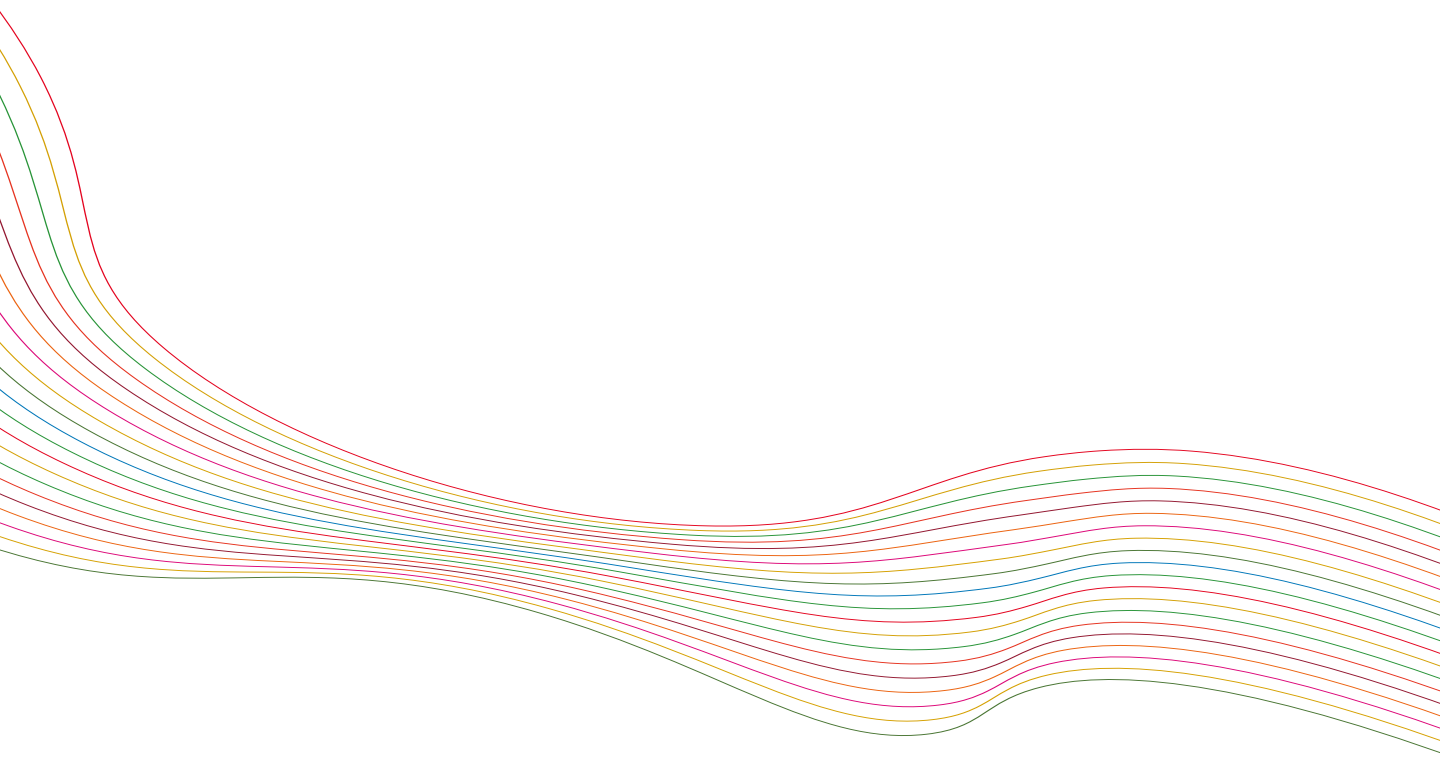

Modelling Secondary Impacts of Health Crises:

Lessons from the COVID-19 Pandemic

2022

Contents

Abbreviations

ARC ..... African Risk Capacity
CGE ..... computable general equilibrium
DRF ..... disaster risk financing
GDP ..... gross domestic product
GNI ..... gross national income
PEF ..... pandemic emergency financing
SARS ..... Severe Acute Respiratory Syndrome
SIR ..... susceptible-infected-removed
SME ..... small and medium-sized enterprises

Acknowledgements

This report was prepared by UNDP based on probono research prepared by Vivid Economics

UNDP Insurance and Risk Finance Facility

The Insurance and Risk Finance Facility (IRFF) is part of the Sustainable Finance Hub (SFH) of the United Nations Development Programme (UNDP), and it is a flagship initiative dedicated to insurance and risk finance. The IRFF manages UNDP's global representation in the insurance space. It is a one-stop shop for innovative solutions for UNDP Country Offices, programme countries and partners. This includes issues related to insurance and risk finance, networking, partnership development, policy and guidelines, technical assistance, project implementation, capacity-building, and financing opportunities.

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SDG financing is one of the four elements of UNDP's SDG integrator role, and it is a cross cutting enabler for the success of all UNDP's thematic areas of work. UNDP, having a long track record of working in public finance and private sector development, through the Sustainable Finance Hub, in collaboration with partners, supports governments, the private sector, civil society and philanthropy to mobilize and align public and private flows of finance with the SDGs and national priorities across different development contexts, including fragile and conflict-affected countries and Small Island Developing States.

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Executive Summary

The disruption and suffering caused by the COVID-19 crisis, and by the responses taken to mitigate its effects, have almost undone the world's progress towards achieving the United Nations Sustainable Development Goals. Its primary impacts, including death, illness and health expenditure, are partly to blame, but its system-wide secondary impacts are equally consequential and potentially longer-lasting. Secondary impacts of health crises generally have more far-reaching effects on a country's overall economy than primary impacts, but modelling them receives less attention from policymakers. Given the magnitude of the consequences, it is essential to identify, define and understand the major socioeconomic impacts countries experience during major health crises and develop solutions to effectively mitigate them.

This research brief discusses the modelling of major secondary impacts, such as disruption of public services, business and education, unemployment, food insecurity, poverty, gender inequality and mental health. Modelling secondary impacts can inform evidence-based social, economic and fiscal policies before (ex-ante), during and after (ex-post) an epidemic event. In the absence of such policies, the transitory effects of epidemics can become permanent. Choosing appropriate modelling approaches (whether quantitative econometric or epidemiological qualitative or mixed methods) is critical to capturing the secondary impacts of health crises and inappropriate methodologies can lead to biased estimates. Although there is no one-size-fits-all methodological solution, key considerations in determining the usability of the modelling approach include disease factors, flexibility, robustness, relevance, granularity, and technical requirements.

Developing countries may lack the technical capacity and resources to use secondary impact modelling within their current risk management and budgetary frameworks for epidemic preparedness. For this reason, countries need support from the development sector. UNDP can integrate the issue of pandemic risk into its development programming and bring it to the attention of the governments of developing countries. UNDP should devote its resources to building Member Countries' technical capacity in secondary impact modelling, particularly in finance ministries and central banks. UNDP could also be an effective mediator between Member Countries and bilateral donor agencies and private foundations to channel technical and financial resources into developing sustained capacity in secondary impact modelling.

Insurance is a well-established tool for risk protection, and increased disaster risk financing (DRF) could reduce economic losses in the poorest countries by as much as 25 percent. UNDP can explore risk protection against the financial risks of major health crises for its Member Countries, exploiting its expertise and experience in DRF and collaborating with insurance industry and development partners. But insurance against a pandemic like COVID-19 is challenging since it is difficult to pool risks when pandemic risks affect everyone at the same time. So, UNDP needs to undertake comprehensive research in collaboration with the insurance industry to develop risk financing models for insuring risk protections against future major health crises like COVID-19.

