-kuang Ho and an anonymous referee for useful suggestions. All remaining errors are mine. The views expressed are mine and do not necessarily represent those of the BIS.

 $<sup>^{\</sup>dagger}\mathrm{Bank}$  for International Settlements

## 1 Introduction

The Covid-19 pandemic is a twin crisis of truly global proportion. It is first and foremost a global health emergency, caused by a novel coronavirus that, absent policy actions, could claim tens of millions of lives.<sup>1</sup> The epidemiological root of the crisis makes it particularly perilous: a virus cannot be negotiated with and does not respect borders. Indeed, no country, rich or poor, large or small, managed to escape from the pandemic's disruptive force. And as the world was galvanised into action in a bid to save lives, the health crisis escalated into an economic one. The historic large-scale lockdowns designed to contain the virus prompted a collapse in economic activity never before seen.

The economic significance of the Covid-19 cannot be overstated. The massive scale of economic losses alone makes the crisis one of the most pressing and consequential problems, for many economists in their lifetimes. The unusual character of the crisis, a mixture between epidemiology and economics, makes the problem a challenging one intellectually. At the same time, in terms of policy prescription, the stake cannot be higher for economists to get it right. How costly have the lockdowns been in output terms? How much livelihood is worth sacrificing to save lives? Does vaccine arrival mean economies can reopen again? These are but some questions that economists can help shed light on. To be sure, the economics of epidemics is not a new field. But the Covid-19 has uncertainly made it mainstream.

It is impossible to do a full justice to a crisis that has spawned a whole new literature, a book collection and a new journal in a matter of few months.<sup>2</sup> The modest objective of this article is two-fold. The first goal is to gain a quantitative sense of economic losses and the channels through which they came about, in the process drawing comparisons with previous pandemics/epidemics. The second part is devoted to discussing the policy challenges in managing the Covid-19 pandemic. Of particular interest is the complex two-way interactions between economic activity and the spread of the virus, and how one could make an informed data-driven decision in striking a balance between lives and livelihood. I will then briefly discuss remaining challenges in the next stage of the crisis, with large-scale vaccination in sight but the virus also mutating continuously.

## 2 Lessons from past epidemics

Experiences with past epidemics hold a number of lessons that resonate with the Covid-19 crisis. Losses of human capital can cause severe and long-lasting economic damages, especially in pandemics.<sup>3</sup> Epidemics with relatively low fatality rate can also significantly harm economic activity in affected areas. Economic losses can arise through various channels. Fears and health concerns can harm sentiments and hold back demand. Public health measures designed to contain the outbreak, somewhat paradoxically, can be detrimental to economic activity. As

<sup>&</sup>lt;sup>1</sup>As of June 2021, there have already been 4 million confirmed deaths from the Covid-19. An uncontrolled pandemic could have claimed many more, e.g. applying age-specific infection fatality rates to the global demographic structure implies 55 million total fatalities. Surges in demand for ICU beds would likely lead to additional deaths.

<sup>&</sup>lt;sup>2</sup>See Brodeur et al. (2021) and Bloom et al. (2021) for literature reviews on the economic impact and comparisons with previous epidemics, echoing some of the same themes in this article.

<sup>&</sup>lt;sup>3</sup>This section draws in part from Boissay and Rungcharoenkitkul (2020).

Epidemics	Fatalities	Studies and methods	Economic losses
Influenza pandemic	Up to 50	Barro et al. (2020)	6 ppt lower GDP growth
	Op to 50	Cross-country panel regressions	8 ppt lower consumption growth
1918-19	minion	Brainerd and Siegler (2003)	Mortality significantly lowers growth in
		US states data	following decade
		Correia et al. (2020)	18% decline in manufacturing activity
		US states data	per year; prompter and more aggressive
			containment helped reduce the impact
		Global Preparedness Monitoring	4.8% loss in annual global GDP
TT (1 (* 1		Board (2019)	
Hypothetical		1918-type pandemic	
pandemics		Fan et al. (2016)	0.4-1% of GDP loss per year due to ex ante
		1918-type pandemic	prospects of a pandemic, 86% of which
		Include intrinsic cost of mortality	is due to mortality and 14% to income
		-	loss. For moderate pandemics, the share
			of income loss is larger at $40\%$
		Keogh-Brown et al. (2010)	1.4-6% loss in annual GDP
		H1N1 pandemic	0.5-2 ppt of which due to mortality
		Multisector CGE, Europe	0.9-4 ppt from school closures and absence
		Burns et al. (2006)	3.1% loss in annual global GDP
		1918-type pandemic	0.4 ppt of which due to mortality
			0.9 ppt from illness and absenteeism
			1.9 ppt from efforts to avoid infection
		Arnold et al. (2006)	4.25% loss in annual GDP
		1918-type pandemic	2.25 ppt from supply side
			2 ppt from demand side
SARS	774	Lee and McKibbin (2004)	0.1% loss in global GDP in 2003
2003	774	CGE model	
		Hai et al. (2004)	1-2 ppt lower GDP growth in China
		Chinese surveys	
H5N1	455	Burns et al. (2006)	0.1% loss in annual global GDP
2003-19		World Bank estimate	0.4% for Asia
Ebola	11,323	World Bank (2014)	2.1-3.4 ppt lower GDP growth in affected
2014-16	·	CGE model	countries in 1st year of epidemic

#### Table 1: Studies on past epidemics

in any recession, financial and credit market procyclical developments can amplify and worsen output losses. The disproportionate effect of an epidemic on the service sector, which depends particularly on social interactions, is also well-recognised from prior experiences.

A key issue addressed by previous research is the magnitude of economic losses in the wake of an epidemic. Table 1 summarises selected studies on notable epidemics and estimates of output losses. The influenza pandemic of 1918 in particular has received much attention in the literature, being one of deadliest pandemics in modern history.<sup>4</sup> Hypothetical studies prior to the Covid-19 indeed often model a pandemic scenario around the 1918 influenza. At the same time, there have also been numerous works on more recent epidemics, such as SARS in 2003 and Ebola during 2014-2016, which serve as a basis for comparison.

