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Economic consequences of pre-COVID-19 epidemics: A literature review

Ilan Noy & Tomáš Uher

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The Administrator
School of Economics and Finance
Victoria University of Wellington
P O Box 600
Wellington 6140
New Zealand

Phone: +64 4 463 5353
Email: jasmine.murray@vuw.ac.nz

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Economic consequences of pre-COVID-19 epidemics: A literature review

Ilan Noy and Tomáš Uher

Victoria University of Wellington

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Abstract

In 2020, we all realized we should know more about the economic impacts of pandemics. Here, we summarize the contemporary research on the economic consequences of past epidemics and pandemics with a primary focus on highly infectious pathogens such as influenza and Ebola (as distinct from less infectious, but maybe ultimately more lethal or damaging diseases like AIDS). The paper draws exclusively from scientific research relating to events preceding the current COVID-19 crisis, though it does describe the many new studies completed recently in connection to the renewed scientific interest in past events. We do not focus on the on-going COVID-19 global crisis, since we believe it is premature to attempt to provide a thorough summary of our state of knowledge about this event. The economic consequences of epidemics are categorized into macroeconomic, microeconomic, socio-economic, sectoral and long-term impacts. Impact pathways and impact determinants relating to these effects are also described. This body of research suggests that epidemics have a broad range of inter-connected economic consequences through both supply and demand-side channels, with the behavioral response of individuals, communities, societies, and governments being one of the most important determinants of these impact (rather than disease prevalence and progression itself). Furthermore, the economic effects of epidemics can be long-lasting.

Keywords: pandemics, epidemics, economic costs

JEL Codes: I15, I19.

1. Introduction

In December 2019, a new strain of a coronavirus, SARS-CoV-2, was identified in Wuhan, China. It was causing a respiratory illness now known as COVID-19. In the following months the virus rapidly spread, causing a global pandemic with significant health, economic, political and societal implications. As a response to the threat of contagion, all countries implemented dramatic interventions that reduced economic activity by curtailing the movement of people, enforcing social distancing, shutting or heavily restricting border crossings, and prohibiting various activities. These measures resulted in deep recessions in many economies, and their precipitousness has not before been seen in the modern era.

In early 2021, with a vaccination campaign only in its starting phase, it is still too early to attempt to summarize what we know about COVID-19's impact on the global economy. The pandemic is still raging around the world, and the daily death toll is still measured in the thousands. However, past epidemic events can potentially provide us useful information about the plausible impact of local epidemics and global pandemics on both the local and global economies.

Except for the 1918 H1N1 Influenza pandemic (often and erroneously known as the Spanish Flu), modern epidemics and pandemics were not severe enough to enable us to fully compare them to the current crisis. In terms of scale, global reach, and mortality, the 1918 event does offer us sobering lessons. However, several factors make learning from this past event challenging. Its concurrence with the end of World War I, and the enormous changes the end of the "War to End All Wars" brought about have hidden many of the impacts of the 1918 pandemic. Yet even though subsequent epidemics were of a smaller scale and severity, we believe they can also still provide us some useful data points with respect to the ways in which these events impacted our economies. The economic research about the impact of these past epidemic events, including the 1918 pandemic, is the focus of this survey.

An epidemic can be viewed as a negative health shock adversely affecting the economies in which it emerges and to which it spread. In an attempt to avoid some of the health consequences of the spread of the infectious disease, populations also significantly change their behavior to reduce the possibility of infection. This behavioral shift happens as a consequence of individual decisions based on their own risk perceptions or because of policy decisions and mandates - the non-pharmaceutical interventions (NPIs) enacted by governments. These NPIs typically impose various restrictions on selected types of movement and social interactions. In many cases, for example during the SARS epidemic of 2003, it is possible to conclude that it was this aggregate behavioral reaction that constitutes the main source of the economic impact associated with the epidemic (Noy and Shields, 2019).