Introduction

The COVID-19 pandemic has demonstrated that major health crises at a global scale can have a profound impact on human lives and livelihoods. At an individual level, health shocks put huge strain on people and households, causing increased mortality, morbidity, and catastrophic health expenditure. At system level, pandemics and other major health crises devastate national economies by weakening national health systems and creating economic, social and political disruption. The disruption and suffering caused by the COVID-19 crisis, and by the responses taken to mitigate its effects, have almost undone the world's progress towards achieving the United Nations Sustainable Development Goals (SDGs).

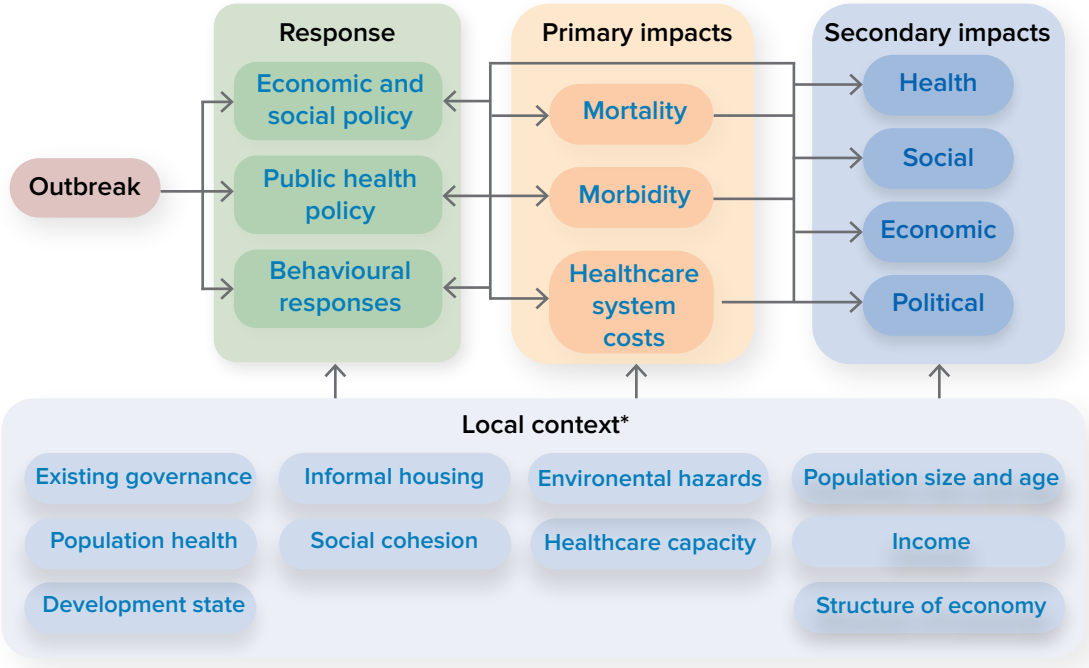
Health crises can have drastic impacts on economies, and countries starting out at a disadvantage may be likely to fare worse. Pandemics and other health crises cause both transient and long-lasting economic damage through many different mechanisms, including short-term fiscal shocks and long-term negative shocks to economic growth.[1] In developing countries where tax systems are weaker, as economic growth declines, fiscal stresses caused by increased expenditure are exacerbated by diminished tax revenues. At the microeconomic level, households lose earnings due to death, sickness, or quarantine, and in low-income countries where appropriate social and financial risk protection may be unavailable, households incur additional health care expenses. The value of intrinsic loss from excess deaths from potential pandemics is estimated to be $490 billion, or 0.6 percent of global income per year.[2] At the macroeconomic level, income losses caused by pandemics could exceed 50 percent of gross national income (GNI) in some low- and middle-income countries.[3]

In 2020, the International Monetary Fund (IMF) predicted that the COVID-19 pandemic would lead to negative global economic growth at a scale that could reverse all progress in curbing global poverty and inequality made since the 1990s.[4] Given existing economic vulnerabilities, the UN has referred to the COVID-19 crisis as a "looming financial tsunami" for developing countries, and has warned of an ensuing global recession that could create a "high-debt, low-growth trap".[5] The Human Development Index (HDI), an indicator of developmental progress measured as a combination of the world's education, health and living standards, continued to grow even through the financial crisis of 2008–2009 (HDI, 0.005), but the COVID-19 pandemic has completely wiped out years of slow and steady improvements (HDI, -0.020).[6]

What are the secondary impacts of health crises?

As COVID-19 has shown, the impacts of health crises and their responses vary in magnitude and dimension based on local social, economic, demographic, environmental and health system contexts (Figure 1). Primary impacts lead to a range of secondary health, social, economic, and political impacts, all of which are interlinked and require common national economic policies and financial responses.

Figure 1. Secondary impacts stem from primary impacts mediated by policy and contextual factors



* Not a comprehensive list of risk factors affecting outbreaks, response, and impacts

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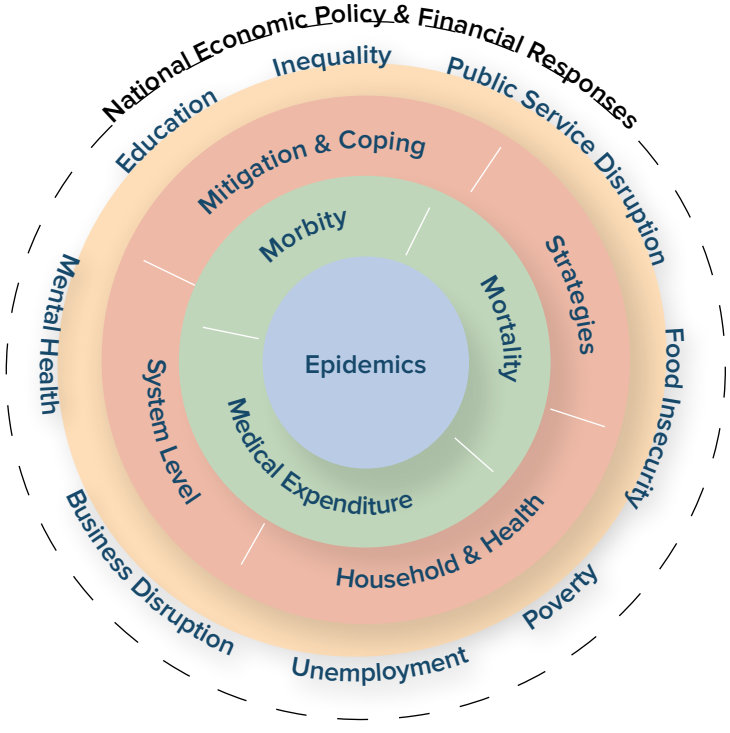
For the purpose of quantifying and modelling secondary impacts, this research brief has prioritized **major secondary impacts of health crises, including disruption of public services, business and education, unemployment, food insecurity, poverty, gender inequality, and mental health.** Figure 2 outlines a conceptual framework to help capture and understand the secondary impacts of heath crises and their mitigation strategies.

Figure 2. Conceptual framework of secondary impacts of major health crises



Secondary impacts of pandemics, as evidenced in the COVID-19 crisis, affect many different systems:

- Critical **public services**, such as health care, education, social services, and transportation, are disrupted. Increased emergency demand, pressure to switch to virtual services, and an incredibly challenging workforce management environment put public services under huge pressure.