It is evident from this research that severe pandemics brought about not only extremely high fatality, but also economics costs that were an order of magnitude larger than those of

<sup>&</sup>lt;sup>4</sup>The world has seen deadlier epidemics in the more distant past. The bubonic plague of the 14th century claimed up to 200 million lives, while the European viruses in Mexico effectively decimated an entire civilisation. But much poorer sanitary standards during these times arguably make these episodes less useful as a benchmark for the current situation.

typical epidemics. The 1918 influenza led to an output loss of around 6-8% of GDP according to Barro et al. (2020)) and a 20% decline in manufacturing employment according to Correia et al. (2020)). Hypothetical studies suggest a present-day repeat of the 1918 pandemic would lead to an output loss of 3-6% of annual global GDP, (see Global Preparedness Monitoring Board (2019), Burns et al. (2006) and Keogh-Brown et al. (2010)). Meanwhile, outbreaks of SARS, H5N1 or Ebola were highly disruptive for the affected countries, but entailed only a negligible output loss as a percentage of global GDP (See Lee and McKibbin (2004) and Hai et al. (2004) for SARS, Burns et al. (2006) for H5N1 and World Bank (2014) for Ebola outbreaks).

While most agree on the high cost of the 1918 pandemic, the precise mechanism generating economic losses remains a subject of debate. One hypothesis is that the pandemic harmed economies by destroying human lives and associated productive capacity. Illnesses and mortality risks could also disrupt economic activity.<sup>5</sup> An alternative view is that much of output losses resulted from governments' non-pharmaceutical intervention (NPIs) such as enforced lockdowns and closures, introduced to mitigate fatality. Sorting out which of these two factors is more important requires a natural experiment. For example, Correia et al. (2020) exploit differences in NPI intensities across states in the US, and find those that implemented NPIs for longer tended to experience lower mortality and higher manufacturing employment growth. They conclude that output loss was a direct consequence of the pandemic rather than policies designed to quell it. Lilley et al. (2020) dispute the finding however, arguing that part of the observed employment expansion were driven by pre-1918 population growth trend. This debate of whether the cure may be worse than the disease and whether there is a health-economic trade-off echoes some of present-day discussion (see next section).

Previous research sometimes divides the transmission mechanism of an epidemic into demand versus supply channels, recognising that both can play a role. Supply effects may include a retrenchment in labour supply, by workers who fall ill or refrain from participation in high-contact jobs due to health concerns. Demand effects include cutbacks in spending on services, or other goods due to lost income. For example, Arnold et al. (2006) examine the supply channel in a 1918-like pandemic, by combining an estimated loss of work days with an estimated productivity per worker. They conclude that, in the first year, the pandemic would reduce GDP by 2.3%. The same study finds the effect through the demand side to be about 2% of GDP, assuming a larger effect in industries reliant on social interactions. In other words, both demand and supply channels appear to be similarly important in quantitative terms.

Another important lesson from previous epidemics is the potential long-lasting effects on the economy. On the supply side, Fan et al. (2016) find that mortality and the reduction of the labour force made up the largest part of the cost associated with the 1918 influenza pandemic, due to its persistent effect. A one-time reduction in labour force raised the capital-to-labour ratio and lowered the rate of return to capital, thus slowing the pace of capital accumulation and GDP growth for many years.<sup>6</sup> Aggregate demand itself could also be persistently depressed.

<sup>&</sup>lt;sup>5</sup>Barro et al. (2020) note that the illness of US President Woodrow Wilson may have contributed to the harsh terms of the Versailles Treaty in 1919, with tragic ramifications in the following decades.

<sup>&</sup>lt;sup>6</sup>Jordà et al. (2020) also find that real wages remained elevated over more than three decades after major pandemics. The concurrent World War I presented an identification challenge in quantifying the pandemic's contribution to mortality, however (see Barro et al. (2020))

Epidemics	Death toll	Containment measures	Financial amplification	Real amplification	Context
1918 pandemic	50 million	Social distancing	Little	Little	WWI; high share of manufacturing in GDP (AEs)
SARS	774	Social distancing	Little	Little	Chinese growth accelerating
Covid-19, 1 Mar	2996	Wuhan/Lombardy lockdowns	Market selloff	Supply chain disruptions	Globalised economies; Integrated
Covid-19, 8 Apr	82,220	Global lockdown	Tightening financial conditions	Supplychaindisruptions;Suddenstop in demand	supply/credit chains; High share of services in GDP for many; High
Covid-19, 9 Oct	1.06 million	Global lockdown eased	Stable financial markets, but banks under pressure	HH/firm balance sheets under duress	leverage in parts of real sector

Table 2: Now and then

Jordà et al. (2020) examine 12 major pandemics in Europe since the 14th century, finding that they were followed by multiple decades of low interest rates. Their interpretation is that higher precautionary saving and scarce investment opportunities kept the natural interest rates low. Unlike wars, pandemics do not destroy physical capital and typically lead to a long period of excess capital relative to workers.

## 3 Covid-19: a unique crisis

While many lessons from past pandemics resonate today, the Covid-19 crisis also has several distinctive characteristics that set it apart from historical benchmarks. Table 2 provides for some bases for comparison. The context of highly globalised and integrated economies alone makes a modern-day pandemic more likely and potentially more destructive to begin with.<sup>7</sup> But the most consequential and defining distinction is the large-scale lockdown policies introduced across the world. The unprecedented health policy response was designed to avert the extremely high death tolls associated with previous major pandemics. At the same time, the collateral damage of putting the economy in an induced coma has been staggering. Indeed, the proximate cause of the *economic* crisis this time is a conscious policy decision to save lives, rather than an unforeseen 'shock' as typically the case in past recessions.

The unique character of the current crisis means the duration of economic duress is directly tied to pandemic developments. The latter are uncertain and highly non-linear: small tweaks to policy could be a difference between infections stabilising or rising exponentially. As Table 2 shows, snapshots from March, April and October painted very different pictures, as the situation deteriorated quickly despite strong policy responses. This section reviews some of these challenges and their macroeconomic implications.

<sup>&</sup>lt;sup>7</sup>In 2018 four billion people boarded flights, an average of one in two global citizens. When SARS hit in 2003, flight passengers totalled just 1.7 billion. Today's close economic integration also permeates the production network, as well as cross-border credit and financial market linkages. Increased connectedness amplifies damages of a pandemic and strengthens the international spillover effects, through both supply and demand.



**Note:** Left panel shows output losses implied by Consensus GDP growth forecasts over successive survey vintages. For each survey, output losses are calculated as the difference between annual GDP growth forecasts and the corresponding forecasts made in January 2020 before the pandemic. Similarly, the difference between cumulative GDP growth forecasts over 2020-2021 between pre- and post-pandemic surveys produces the expected output loss over the 2020-2021 period. Right panel shows GDP forecast disagreement at each survey, measured as the cross-sectional standard deviations over different forecasters. Lines are cross-country medians, and shaded areas are cross-country interquartile ranges.

Figure 1: Forecast revisions over time

#### 3.1 The great lockdown

In a prescient 2018 speech, Bill Gates warned of "a significant probability of a large and lethal, modern-day pandemic occurring in our lifetimes" and that "the health infrastructure we have for normal times breaks down very rapidly during major infectious disease outbreaks" (Gates (2018)). The world unfortunately remained little prepared two years on when the Covid-19 struck, and collectively could not prevent a full-blown pandemic. The lack of a prompt and coordinated global response illustrates the immense difficulty of assessing a rare-event risk in real time, not least when the last major pandemic was but a distant memory. Indeed, few anticipated a highly disruptive pandemic even after Italy's national lockdown and infections having cropped up in all parts of the world. In early March, most forecasters still expected global growth in 2020 to hold up well (Figure 1a), and with only few contrarians (Figure 1b). Unfortunately, the lack of an early decisive action makes much stronger intervention later on necessary in many cases.

As situation deteriorated rapidly in the course of March, many authorities placed their countries under lockdowns, including in France and the UK. These stringent measures prompted a major reassessment of the macroeconomic impact.<sup>8</sup> As shown in Table 3, impact assessments underwent a regime shift around mid March. The usual depiction of economies being subject to occasional disturbances gave way to sudden-stop economics. The rough-and-ready calculations of the lockdown implications replaced sophisticated model-based estimates, and suggested a much larger decline in activity than in previous assessments. The April consensus forecasts

<sup>&</sup>lt;sup>8</sup>For a detailed chronicle of the pandemic and government policy responses, see Bank for International Settlements (2020) and International Monetary Fund (2020b).

Studies	Methodology	Economic losses
McKibbin and Fernando (2020	) Hybrid between DSGE and	Non-pandemic: 0.3-2.2% annual global GDP loss
2 Mar	CGE models	Pandemic: $2.5\text{-}11\%$ global GDP loss
OECD (2020a)	Semi-structural model	Baseline: 0.5-1.5 ppt lower annual global GDP growth.
2 Mar		Severe: $\downarrow 2\%$ domestic demand, $\uparrow$ 50bps risk premium.
UNCTAD (2020)	Analysis of intra-industry	Manufacturing affected from China supply disruptions.
4 Mar	trade	EA, US, JP, KR most affected
Gourinchas (2020)	Illustrative calculations	6.5 ppt lower annual GDP growth if 50% is shut down
13 Mar		for a month, with $25\%$ shutdown for 2 months
Saez and Zucman (2020)	Illustrative calculations	30% loss in US output from shutdown
18 Mar		7.5 ppt lower GDP growth for 1-quarter shutdown
Faria-e Castro (2020)	Illustrative calculations	32% US unemployment rate in the 2nd quarter
24 Mar		
Gormsen and Koijen (2020)	Inference from high-frequency	2.2 and 2.8 ppt lower annual GDP growth in US and
25 Mar	data on dividend futures	EA respectively
UNWTO (2020)	Estimates/judgements	20-30% lower international tourists in 2020
27 Mar		$300\text{-}450\mathrm{bn}$ tourism revenue (0.3-0.5% of global GDP)
OECD (2020b)	Analysis of sectoral output	20-25% GDP loss from shutdown
30 Mar	and consumption	$2 \mathrm{ppt}$ off annual GDP growth for 1-month shutdown

 Table 3: Impact assessments made in March

revealed a sharp worsening in 2020 outlook, with output loss estimated to be about 6 percent for the year (Figure 1a). This order of magnitude is similar to the 1918 pandemic loss, previously seen by many to be a conservative worst-case scenario (e.g. see Barro et al. (2020)).

Pushing back the first infection wave would end up taking an even heavier toll than first estimated. Lockdowns put swath of economic activity into a frozen state overnight, and subjected businesses and households to an unprecedented period of lost incomes. Despite massive policy support, insolvency risks and unemployment loomed large, especially for most affected economic sectors. These led to further downward growth revisions between spring and summer. By June, the expected output loss was 8 percent for the median economy (Figure 1a). Subsequent easing of restrictions in the summer led to some improvements in the economic outlook, as the median output loss for 2020 was revised to around 6.5 percent. The economic outlook started to improve more noticeably around late 2020 and early 2021, buoyed by the sooner-than-expected arrival of vaccines. Even so, the median output level was still projected to remain 4 percent below the pre-pandemic trend at the end of 2021.

While the Covid-19 is truly a global crisis, the economic impact has also been highly differentiated across countries. As Figure 1 shows, this became particularly clear in the second half of 2020, with the range of expected output losses widening markedly across countries, just as disagreements about individual estimates narrowed. Latest projections of 2020 output losses vary from around 3 percent in Norway and Korea to more than 10 percent in the United Kingdom, Spain, India, Peru and the Philippines (Figure 2). This heterogeneity partly reflects different effectiveness in dealing with the pandemic, e.g. Korea and China managed to contain the virus spread in 2020 without resorting to prolonged and widespread lockdowns. It is also related to strengths of policy responses and weights societies attach to health and economic objectives. Countries moreover differ in their inherent vulnerabilities to the pandemic, e.g. dependence on tourism and services industries, population density, compliance with government orders and so on. For countries hardest hit by the pandemic, economic damages have thus been



**Note:** Left panel shows implied output losses, computed as cumulative revisions in average Consensus GDP growth forecasts made between January 2020 and May 2021 (latest survey). '2020' and '2020-2021' are the periods over which output losses occur (see note to Figure 1). From April 2021, 2020 growth outturns are used in place of survey results. Right panel shows revisions of 2020-2021 GDP growth forecasts made between October 2020 and April 2021, according to Consensus Economics surveys and the International Monetary Fund.