- **Business** activities are seriously affected by supply chain disruptions and by preventive measures, such as quarantine, isolation, and lockdown. The COVID-19 pandemic is set to shrink global economic activity by as much as 7.6 percent.[7] The most positive prediction for the global impact on tourism foresees losses of $1.17 trillion, equivalent to 1.5 percent of world GDP[8], putting severe financial strain on many developing countries. Pandemics and pandemic responses also cause uncertainty, which seriously inhibits foreign and domestic investment.[9]

- **Education** is negatively affected during pandemics due to full and partial school closures, with even open schools suffering from high infection rates among students and teachers alike. The secondary impact of COVID-19 on poverty has put up to 9.7 million children and young people at risk of dropping out of school permanently.[10] Some children and youth may find it hard to re-enrol even after the crisis has passed, due to abuse, exploitation, neglect, and adolescent pregnancy.

- COVID-19 has caused **unemployment** to skyrocket in many countries. An estimated 8.8 percent of all working hours in the world were lost in 2020, equivalent to 255 million full-time jobs lost in one year.[11] Job loss has placed great strain on households, limiting income and consumption.

- COVID-19 has also deepened **gender inequality**. Women workers have been disproportionately affected by job losses, since almost 40 percent of all employed women work in hard-hit sectors such as accommodation, food services, retail, business, and administration. The disproportionate impact of COVID-19 on women and girls makes SDG 5, on gender equality, even more distant than before, according to UN estimates.[12] UN Women has reported an increased rate of gender-based violence in most countries during the pandemic, due to declining income, loss of livelihood, sexual exploitation and forced marriage. This is evidenced in the increased number of calls to gender-based violence hotlines, ranging from a 40 percent increase in Malaysia to a 400 percent increase in Tunisia.[13]

- Pandemics and their responses disrupt livelihoods and food supplies, leading to **poverty** and **food insecurity**. The World Health Organization (WHO) reports that almost half of the world's 3.3 billion global workforce are at risk of losing their livelihoods.[14] The World Bank estimates that globally, the number of people living in extreme poverty – that is, people living on less than $1.90 per day – may have risen to 150 million by 2021.[15] Chronic malnutrition is on the rise in developing countries due to COVID-19[16]; according to UNICEF, 6.7 million

additional children aged under 5 may have suffered from wasting (low weight-for-height) during the first year of the pandemic.

- As resources are diverted to pandemic responses, national health systems struggle to cope with regular health care services. The trauma caused by pandemics and their impacts increases **mental health** problems, including anxiety, depression, and post-traumatic stress disorder, which can persist even years after the health crisis has passed.[17]

Why model secondary impacts?

The primary impacts of health crises (morbidity, mortality, and health system costs), along with recovery and prevention, receive the most upfront attention from policymakers, because of their direct effects on human lives. A review of available literature on major cholera and Ebola outbreaks since 2010 found that not much research focused on those outbreaks' secondary impacts.[18] Quantifying and modelling the secondary impacts of health crises is less frequently done, despite the fact that **secondary impacts are further reaching and longer lasting than primary impacts.** Given that the secondary impacts of health crises have wide-reaching consequences, it is critical to identify, define and understand the major socioeconomic impacts that countries experience during pandemics and epidemics and develop solutions to effectively mitigate them.

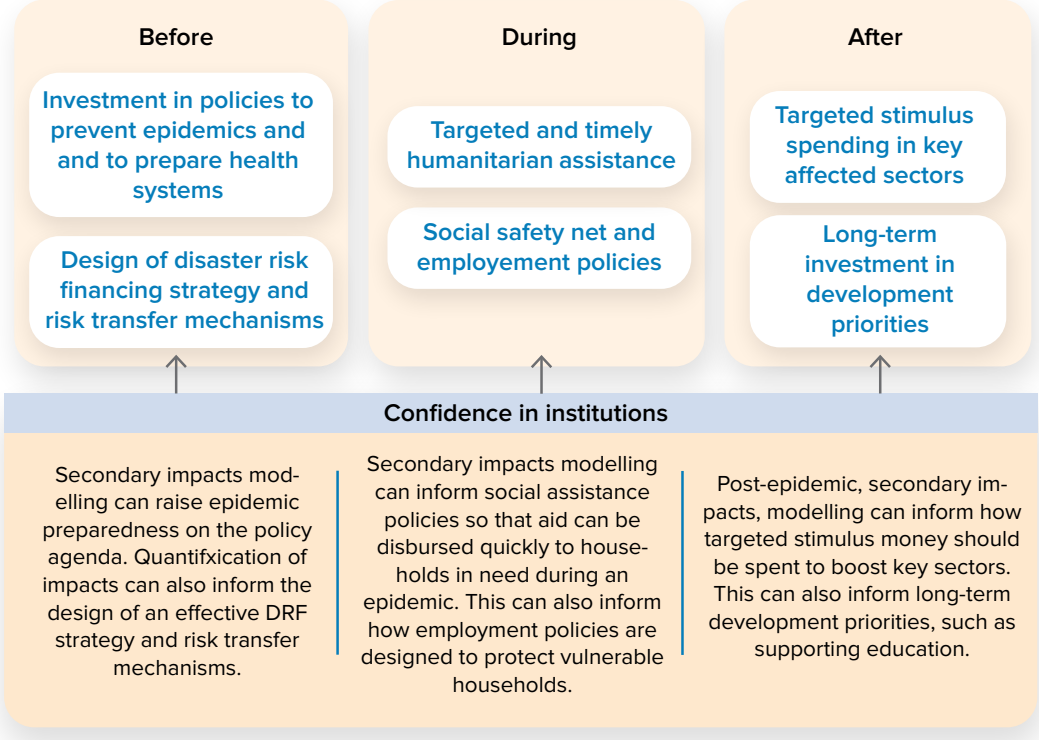
The COVID-19 pandemic has shown that the modern world is simply not prepared to respond to catastrophic health crises. The Global Health Security Index (GHSI) assessed the readiness of 195 countries to manage infectious disease threats, examining prevention, detection, response, health services and policy. The average score across all countries was 40 points out of 100; all high-income countries and some upper middle-income countries scored just over 50 while least developed countries scored just 29, with very worrying capacity gaps in pandemic response.[19] It should be noted, however, that in the post-COVID period, the GHSI was criticized, given the inverted relationship between the predicted and actual pandemic preparedness of the countries.[20]

Modelling secondary impacts of major health crises can help prepare the world better for the next crisis. **Secondary impact modelling can build awareness among policymakers and equip countries to respond to and mitigate socioeconomic losses**. Examining secondary impacts through science, modelling and data, as well as using the insurance industry's ability and capacity to model and analyse risk and outline scenarios, could help countries to plan better, respond better and reduce risk better both ex-ante, during, and ex-post pandemics, by creating an evidence base for formulating national economic policies and financial decision making (Figure 3).

Secondary impact modelling can benefit countries in many ways. First, it can create awareness among decision makers of the risks of health outbreaks and their consequences, helping countries to understand likely future scenarios and enabling better risk-informed decisions. It can provide countries with a clearer idea of the most critical sectors across society and the economy and help them understand how to prioritize and utilize scarce resources. Understanding potential future risk scenarios can give insight into the impact of health outbreaks on a country's socio-economic

indicators – from the macroeconomy to household budgets to those who are most vulnerable. Modelling secondary impacts can support the insurance industry by unpacking the secondary impacts of outbreaks and providing useful data, information and analysis to curate smarter and more robust products that can protect vulnerable people and communities from the shocks of health crises. And finally, embedding risk knowledge and scenarios into development financing will put countries in a stronger position to prepare financially for the outbreak, by developing contingency measures for avoiding disruption in public services including health and education, financing risk, and improving readiness to recover. Since epidemics can pose a significant fiscal risk, and understanding and preparing for secondary impacts can have implications for fiscal decision-making, finance ministries need forward-looking investment on modelling secondary impacts to inform risk reduction investments, risk financing, budget planning, preparedness and allocations, and economic policies.