Figure 2: Output losses and growth forecast revisions

extremely large, in some cases surpassing even those of previous financial crises.

### 3.2 The economic sudden stop

With so much at stake and the situation being highly fluid, tracking economic activity in real time has become indispensable during the pandemic. Traditional macroeconomic statistics were not timely enough for monitoring events that could take a sharp turn in a matter of days. Various high-frequency indicators have thus been adapted for macroeconomic monitoring and to guide policy decisions. Since the first lockdown in Hubei, indicators such as electric consumption, daily underground passengers and traffic congestion indices have all been used to gauge the economic fallout from the large-scale containment. Similarly as the containment measures were relaxed, these indicators helped illuminate how quickly economic activity resumed.

One simple and useful set of high-frequency indicators is based on location history of mobile devices, exceptionally made available by Apple and Google in the wake of the Covid-19 crisis.<sup>9</sup> They provide a timely pulse of economic activity, proxied by the extent to which people frequent recreational spots and their workplaces. Figure 3 shows the Google mobility indices for a range of countries, illustrating how economic activity came to a sudden stop in real time. Mobility in most countries dipped sharply in late March and April as restrictions came into effect, before gradually recovering in subsequent months. Mobility declined again toward the end of 2020 as countries faced the second wave of infection, and recovered in early 2021 as the vaccine rollout accelerated. Mobility continued to increase through the second quarter of 2021, though remained more than 15 percent below pre-pandemic levels as of June 2021 in most countries.

Readings from mobility indices and other high-frequency indicators align reasonably closely, at least in the initial phase of the pandemic. As shown in Figure 3a, alternative measures of real-time activity such as the Global Activity Factor (GAF) based on a dynamic factor model of Leiva-Leon et al. (2020), export shipment from transponder data due to Cerdeiro et al. (2020) and the weekly Tracker based on Google Trends of Woloszko (2020), all pointed to a sharp output contraction in the spring of 2020 and a gradual recovery in the summer. Mobility indices and the Tracker are arguably the most timely indicators, having reacted most promptly during both contraction and recovery phases. At the same time, mobility appears less correlated with other indicators over the more recent sample – mobility plunged during the second wave while both GAF and Weekly Tracker held up well. One interpretation is that societies may have adapted to the pandemic over time, making output less sensitive to mobility restrictions. That said, structural breaks between high-frequency indicators and aggregate output are potential problems for most of these measures.

In addition to its timeliness, another advantage of the mobility indices is their standardised format and availability for a large group of economies, which allow cross-country comparisons. Figure 3b shows selected countries at both tails of the distribution - those whose mobility declined the most, such India and the United Kingdom, versus the other end of spectrum such as South Korea and the Nordic countries. This cross-country heterogeneity provides a basis for policy evaluation and comparative analysis. E.g. what are the implications of different

<sup>&</sup>lt;sup>9</sup>See https://covid19.apple.com/mobility and https://www.google.com/covid19/mobility/



Note: Left panel shows the cross-country interquartile ranges of Google mobility indices (shaded area), alongside three other high-frequency indicators. Each Google mobility index is the average of retail and recreation, transit, and workplace activities subindices. 'GAF' is the cumulative Global Activity Factor from Leiva-Leon et al. (2020), a proxy for global economic activity based on a dynamic factor model. 'Export shipment' is the deadweight tonnage of exports relative to 2017-2019 from Automatic Identification System (AIS) transponder data, computed by Cerdeiro et al. (2020). 'Tracker' is the cross-country interquartile ranges of OECD Weekly Tracker which uses Google Trends as predictors of GDP growth – see Woloszko (2020). Right panel shows the same cross-country mobility ranges together with mobility indices of selected countries.

Figure 3: Tracking real-time activity

approaches to lockdown in terms of health and macroeconomic outcomes?

Differences in average mobility indeed explain almost 40 percent of cross-country variations in growth outcomes in 2020, suggesting that the mobility index has performed relatively well as a nowcasting tool at least in the early stage of the pandemic. Figure 4a shows average mobility on the horizontal axis and the corresponding growth forecast revisions for 2020 on the vertical axis. There is a positive relationship as one might expect, with 10 percentage points of mobility being equivalent to about 2.4 percentage points of GDP growth on average. The estimate is statistically significant, despite leaving out many relevant factors. Countries such as Spain, Italy, Greece and Thailand experience larger falls in expected GDP growth than suggested by their average mobility alone, which could be explained by their heavy reliance on tourism.

The mobility index is sometimes interpreted as a policy variable, a measure of government restriction stringency. Mobility is indeed negatively correlated with the 'stringency index' as shown in Figure 4b: countries whose governments impose more stringent measures than others tend to have lower mobility. That said, mobility and policy stringency are strictly distinct concepts. Public health policies could be ineffective in reducing mobility if public compliance is low. By the same token, relaxing restrictions does not guarantee free-flowing economic activity if the general public remains concerned about the virus. In fact, the mobility index reflects both government policies and preferences of the general public, and is better thought of as the *society*'s policy choice rather than that of the government alone.



**Note:** 'Mobility' on the horizontal axes is the Google mobility index (computed as in Figure 3), averaged over the first 60 days since first confirmed case. 'Growth revision' is the difference between December and January 2020 Consensus forecasts of GDP growth, in percentage points. 'Stringency index' is the sample average of aggregate policy stringency index from Hale et al. (2021).