Figure 3. Modelling secondary impacts informs evidence-based policies before, during and after health crises



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The following sections of the research brief demonstrate how governments can develop ex-ante, during and ex-post scenarios for potential health crises by applying secondary impact modelling and can take appropriate policy and financial decisions to mitigate negative impacts for their countries. Next, methodological considerations are discussed, reviewing existing methodological approaches and their relevance, usability and robustness, and methods are suggested for modelling secondary impacts of health crises. Then, potential outputs/outcomes of secondary impacts modelling are explored, drawing from past examples of health crises. The brief discusses ways in which decision makers can exploit these models, examining the benefit of understanding secondary impacts in taking financial decisions. Finally, a way ahead is recommended by setting out what is needed now, why it is important, and how to get there. The research brief is primarily based on a scoping review conducted by Vivid Economics for UNDP (2021).[21]

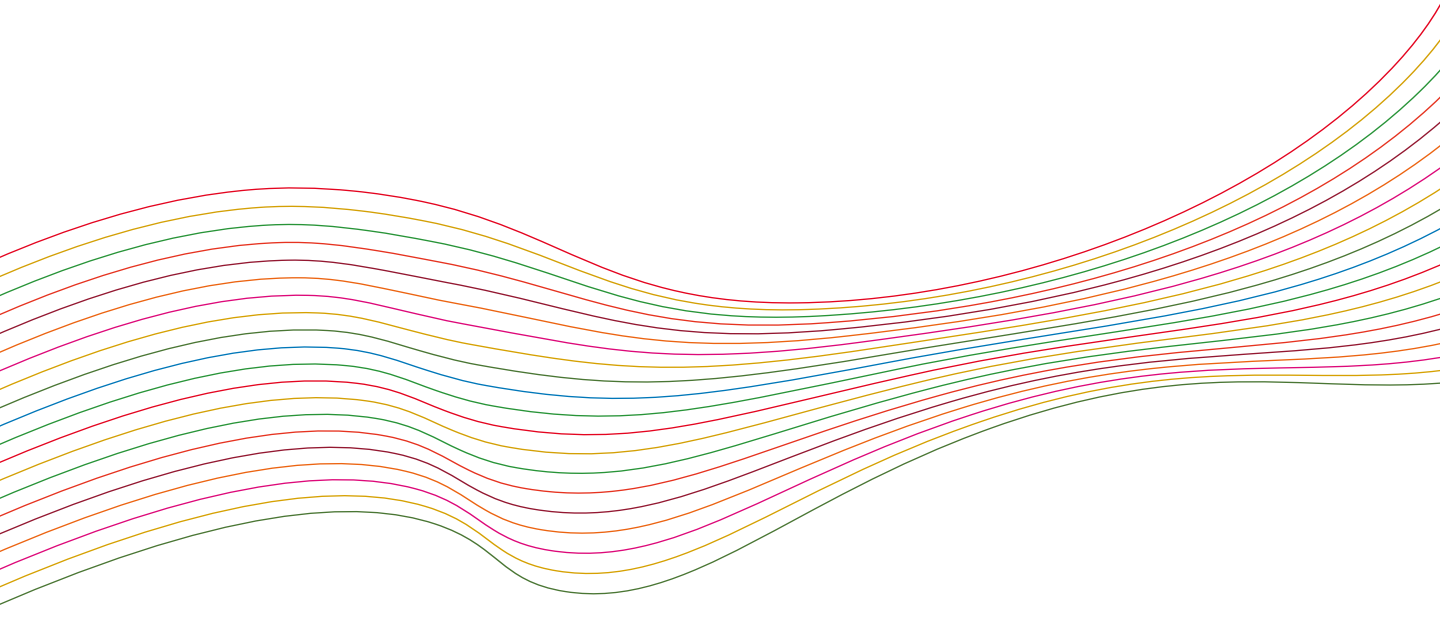
Making the case

Countries at risk from major health crises can develop scenarios of secondary impacts built on past experience and can design social, economic, monetary and fiscal policies that can quickly mobilize resources to minimize long-lasting damage to the economy. **Modelling secondary impacts can inform evidence-based policies before (ex-ante), during and after (ex-post) an epidemic event** (Figure 3). Before the epidemic, quantifying and modelling secondary impacts can help countries raise epidemic preparedness on the policy agenda and invest in policies to prevent epidemics and prepare health care systems. In advance of a crisis, modelling can inform the design of an effective DRF strategy and risk transfer mechanisms. During the epidemic, modelling secondary impacts can help countries to design social assistance policies, social safety nets and employment policies, and can help target timely humanitarian assistance to protect vulnerable households. After the epidemic, secondary impact modelling can inform how targeted stimulus money should be spent to boost key affected sectors of the economy and can guide long-term investments in development priorities, such as supporting education.

In the absence of effective fiscal and social policies, the transitory effects of epidemics can become permanent. Without adequate safeguards in place, viable businesses may become illiquid, with knock-on effects for employment, expenditure and economic growth. The experience of COVID-19 and of previous economic and health emergencies indicate a number of policy measures that can promote economic resilience.[22] These include supporting household and business liquidity and minimizing unnecessary bankruptcies that could cause permanent damage to the economy; protecting the financial system; offsetting lost wages for workers and ensuring people have disposable income; protecting the most vulnerable through social protection measures, including targeted transfers; and stimulating the economy more broadly, through public investment and tax relief and subsidies to support business continuity, particularly for small and medium-sized enterprises (SMEs) and the self-employed.

COVID-19 was the first pandemic of its kind for a century, so the world took few ex-ante measures to respond to the secondary impacts of such a catastrophic health crisis. However, emerging economies took substantial economic measures during the pandemic. For example, Taiwan's COVID-19 response became the envy of the world. According to KPMG, the Taiwanese Government budgeted 51.1 billion New Taiwan dollars for its Triple Stimulus Voucher programme, which aimed to stimulate the local economy following COVID-19.[23] Economic stimulus measures included supporting SME funding, loan extensions for companies and individuals, credit card payment deferral without penalty, reducing interest rates from public banks, rental concessions/adjustments, and a 100 billion New Taiwan dollar package for all affected businesses from commercial banks. The Taiwanese government also introduced supportive tax measures and employment-related measures such as subsidized training programmes, salary subsidies and unemployment benefit of up to 60 percent of the average monthly insurance salary. Viet Nam, too, took measures to mitigate the pandemic's economic effects. It designed a credit support and fiscal package of $12 billion, including a $1.16 billion assistance package for the business sector to assist struggling companies with tax breaks, delayed tax payments and reductions in land lease fees.[24] The package also included measures such as debt restricting and preferential

interest rates. Another South Asian emerging economy, Bangladesh, took a series of economic measures to protect its business and export-oriented economy. According to KPMG, Bangladesh planned a $8.80 billion package to rescue its business sector and implement immediate, short- and long-term measures, including by increasing public expenditure, formulating a stimulus package for export-oriented industries, widening social safety net coverage, increasing monetary supply, and providing direct cash assistance to informal sector workers.[25]



Methodological approaches to secondary impact modelling

Determining the appropriate modelling approach to use is essential if the secondary impacts of health crises are to be effectively captured. Countries at risk could measure the secondary impacts of epidemics by applying customized modelling approaches and answering targeted policy questions in a range of key areas. Each area of inquiry will require information informed by secondary impact modelling, as follows:

- To answer policy questions on investment in **epidemic prevention and preparation of health systems**, countries need to examine how spending in this area can be made cost effective compared to other government priorities.

- To design **DRF strategy and risk transfer mechanisms**, policymakers need to find out the costs/expenditures that are likely to be incurred in the event of an epidemic.

- In designing **targeted and timely humanitarian assistance** (i.e., cash transfers or food assistance), data is needed on which households are most likely to be impacted and what specific needs will likely arise in different epidemic conditions.

- In answering policy questions on **social safety nets and benefits**, countries need to examine the social protection policies needed to minimize the spread of infection, and the **employment policies** needed to support households and businesses during an epidemic.

- Countries need to identify the sectors most likely to be affected by different types of epidemic outbreaks to formulate policies on **targeted stimulus spending in key affected sectors.**

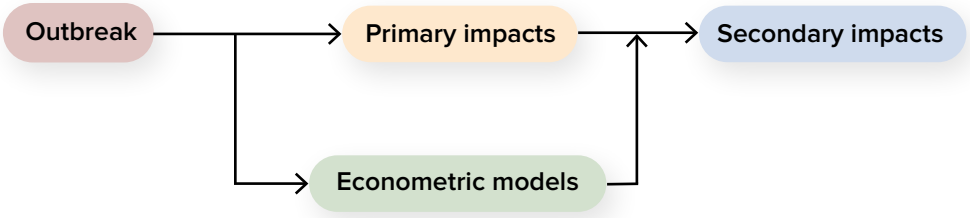
- Long-term impacts of pandemics on social and development outcomes need to be examined in order to formulate **long-term investment policies in development priorities.**

Secondary impacts could be directly assessed through a reduced form of modelling as a function of key variables (Figure 4). Given appropriate data availability and information on epidemic contexts, social, economic and political outcomes can be directly estimated using econometric or statistical approaches. By applying these approaches, countries can directly estimate the impacts of epidemics on health systems, mental health, gender-based violence, businesses, education, public service, employment, food security, inequality and poverty. Some social outcomes might stem from economic impacts and could be extrapolated from economic models. This could be done through a qualitative interpretation based on country-specific contexts or could take the form of interpretive analysis using established literature linking economic shocks to social and political responses.

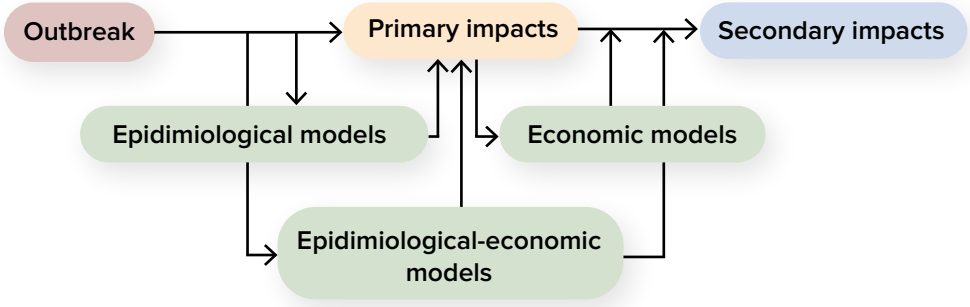
One drawback of using this method is that inappropriately designed econometric methodologies can lead to biased estimates. Robust econometric methods can reduce errors, but this requires longitudinal/panel data and a higher level of technical acumen in econometric study design, data analysis, interpretation of results, and reporting.

Figure 4. Secondary impacts modelling options: reduced form modelling or linked modelling

Reduced form modelling



Linked modelling



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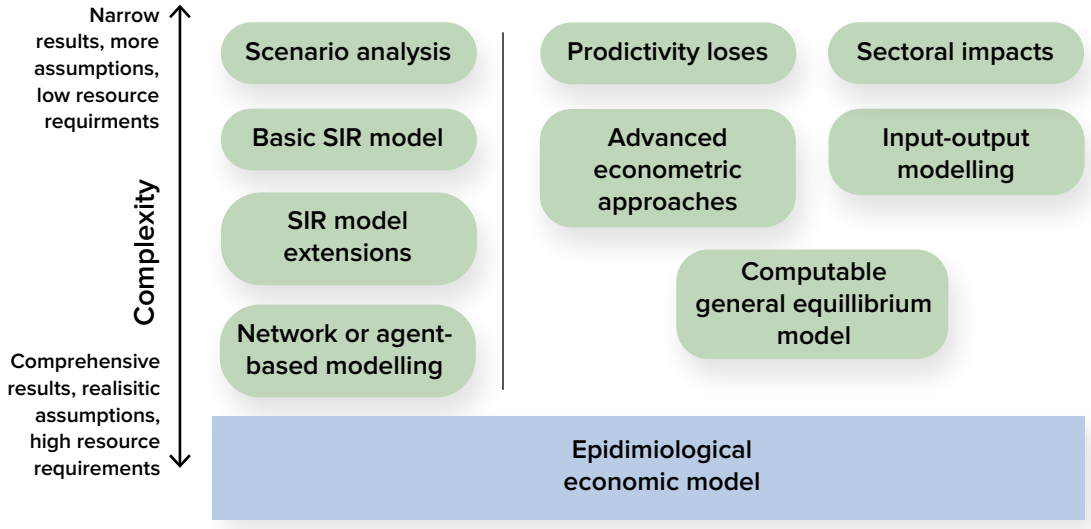
Secondary impacts could also be directly assessed through linked multi-stage modelling as a function of primary impacts (Figure 4). Here, the outputs of an epidemiological model are used as inputs into an economic model, which thus creates a link between epidemiological and economic models. An epidemiological model often characterizes an outbreak in terms of morbidity and mortality; in order to generate economy-wide impacts (macroeconomic indices), these can be fed into an economic model as health shocks to selected economic outcomes, such as labour supply, lost income, production losses, cost increase, trade interruptions, or changes in premiums/interest rates. Both epidemiological and economic models can range in robustness and complexity. But there is a trade-off between robustness and resource constraints within the species of epidemiological and economic models (Figure 5). Models with low resource requirements produce narrow results with more assumptions, whereas more robust models that produce comprehensive results with realistic assumptions have high resource requirements.

Most existing research models epidemics and economics separately, but an emerging field of economic epidemiology extends epidemiological models to account for economic actors/interactions. For example, one recent study developed an SIR (susceptible-infected-removed) macroeconomic model, which links economic activity to increased contact and spread of disease, as has been observed during the COVID-19 pandemic.[26] Most research approaches

build analytical rigour into one of the two linked models, but few policy-relevant examples have robust epidemiological and economic modelling.

Figure 5. Trade-off between epidemiological and economic modelling of health crises



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Another type of economic modelling takes a layered approach to estimate the secondary social and economic impacts of epidemics, in which aggregate impacts of individual sectors lead to economy-wide impacts (Figure 6). These economy-wide impacts subsequently generate social and political impacts. Sectoral losses can stem from death and disability-induced absenteeism, prophylactic absenteeism and absenteeism driven by school closures. Individual sectors may be affected by the disease or by response policies such as lockdown. The sectors that are affected depend on the mode of transmission and nature of the disease. For example, controlling airborne disease necessitates social distancing and lockdowns, which may disproportionately affect the hospitality sector. Losses in productivity as a sectoral impact has economy-wide implications. A full macroeconomic modelling approach can translate sectoral spillovers and interdependencies in the economic system into economy-wide impacts on GDP, employment, trade, and other key macroeconomic variables. Eventually, economy-wide impacts can cause many social impacts, which can again be estimated as a function of economic impacts.[27] A full macroeconomic analysis can provide more insights into the distributional effects of epidemics (i.e., which sectors are more affected than others), and social implications can also be estimated from sectoral impacts in a more simplified way.