Figure 4: Two interpretations of mobility indices

#### 3.3 The lives versus livelihood tradeoff

Most scientists including the WHO considered strict containment measures including lockdowns as necessary on medical grounds to counter rapidly rising new infections.<sup>10</sup> Ferguson et al (2020) is an early influential study showing that in the absence of a 'suppression' strategy, surges of new patients could overrun hospital capacity and lead to more deaths - Bill Gates' doom scenario. The conclusion follows from a simple epidemiological arithmetic: if each infected person continues passing the virus on to more than one person, infections will continue rising at an exponential rate. With the inherent infectiousness of SARS-CoV-2, the explosive reproductive dynamic will continue until much of the population has either developed immunity or died. Lockdowns are designed to drastically reduce the infection rate and avoid exposing a large fraction of population to the virus. Some scientists have argued against strict lockdowns in response to the first wave on the grounds that a significant part of the population may likely acquired immunity naturally (see Boissay et al. (2020) for a review of the debate). But subsequent infection waves have by and large dispelled any perception that the 'herd immunity' was close to being achieved early on in the pandemic.

Controversies surrounding lockdowns also arise from the potential conflict between health and economic objectives. One view is that there is a health-economic tradeoff, between 'lives and livelihood'. Lockdowns are detrimental to the economies but help save lives. The question is whether severe lockdowns go too far along the latter dimension from a welfare perspective. One approach to answering this question is to quantify lives saved in economic terms, using the Value of a Statistical Life (VSL), which measures how much a person values his or her own life.

<sup>&</sup>lt;sup>10</sup>The health emergency proviso in important. Some countries have managed to avoid severe lockdowns, through a combination of earlier responses, extensive uses of masks and aggressive test-and-quarantine strategy.



**Note:** On the left panel, the horizontal axis is the average mobility over the first 60 days after the first confirmed case. The vertical axis shows deaths per million population, as of end of October 2020.

#### Figure 5: Health-economics tradeoff

The VSL is one metric of the social welfare, on the ground that a priori a pandemic could affect just anyone. Greenstone and Nigram (2020) applies this approach in the case of the United States, and found that saving 530,000 lives is worth over one third of US annual GDP, achievable through *moderate* social distancing. Cutler and Summers (2020) use the VSL to calculate losses from long-term and mental health problems, finding that these are as large as the economic costs of mortality. See Boissay et al. (2020) for further discussion of the VSL approach and its limits. A different approach to quantifying the tradeoff is to examine the impact of livelihood on lives. Recessions could also have harmful effects on health and mortality, especially in economies with weak social safety nets and limited fiscal resources. These considerations tend to nudge the balance towards the economic objective - see Hausmann and Schetter (2020) and Doerr and Hofmann (2020).

Another view on the debate is that there may not be a tradeoff at all. The argument is that normal economic activity cannot resume as long as a pandemic is still raging. Households conscious of health risks cannot freely spend while businesses will put off investment until the coast is clear. In this environment where a more severe health crisis only leads to a deeper economic fallout, the solution is to do whatever it takes to beat the pandemic - see Portes (2020) and Chang and Velasco (2020). Indeed, the data seem to support this view, as the supposed tradeoff between economic activity and health outcomes is elusive. Figure 5a shows the cross-country scatter plot of deaths per million on average mobility during the early phase of the pandemic.<sup>11</sup> The negative slope suggests that on average those countries that suffer more economically are also the one with worse health outcomes. There is seemingly no tradeoff.<sup>12</sup>

One way to reconcile these viewpoints is to distinguish two independent forces. The

<sup>&</sup>lt;sup>11</sup>I allow for some time lag between mobility and eventual health outcomes because of epidemiological inertia, but other lag choices deliver similar results. This supposedly 'perverse' relationship has also been widely documented by others, including in the press.

<sup>&</sup>lt;sup>12</sup>See also Oliu-Barton et al. (2021) which uses weekly Tracker of Woloszko (2020) instead of GDP and arrive at the same conclusion.



Figure 6: Feasible set from model simulations

first is the epidemiological link between social interactions and the pandemic severity – more interactions lead to higher infections and deaths. This is summarised schematically by the upward-sloping 'pandemic curve' in Figure 5b, where greater activity implies more deaths. The second force is the society's preferences over health-economic outcomes, represented by the 'Society's response' schedule. It is downward-sloping because the society exercises greater precaution in response to a worsening pandemic, by curtailing economic activity.<sup>13</sup> The relative positions of these two schedules then dictate differences in cross-country outcomes. An explanation for the negative slope in Figure 5a is that shifts in the pandemic curve dominate those of society's response. Large epidemiological variations across countries thus trace out the average societies' response curve, revealing the estimated downward-sloping relationship. In truth, the society as a whole still faces an epidemiological constraint as defined by the pandemic curve, as the pandemic inescapably narrows the set of feasible health-economic outcomes available to the society.<sup>14</sup>

Having an estimate of the pandemic curve would provide useful information about the feasible health-economic set for policymakers whatever their preferences may be. Recovering it requires a structural epidemiological model that internalises how the infection rate interacts with the society's choice.<sup>15</sup> Figure 6a shows the estimated pandemic curves for selected countries,

Note: Simulation from the epidemiological-economic model of Rungcharoenkitkul (2021), estimated as of end-June 2021. Each line represents the feasible set of health and economic outcomes, respectively new fatalities and average mobility projected in the second half of 2021. The left panel shows the feasible sets for four selected countries. The right panel presents results for India under baseline and two other scenarios. Under 'Slow vaccination', the vaccine supply/take-up slows to a third of the baseline, while under 'Virus mutation', each vaccinated/recovered person loses immunity after 60 days.

<sup>&</sup>lt;sup>13</sup>In keeping with the previous section, I refer to the society to make clear that such decision is jointly made by the general public and the government. More precisely, the society's response curve is defined by the more stringent of the two. If government regulations are laxer than the public prefers, the public response curve will prevail, and vice versa assuming perfect compliance.

<sup>&</sup>lt;sup>14</sup>From this perspective, the argument of Portes (2020) may be more about the relevance rather than the existence of a tradeoff. If the society cannot tolerate very high level of fatality (its response curve has a ceiling), then the upper portion of the pandemic curve is never binding.

<sup>&</sup>lt;sup>15</sup>A number of papers have explored this interaction in a stylised setting – see Álvarez et al. (2021), Eichenbaum

based on the epidemiological-economic model of Rungcharoenkitkul (2021) which augments an SEIR-type model with an optimising unit representing the societies' preferences over lives and livelihood. The model is fit to daily health data (cases and deaths) and mobility, using a fast filtering method (see https://github.com/phurichai/covid19macro for the open-source code). The estimated model is used to construct counterfactual scenarios by simulating over alternative live-vs-livelihood preference parameters. As shown in Figure 6a, the feasible set is always upward sloping at any given moment – saving more lives comes at the expense of lower mobility.

The terms of health-economic tradeoff can vary across economies depending on context and initial conditions. As illustrated by Figure 6a, reducing mobility by 5 percent can save more than 200 lives per million in India (almost 300 thousand lives), but less than 100 lives per million in the United States. Country-specific factors such as population density ad effectiveness of policy may partly explain these differences. Also important is the size of susceptible population. Those that have already experienced previous large infection waves and/or have made substantial progress in vaccination would be less exposed to additional deaths. In these cases, restricting mobility would entail lower marginal benefits.

The terms of tradeoff can also vary over time in a given country as the situation evolves. The arrival of vaccination, by granting immunity to individuals without exposing them to the virus, eases the terms of tradeoff and allows economies to remove restrictions at fewer fatalities. Improving treatment standard, by suppressing the case-fatality rate, can similarly deliver better outcomes. Conversely, any setback to the vaccination programme could justify a reenactment of restrictions. The tradeoff could also deteriorate if new virus strains emerge that overcome existing immunity in the population. The epidemiological-economic model can again provide some quantitative implications of these contingencies. Figure 6b depicts the tradeoff schedules under the baseline and two downside scenarios, using India as an illustration. If vaccination progress stalls or virus mutations compromise immunity, mobility may need to be further reduced by 5-10 percent if new deaths were to be kept below 300 per million.

#### 3.4 The new normal

At the time of writing (summer 2021), many countries were still grappling with rising new cases and most countries still had some form of restrictions in place. As foreshadowed by the 1918 flu pandemic, subsequent infection waves proved to be the deadlier ones. At the same time, containment measures have generally become less stringent compared to the first infection wave. One reason was greater perceived effectiveness of even moderate and targeted lockdowns, given better sanitation practices (e.g. public mask wearing), improved treatment protocols, and more rigorous trace-and-quarantine practices. Another reason was a concern that another strict lockdown could be much more debilitating economically than in the early stage, especially due to higher risks of bankruptcies.<sup>16</sup> Lockdown fatigue and dwindling political support in some

et al. (2021), Glover et al. (2020), Jones et al. (forthcoming) and Krueger et al. (2020) among others and Boissay et al. (2020) for a review of this new literature.

<sup>&</sup>lt;sup>16</sup>Firms and households have drawn on much of their liquidity and equity cushions during the first lockdown, though bankruptcies have so far been fewer than suggested by output (see Banerjee and Kharroubi (2020) and Banerjee et al. (2020)). Extraordinary government support has clearly played an important role as a shock

cases may have also played a role.

A quick end of the pandemic is far from assured. The early arrival of vaccines promised to be a game changer, but scaling vaccination globally has been an immense challenge. Under pressure to contain infections at home, many countries rushed to secure vaccine doses amid limited global supply. Relatively few managed to obtain more than adequate supply for their population, while others had to contend with infection surges with little vaccine protection. The lack of a global coordination has likely made it easier for new virus variants to emerge and take hold. The much more contagious Delta variant has already become rampant in many countries, and is capable of causing breakthrough infections among those vaccinated. As the race between vaccination and virus mutations gets protracted, eradication appears further out of reach while an endemic Covid-19 in the longer term becomes an increasingly likely prospect.

Looking beyond the pandemic, it is likely that the global economy would not return to what it once was. For one, the large and uneven impact on the economy is providing strong impetus for resource allocations. Those industries reliant on face-to-face interactions, hardest hit by the pandemic, may face a more protracted recovery and falling output share (see Rees (2020)). Meanwhile, winning sectors from the pandemic could benefit from permanent preference shifts e.g. towards conducting virtual meetings and working from home. The pandemic also disproportionately affected smaller firms and low-income group, which could have long-term ramifications on employment prospects and income distribution (see Yonzan et al. (2020)).

The pandemic could also leave lasting impressions on people's beliefs and influence their behaviour long after it is gone. Kozlowski et al. (2020) argue that, because a pandemic is so rare, once it happens its perceived likelihood jumps and persists. And because a pandemic precipitates resource allocations and capital obsolescence, concerns about future pandemics can have significant effects on today's risk premium and investment. They estimate that this 'belief scarring effect' could generate a long-term cost 10 times larger than the short-term GDP loss.

Finally, the pandemic could cast a long shadow on the policy landscape for years if not decades to come. The provision of fiscal backstop during lockdowns totalled \$12 trillion globally, equivalent to 12 percent of global GDP (International Monetary Fund (2020a)). Most of the stimulus is accounted for by advanced economies, whose public debt is now at over 120 percent of GDP, the highest level since World War II. Emerging market economies have been more constrained fiscally, but have themselves seen public debt rising to historical high at over 60 percent. Any major bankruptcy events, a non-negligible risk, could make further fiscal commitments necessary. High public debt levels coupled with low growth could present challenges for central banks when the time comes to rebuild policy space (Borio (2020)). Monetary policy normalisation, even if justified on macroeconomic grounds, could be subordinate to fiscal sustainability concerns. As a result, the low-for-long interest rate environment could be further entrenched by the pandemic, putting even more burden on macroprudential policies to deliver on financial stability (Rungcharoenkitkul (2020)). It is not clear if they can achieve this by themselves.

absorber, but scope to provide a blanket backstop has significantly narrowed.

## 4 Conclusions: lessons from the Covid-19

The pandemic is by no means over and there may be more surprises in store. Nonetheless, the last 18 months already hold some useful lessons for the future.