Computable general equilibrium (CGE) modelling is considered the most robust modelling framework for estimating the economy-wide impacts of a shock. CGEs specify a system of equations that describe an economy and estimate how it might react to a shock. CGEs can be calibrated to real economic data and empirically derived coefficients. An epidemic-induced shock in a CGE model could typically be characterized in terms of impact on labour productivity, supply, demand and/or risk premium shocks. CGEs can produce a large range of macroeconomic variables, with changes in GDP the primary result. Depending on the model, they can also produce distributional impacts, sector-level output and changes in tax revenue. CGE models also incorporate the supply side, therefore allowing for price movements. However, they are

computationally and data intensive and can be difficult to solve. A recent example suggests applying a compound risk multiplier to measure economic losses associated with the cascading impacts of climate, economic and pandemic shocks. It finds that the amplification effect can peak at over 150 percent – that is, the GDP impacts of the compound shock can be 50 percent larger than the sum of the individual shocks.[28] Failure to incorporate these compounding risks into secondary impact modelling could make it difficult to fully capture the consequences of shocks and prepare for future crises.

Economic modelling of secondary impacts can address different policy questions and needs at varying levels of robustness. Depending on the type of economic model used (such as econometric models, parameter-based models, input-output models, CGE models and macroeconomic epidemiology-linked models), **key considerations across modelling approaches should include disease factors, flexibility, robustness, relevance, granularity and technical requirements, since these factors together determine the ultimate usability of the modelling approach.**

- **Disease factors** relates to the extent to which a modelling approach captures the impacts of differing disease types, including the characteristics of infection such as delay between infection and symptoms onset, the time profile of infectiousness, the time to reach epidemic proportions, and case fatality rate.

- **Flexibility** assesses the degree to which the approach is responsive to epidemic conditions and socioeconomic scenarios and able to assess intervention impacts.

- **Robustness** depends on the extent to which the outputs of the secondary impact modelling change when one or more plausible assumptions of the specific modelling approach is changed.

- Whatever the methodological rigour and robustness, the **relevance** of the modelling approach is of paramount importance in the context of policymaking. So, it is worth carefully checking whether the modelling approach produces policy-relevant outputs to inform decision-making.

- **Granularity** assesses the level of spatial or temporal specificity and detail in the outputs produced by the secondary impact modelling.

- Last but not the least, the **technical requirements** of the selected modelling approach should be considered: that is, the amount of data collection and analytical capacity that is needed to make assessments and interpret modelling outputs.

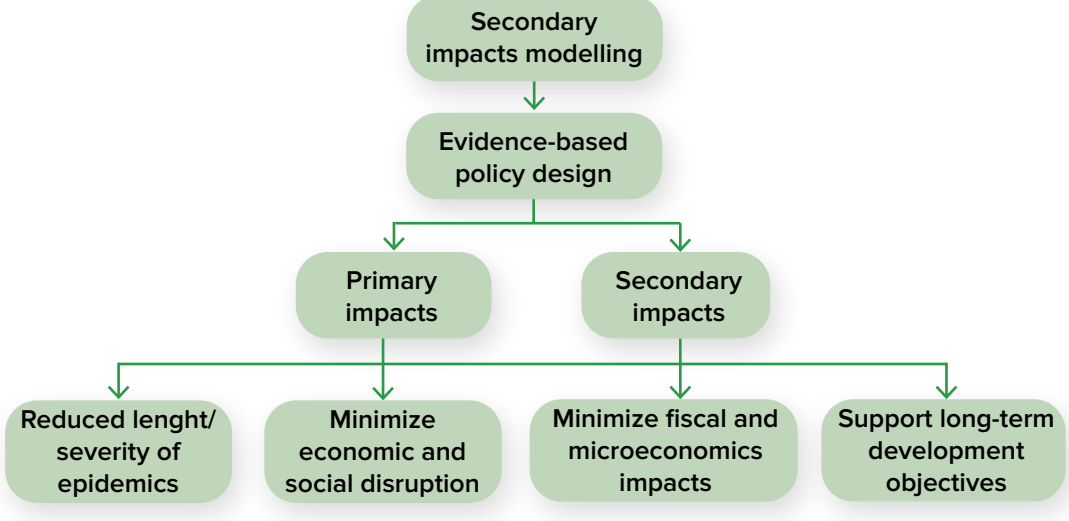
Before choosing one of the quantitative modelling approaches discussed above, one fundamental methodological question needs to be asked: is quantitative modelling sufficient to capture the secondary impacts of epidemics and derive usable policy-relevant outputs? Or would a mixed-method study approach, incorporating both quantitative modelling and qualitative exploration, suit the purpose better? Quantitative modelling approaches have compelling benefits, including large sample size and reproducible outputs. But they also have inherent limitations in answering

more contextual socioeconomic and cultural questions, which are always critical in formulating community-driven localized solutions to the secondary impacts of epidemics. In designing interventions, *how* and *why* questions frequently need to be answered, and qualitative methods are appropriate in collecting and analysing such qualitative information. Large sample size is critical in quantitative modelling in order to produce statistically meaningful results and make convincing recommendations. However, large sample sizes are sometimes impossible to obtain; for example, data may be needed from organizational or policy leadership levels, but there may simply not be enough individuals involved to gain statistically relevant quantitative data. In this case, obtaining qualitative data, in the form of expert opinion from individuals at these levels, for example, may be critical in formulating policy-relevant decisions. Openness and flexibility is needed in making choices between quantitative and qualitative methods/ mixed-methods in secondary impact modelling based on local socioeconomic and cultural contexts, since there is no one-size-fits-all solution.

Potential outputs/outcomes

Secondary impact modelling of health crises can help at-risk countries to formulate sector-specific key policies ex-ante, during and ex-post pandemics. **Designing and implementing evidence-based policies in a timely way can minimize social, economic and fiscal disruption and produce positive health system, economic, social, political and fiscal outcomes** (Figure 7). Modelling long-term health vulnerabilities and effective treatments can help countries to design and formulate investment policies for preventing epidemics and preparing health systems. Without secondary impact forecasting, affected countries during the COVID-19 pandemic struggled with limited health system capacity in managing the additional demand placed on health services. By modelling ways to support business continuity, employment, food security and poverty alleviation, countries can design effective DRF strategies, risk transfer mechanisms, targeted humanitarian assistance, social safety nets and employment policies, and thus can minimize household economic vulnerabilities.