First, it is now clear that a highly disruptive pandemic remains a possibility today and underestimating its risk can come at great cost. This urgently calls for enhancing global preparedness to quickly identify and thwart future threats, as well as a concrete well-orchestrated contingency plan of actions once an outbreak has occurred. Second, severe lockdowns of the type seen in the spring of 2020 can be introduced only so many times over the course of a pandemic. Economic damages and policy resources needed to alleviate them are extremely high and tend to increase nonlinearly as restrictions are repeated. This last-resort solution must therefore be accompanied by other less disruptive measures as part of the overall strategy. Third, maximising effectiveness of these other measures is key for limiting the total pandemic cost. Draconian but targeted policies are far less expensive than indiscriminate measures, but there may be only a small window of opportunity where they are effective. Enforcing strict quarantine rules, tightening border controls and conducting extensive contact tracing very early on in an outbreak could be the key difference.

## References

- ÁLVAREZ, F., D. ARGENTE, AND F. LIPPI (2021): "A simple planning problem for COVID-19 lockdown," American Economic Review: Insights.
- ARNOLD, R., J. DE SA, T. GRONNIGER, A. PERCY, AND J. SOMERS (2006): "A potential influenza pandemic: possible macroeconomic effects and policy issues," report to the Congressional Budget Office.
- BANERJEE, R. AND E. KHARROUBI (2020): "The financial vulnerabilities driving firms to the exit," *BIS Quarterly Review*.
- BANERJEE, R., E. KHARROUBI, AND U. LEWRICK (2020): "Bankruptcies, unemployment and reallocation from Covid-19," *BIS Bulletin*, 31.
- BANK FOR INTERNATIONAL SETTLEMENTS (2020): BIS Annual Economic Report, Basel, Switzerland.
- BARRO, R., J. URSUA, AND J. WENG (2020): "The coronavirus and the Great Influenza Pandemic: lessons from the 'Spanish flu' for the coronavirus' potential effects on mortality and economic activity," NBER Working Papers 26866.
- BLOOM, D., M. KUHN, AND K. PRETTNER (2021): "Modern infectious diseases: macroeconomic impacts and policy responses," CEPR Discussion Papers 15997.
- BOISSAY, F., D. REES, AND P. RUNGCHAROENKITKUL (2020): "Dealing with Covid-19: understanding the policy choices," *BIS Bulletin*, 19.
- BOISSAY, F. AND P. RUNGCHAROENKITKUL (2020): "Macroeconomic effects of Covid-19: an early review," *BIS Bulletin*, 7.
- BORIO, C. (2020): "The Covid-19 economic crisis: dangerously unique," National Association for Business Economics, Perspectives on the Pandemic Webinar Series.
- BRAINERD, E. AND M. SIEGLER (2003): "The economic effects of the 1918 influenza epidemic," CEPR Discussion Papers 3791.
- BRODEUR, A., D. GRAY, A. ISLAM, AND S. BHUIYAN (2021): "A literature review of the economics of Covid-19," *Journal of Economic Surveys*.
- BURNS, A., D. VAN DER MENSBRUGGHE, AND H. TIMMER (2006): "Evaluating the economic consequences of avian influenza," World Bank Working Paper 47417.
- CERDEIRO, D. A., A. KOMAROMI, Y. LIU, AND M. SAEED (2020): "World seaborne trade in real time: a proof of concept for building AIS-based nowcasts from scratch," IMF Working Papers 20/57.
- CHANG, R. AND A. VELASCO (2020): "Economic policy incentives to preserve lives and livelihoods," *Covid Economics*, 33–56.
- CORREIA, S., S. LUCK, AND E. VERNER (2020): "Pandemics depress the economy, public health interventions do not: evidence from the 1918 flu," mimeo.
- CUTLER, D. AND L. SUMMERS (2020): "The Covid-19 pandemic and the \$16 trillion virus," *Journal of American Medical Association*, 324.
- DOERR, S. AND B. HOFMANN (2020): "Recessions and mortality: a global perspective," BIS Working Paper 910.

- EICHENBAUM, M. S., S. REBELO, AND M. TRABANDT (2021): "The Macroeconomics of Epidemics," *The Review of Financial Studies*, hhab040.
- FAN, V., D. JAMISON, AND L. SUMMERS (2016): "The inclusive cost of pandemic influenza risk," NBER Working Papers 22137.
- FARIA-E CASTRO, M. (2020): "Back-of-the-envelope estimates of next quarter's unemployment rate," On the economy blog, Federal Reserve Bank of St. Louis.
- FERGUSON ET AL, N. (2020): "Impact of non-pharmaceutical interventions (NPIs) to reduce COVID-19 mortality and healthcare demand," Imperial College COVID-19 Response Team Report 9.
- GATES, B. (2018): "Shattuck Lecture," https://www.gatesfoundation.org/ Media-Center/Speeches/2018/04/Shattuck-Lecture-Innovation-for-Pandemics, Boston, Massachusetts.
- GLOBAL PREPAREDNESS MONITORING BOARD (2019): "A world at risk: annual report on global preparedness for health emergencies," Tech. rep.
- GLOVER, A., J. HEATHCOTE, D. KRUEGER, AND J. RIOS-RULL (2020): "Health versus Wealth: On the Distributional Effects of Controlling a Pandemic," Centre for economic policy research.
- GORMSEN, N. J. AND R. S. J. KOIJEN (2020): "Coronavirus: Impact on stock prices and growth expectations," Working paper, University of Chicago Booth School of Business.
- GOURINCHAS, P. O. (2020): "Flattening pandemic and recession curves," mimeo.
- GREENSTONE, M. AND V. NIGRAM (2020): "Does social distancing matter?" Becker Friedman Institute Working Paper 26.
- HAI, W., Z. ZHAO, J. WANG, AND Z. G. HOU (2004): "The short-term impact of SARS on the Chinese economy," Asian Economic Papers, 3.
- HALE, T., N. ANGRIST, R. GOLDSZMIDT, B. KIRA, A. PETHERICK, T. PHILLIPS, S. WEBSTER, E. CAMERON-BLAKE, L. HALLAS, S. MAJUMDAR, AND H. TATLOW (2021):
  "A global panel database of pandemic policies (Oxford Covid-19 Government Response Tracker)," *Nature Human Behaviour*, 5, 529–538.
- HAUSMANN, R. AND U. SCHETTER (2020): "Horrible trade-offs in a pandemic: lockdowns, transfers, fiscal space, and compliance," CID Faculty Working Paper 382.
- INTERNATIONAL MONETARY FUND (2020a): Fiscal Monitor, October 2020 Policies for the Recovery, Washington, DC.
  - (2020b): World Economic Outlook, Chapter 1, the Great Lockdown, Washington, DC.
- JONES, C., T. PHILLIPON, AND V. VENKATESWARAN (forthcoming): "Optimal Mitigation Policies in a Pandemic," *Review of Financial Studies*.
- JORDÀ, O., S. SINGH, AND A. TAYLOR (2020): "Longer-run economic consequences of pandemics," mimeo.
- KEOGH-BROWN, M., R. SMITH, J. EDMUNDS, AND P. BEUTELS (2010): "The macroeconomic impact of pandemic influenza: estimates from models of the United Kingdom, France, Belgium and The Netherlands," *European Journal of Health Economics*, 11.

- KOZLOWSKI, J., L. VELDKAMP, AND V. VENKATESWARAN (2020): "Scarring body and mind: the long-term belief-scarring effects of COVID-19," Economic policy symposium proceedings, the federal reserve bank of kansas city.
- KRUEGER, D., H. UHLIG, AND T. XIE (2020): "Macroeconomic Dynamics and Reallocation in an Epidemic: Evaluating the "Swedish Solution"," Centre for economic policy research.
- LEE, J. W. AND W. MCKIBBIN (2004): "Estimating the global economic costs of SARS," in *Learning from SARS: preparing for the next outbreak*, ed. by S. Knobler, A. Mahmoud, S. Lemon, A. Mack, L. Sivitz, and K. Oberholtzer, The National Academies Press.
- LEIVA-LEON, D., G. PEREZ-QUIROS, AND E. ROTS (2020): "Real-time weakness of the global economy: a first assessment of the coronavirus crisis," ECB Working Paper Series 2381.
- LILLEY, A., M. LILLEY, AND G. RINALDI (2020): "Public health interventions and economic growth: revisiting the Spanish flu evidence," mimeo.
- MCKIBBIN, W. AND R. FERNANDO (2020): "The global macroeconomic impacts of Covid-19: seven scenarios," CAMA Working Paper 19.
- OECD (2020a): "Coronavirus: the world economy at risk," Oecd interim economic assessment.

(2020b): "Evaluating the initial impact of Covid containment measures on activity," Tech. rep.

- OLIU-BARTON, M., B. S. R. PRADELSKI, P. AGHION, P. ARTUS, I. KICKBUSCH, J. V. LAZARUS, D. SRIDHAR, AND S. VANDERSLOTT (2021): "SARS-CoV-2 elimination, not mitigation, creates best outcomes for health, the economy, and civil liberties," *The Lancet*, 10291, 2234 2236.
- PORTES, J. (2020): "Don't believe the myth that we must sacrifice lives to save the economy," The guardian, opinion.
- REES, D. (2020): "What comes next?" BIS Working Papers 898.
- RUNGCHAROENKITKUL, P. (2020): "An integrated macroprudential framework in the postpandemic world," in *How do monetary, micro- and macroprudential policies interact? Proceedings of OeNB Workshops*, Oesterreichische Nationalbank, vol. 22.
- ——— (2021): "Macroeconomic consequences of pandexit," BIS Working Papers 932.
- SAEZ, E. AND G. ZUCMAN (2020): "Keeping business alive: the government will pay," Social europe.
- UNCTAD (2020): "Global trade impact of the coronavirus (Covid-19) epidemic," Report.
- UNWTO (2020): "Impact assessment of the Covid-19 outbreak on international tourism," Report.
- WOLOSZKO, N. (2020): "Tracking activity in real time with Google trends," OECD Economics Department Working Papers 1634.
- WORLD BANK (2014): "The economic impact of the 2014 ebola epidemic: short and medium term estimates for West Africa," Report.
- YONZAN, Ν.,  $\mathbf{C}.$ LAKNER, D. G. MAHLER, R. А. С. AGUILAR, AND "The Η. Wu (2020): impact of COVID-19 on global poverty under inequality," https://blogs.worldbank.org/opendata/ worsening growth and impact-covid-19-global-poverty-under-worsening-growth-and-inequality, world Bank Data Blog.

## Previous volumes in this series

958 August 2021	Sharing asymmetric tail risk smoothing, asset pricing and terms of trade	Giancarlo Corsetti, Anna Lipińska and Giovanni Lombardo
957 August 2021	Ripple effects of monetary policy	Frederic Boissay, Emilia Garcia- Appendini, and Steven Ongena
956 August 2021	Are households indifferent to monetary policy announcements?	Fiorella De Fiore, Marco Lombardi and Johannes Schuffels
955 August 2021	Quantifying the high-frequency trading "arms race"	Matteo Aquilina, Eric Budish and Peter O'Neill
954 July 2021	Fiscal and monetary policy interactions in a low interest rate world	Boris Hofmann, Marco J Lombardi, Benoît Mojon and Athanasios Orphanides
953 July 2021	Limits of stress-test based bank regulation	Isha Agarwal and Tirupam Goel
952 July 2021	Passive funds affect prices: Evidence from the most ETF-dominated asset classes	Karamfil Todorov
951 July 2021	Distrust or speculation? The socioeconomic drivers of US cryptocurrency investments	Raphael Auer and David Tercero-Lucas
950 June 2021	Fiscal regimes and the exchange rate	Enrique Alberola, Carlos Cantú, Paolo Cavallino and Nikola Mirkov
949 June 2021	The natural interest rate in China	Sun Guofeng and Daniel M Rees
948 June 2021	Central bank digital currency: the quest for minimally invasive technology	Raphael Auer and Rainer Böhme
947 June 2021	Money, technology and banking: what lessons can China teach the rest of the world?	Michael Chui
946 June 2021	The pricing of carbon risk in syndicated loans: which risks are priced and why?	Torsten Ehlers, Frank Packer and Kathrin de Greiff
945 May 2021	US monetary policy and the financial channel of the exchange rate: evidence from India	Shesadri Banerjee and M S Mohanty