Figure 6. Epidemic preparedness and policy response reduce human, social and economic impacts

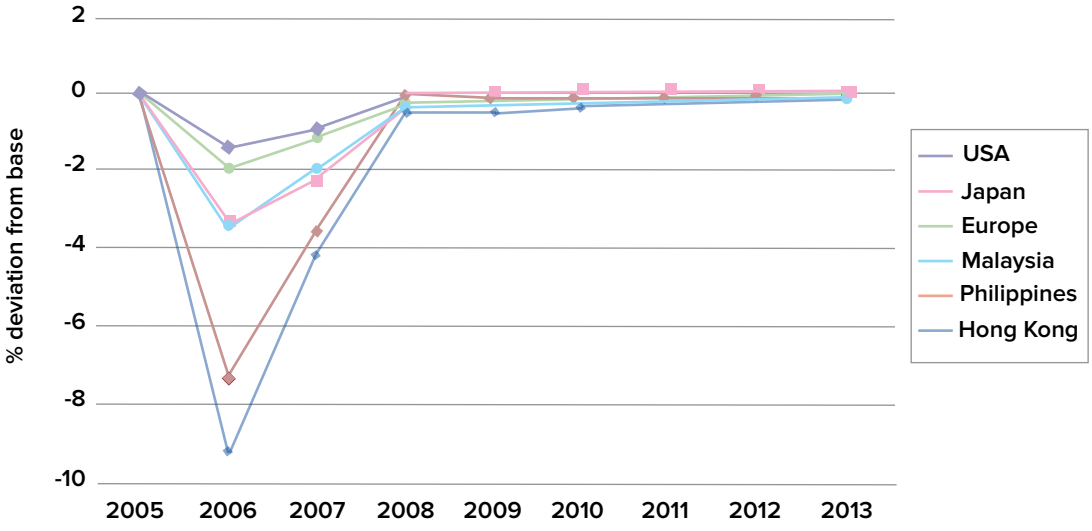


By modelling fiscal risk management, sector-specific economic impacts, and confidence in institutions, countries can design adjusted fiscal management policies, plan to target stimulus spending to key affected areas, and devise ways to invest in long-term development priorities. These policies can help countries to limit the risk of economic recession and to sustain macroeconomic functionalities and stability during and ex-post the economic shocks from pandemics.

A tiered approach to building epidemic risk management capacity can support evidence-based decision-making. But finance ministries in developing **countries may lack the appropriate capacity and resources to use technical epidemiological and economic models within their current risk management and budgetary frameworks.** Therefore, countries need support from the development sector to build technical capacity in the short and long term. In the short term, parameter-based modelling approaches can bridge gaps in decision-making. For example, for waterborne epidemics, experienced more regularly in countries with poor water, sanitation, and hygiene (WASH) infrastructure and spread by contaminated water, food or exposure to faecal matter, parameter-based economic models can provide sufficient information to inform investment in epidemic risk reduction and budgetary requirements. In the long term, investing in user-friendly and standardized modelling tools can inform coordinated approaches to epidemic and pandemic risk management. For example, for diseases spread by human-to-human contact, more complex linked models may be needed to assess the trade-offs in policies that reduce both economic activity and the spread of disease. Decisions can be informed by more robust macroeconomic-epidemiological modelling tools calibrated to assess the costs and benefits of economic and public health policies.

Examples exist of the kind of modelling that could help countries to better formulate policy by examining risk. McKibbin and Sidorenko[29], for instance, use a range of historical epidemic scenarios (mild, moderate, severe and ultra) of influenza outbreaks of the twentieth century, applying a CGE model to investigate global shocks to GDP (Figure 8). The study finds that even a mild pandemic scenario could cost the world 1.4 million lives and close to 0.8 percent of GDP (approximately $330 billion) in lost economic output, while in the ultra scenario, a massive global economic slowdown would occur, with over 142.2 million people killed and a GDP loss of $4.4 trillion. The study also observed that the composition of the economic slowdown differs sharply across countries, with a major shift of global capital from affected economies to less affected safe haven economies (i.e., North America and Europe). By employing such robust modelling, at-risk countries can formulate economic and investment policies and inform risk reduction investment.

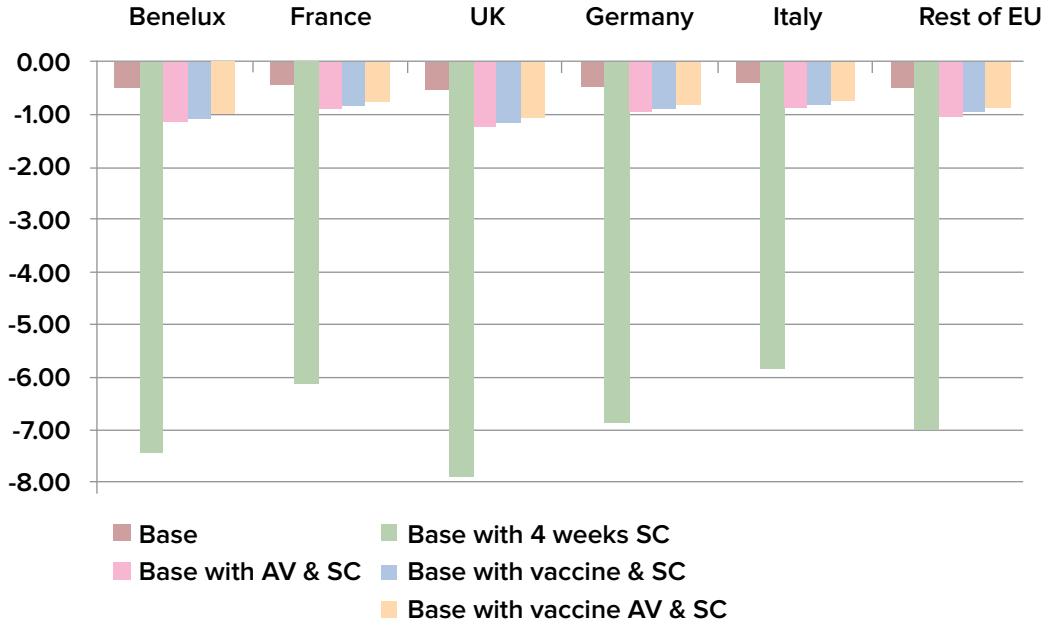
Figure 7. Impacts of global epidemics on countries' GDP



| McKibbin and Sidorenko 2006

Another example by Keogh-Brown and others[30] estimates the impact of a potential influenza pandemic on global macroeconomic outcomes (Figure 9). The study unites disease parameters and policies for pandemic response planning, applying CGE modelling to capture the potential cost of a future influenza outbreak for the global economy. The model reveals that policies introduced to mitigate disease spread, such as school closure, result in unprecedented losses to the economy of up to 8 percent of GDP, even though the impact of the base disease scenario is quite small (GDP loss of approximately 0.5 percent).

Figure 8. GDP impact due to disease mitigation policy in a global influenza pandemic



Note: Base=Base disease scenario; SC=School Closure; AV=Antiviral and Vaccination.

| Keogh-Brown and others 2008

Keogh-Brown and Smith[31] conducted a retrospective analysis of the macroeconomic impact of the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak to provide a more accurate estimate of the actual impact of the outbreak. Their analysis suggests that the scale of the SARS impact on affected economies was far smaller than suggested by contemporary media reports and model estimates, a finding that holds important lessons for estimating the economic impact of future outbreaks. Policymakers need to be sure to use modelling outputs carefully to avoid model-induced negative economic outcomes.

In adapting frameworks for secondary impact modelling, no single modelling approach is likely to be able to support all evidence-based policy priorities and investment surrounding health crises across countries. Countries need to identify their own priority secondary impacts for modelling. Countries also need to identify the likely users of modelling outputs and what their specific needs would be. They should decide on the existing structures with which the secondary impact modelling should align. To calibrate existing modelling approaches to meet specific policy needs, countries need to conduct further research in several areas. For example, since the key outcome of modelling is understanding the impacts of policies/investments, countries will need analysis to link policies with modelling of secondary impacts. Analysis will be needed to connect policies to model parameters, model inputs or model outputs. Countries may need modelling of additional secondary impacts since the secondary impacts of interest may not be the direct outputs of economic models but may be able to be assessed based on macroeconomic variables. For example, income inequality could be extrapolated from direct CGE model outputs. Countries may also need more research on treatment of risk, since epidemiological research on the risk of future epidemics and pandemics is nascent, and epidemiological models contain limited treatment of risk.

The way forward

Global health crises such as COVID-19 create a natural experiment, as different countries, territories and localities address the same problem with different behavioural, social, political, economic and financial policy responses to control the disease and mitigate its consequences. There is a lot to be learned from this process, both on the modelling side and on the policy response side. The COVID-19 pandemic has exacerbated countries' economic vulnerabilities, leading to a significant disruption of public service, business, education, employment, food security, poverty, gender inequality and mental health. Health crises like this sometimes have long-lasting aggregate secondary economic impacts which need critical economic responses from central banks in terms of customized monetary policies aimed at controlling inflation and reducing unemployment rates. The collapse of global supply chains during pandemics can raise commodity prices, which can contribute to high inflation rates in many parts of the world. This could bring about stagflation, in which a country's economy is trapped in high inflation alongside low economic growth and high unemployment, especially in fragile developing economies. In such situations, central banks increase bank interest rates to reduce inflation rates, making both bank loans and investments expensive. As a result, countries experience declining investment, which translates into high unemployment rates. In this way, economic recessions from major health crises can be long lasting – perhaps the single most important reason why secondary impact modelling of health crises is imperative in order to help countries avoid these consequences.

Moving forward, UNDP can take the following actions to help promote secondary impact modelling:

- Integrate the issues of pandemic risk into UNDP's development programming, prioritize secondary impact modelling of pandemics and bring the issue to the attention of the governments of developing countries. In doing so, UNDP can demonstrate how secondary impact modelling of future health crises can help developing Member Countries to improve their financial planning, risk management strategies and preparedness for future health crises. Member Countries will gain an understanding of how risk quantification of secondary impacts can elevate the value of investing in public health, improve crisis response and preparedness, and minimize social and economic disruptions when health emergencies strike.

- UNDP should devote its resources to build the technical capacity of the Member Countries, and particularly of finance ministries and central banks, in secondary impact modelling of health crises. UNDP should assist countries in planning, responding to and reducing risks by using science, data, and the insurance industry's techniques to analyse risk impacts from health crises. In this way, countries will gain the skillsets to leverage modelled outputs to inform risk-reduction policy development ex-ante, during and ex-post health crises.

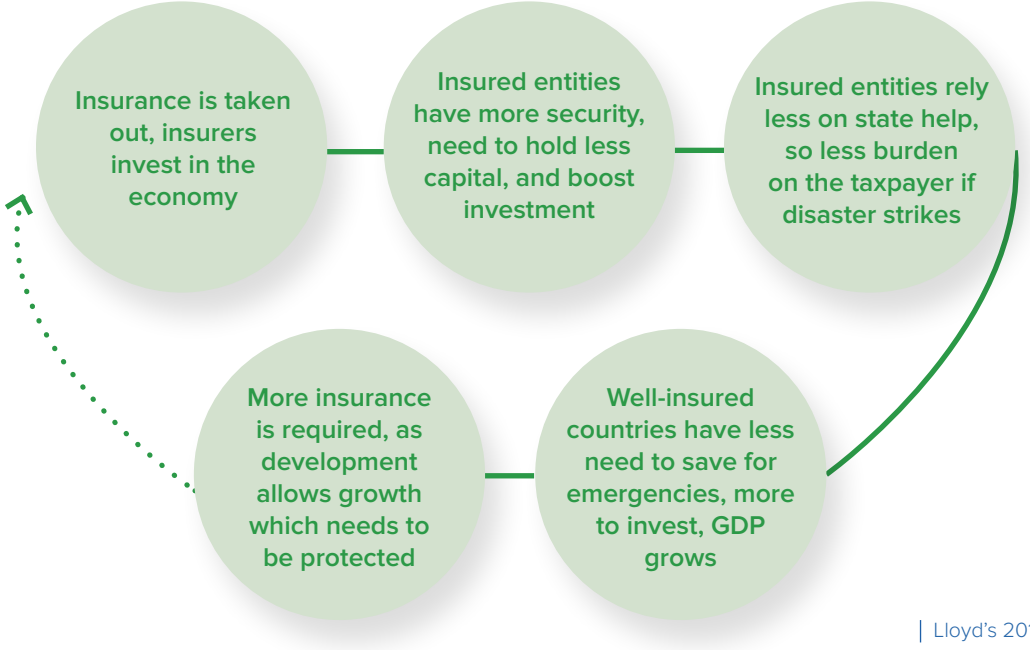
- UNDP could also act as an effective mediator between Member Countries and bilateral donor agencies and private foundations to channel technical and financial resources towards developing sustained capacity in secondary impact modelling and to help in formulating

ex-ante, during and ex-post policy responses. This effort will not only help countries to recover from the economic shocks due to health crises but also to reclaim hard-won development, enhance resilience and achieve progress on the SDGs by 2030. This would draw on a critical mass of UNDP expertise, initiatives, and partnerships to support mobilization and leveraging resources to achieve the SDGs.

Insuring against pandemic risk

In risk protection, insurance is a well-established tool for risk-averse individuals and businesses, pooling risk through distributing the risks of a few individuals/businesses across insurance members before any risk emerges. Consumers buy insurance to replace uncertainty/insure against the probability of a large loss or major expenditure by sacrificing a relatively small, certain, regular premium. Insurance reduces the variability of the insured's income by pooling many individuals and businesses and operating on the principle of the law of large numbers.[32] Following the same approach, insurance can work as a tool to support economic growth against disaster risks (Figure 10). However, disaster risk insurance covered less than half of the $510 billion in losses from disasters in 2017 and 2018.[33]

Figure 9. Insurance as a tool to support economic growth against risks



| Lloyd's 2012

If properly leveraged, insurance and risk financing could play a critical role in delivering the SDGs and building resilience by reducing vulnerabilities to socio-economic, climate, health, and disaster risks. Insurance and risk financing can provide a critical safety net, protecting assets, lives, and livelihoods from the impact of disaster crises. Research into DRF further suggests that increased insurance coverage could reduce losses in the poorest countries by as much as 25 percent through a range of instruments, including parametric insurance, insurance-backed social protection, and indemnity-based products.[34]

UNDP can exploit its experience and expertise in DRF to explore risk protections against the financial risks to its Member Countries arising from major health crises. One example of the application of insurance to response outbreaks and epidemics is the pandemic emergency financing (PEF), an insurance-based financing mechanism developed by the World Bank in consultation with the WHO, other development partners and the private sector, which provides surge financing for response efforts to the Bank's International Development Association credit for eligible poorest countries affected by a large-scale outbreak. Another example is the Outbreaks & Epidemics (O&E) parametric insurance product of the African Risk Capacity (ARC), which originated in the wake of the devastating West African Ebola crisis in 2014.

These examples are useful but insuring against a pandemic like COVID-19 is extremely challenging, since it is difficult to pool risks when pandemic risks explode everywhere and affect everyone at the same time. One guide to help address the problem might be the existing universal health coverage model, which provides financial risk protections to every citizen of a country, unlike the protections provided to limited members and groups by private insurance. Comprehensive research should be conducted in collaboration with the insurance industry to develop risk financing models for insuring risk protections against future pandemics like COVID-19. Secondary impact modelling will be a critical addition for future risk-informed development financing. Through collaboration between the insurance industry and the development sector, countries can put in place risk-informed development financing against the financial risks posed by epidemics. In this way, developing countries can leverage the insurance industry's expertise in modelling risk, developing and articulating likely scenarios, and outlining recommendations to decision-makers. This type of collaboration between insurance companies and the development sector would not only deliver insurance and risk financing solutions to countries and communities but would also create long-term transformational change and growth in insurance markets. In this way, insurance and risk transfer solutions, alongside UNDP's collaboration with the insurance industry, could add significantly to achieving and delivering on the SDGs.

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