The increasing connectedness of the world's societies and economies accelerates the spread of contagions, as well as their economic impacts because of these cascading behavioral reactions. The increasing disease transmission linkages also result in these cascading effects, further worsening the severity of the economic downturn. Conversely, however, global economic connectedness has also led to increasing development and increasing healthcare standards around the world, which can potentially reduce the societal and economic vulnerability to epidemics' adverse consequences (Bloom and Canning, 2004; Barro et al., 2020). For example, we have seen both channels operate during the COVID crisis, with global connectedness both increasing and decreasing the economic impact of the pandemic.

As for any large shock, including those associated with natural hazards, the economic impacts of epidemics are heterogeneous across countries, across economic sectors, and across socio-economic classes. While research suggests that many economic sectors are affected adversely from an adverse event, epidemic occurrence may also be beneficial for certain industries (Hassan et al., 2020). One sector that can benefit, for example, is healthcare manufacturing (e.g., for personal protective equipment), in the same way that the construction sector typically experiences a boost from earthquakes.

There are other potential positive impacts. In the case of the current COVID-19 pandemic, the resulting global lockdown led to some temporary positive environmental effects by reducing air pollution and greenhouse gases emissions (Khan et al., 2020; Muhammad et al., 2020). However, these positive impacts are typically degrees of magnitude smaller than the damage from these events. Forster et al. (2020), for example, estimated only a negligible cooling effect from the COVID-19 lockdown.

Similarly, one positive potential impact is a renewed commitment to reduce vulnerability to future epidemics – this is the public health version of the Build Back Better aspiration common in post-disaster recoveries (Noy, et al., 2020b). Whether indeed an occurrence of an epidemic serves as an alarm bell for the affected society in terms of formulating better pandemic preparedness for the future and potentially more severe events (and therefore reducing their consequences) remains an unanswered question – though some circumstantial observations suggest that the countries exposed to SARS in 2003 performed better in 2020 because of that past exposure.

2. Impact pathways

Epidemics affect economic activity negatively through both demand-side and supply-side effects, and several researchers have attempted to establish the degree of importance for these differing channels of effects. When analyzing the 1918 pandemic, some researchers estimate its economic consequences to be brought about mostly by supply-side disruptions, as the pandemic negatively primarily affected

the working age population and thus especially labor-intensive manufacturing that was often done in very crowded conditions (Beach et al., 2020; Garrett, 2009; Velde, 2020, Noy et al., 2020a).

Along with these substantial supply-side negative effects, Correia et al. (2020) also find evidence for demand-side influence due to the negative impacts on the stock of durable goods and bank assets in the US (creating decreases in demand through the loss of collateral value or tightening budget constraints). A relatively different perspective is offered by Basco et al. (2020). Focusing on Spain, Basco et al. interpret the short-term decrease in real wages they observe in Spain to argue it mostly represents a negative demand shock in labor markets.

Jinjarak et al. (2020) point to both supply and demand-side effects in the case of the 1968 H3N2 pandemic. Siu and Wong (2004) analyze the 2003 SARS epidemic; they conclude that SARS constituted a negative demand shock with widespread lockdowns imposed or voluntarily adopted, and that the supply side of the affected economies in East Asia remained relatively unaffected. Dixon et al. (2010) also find the severity of the economic impacts to be more sensitive to demand-side effects (e.g., reduction in tourism and leisure activities) when they simulate a hypothetical H1N1 pandemic in the US using a Computable General Equilibrium (CGE) modelling approach. These discussions around the nature of the shock (supply or demand) are important from a policy perspective. Dixon et al. (2010), for example, propose that their demand-focused finding suggests that demand-increasing policies may be an effective response to mitigate the adverse economic repercussions of the hypothetical pandemic they investigate.

3. Macroeconomic impacts

The macroeconomic consequences of epidemics and pandemics are typically examined using the standard aggregate macro indicators. Predominantly, the variables that are examined are GDP, consumption, investment, labor market indicators, and stock markets.

3.1. GDP and Consumption

By far the most extensive literature on the impact of pandemics (as is the case for natural hazards and disasters more generally) is an examination of GDP. The majority of researchers conclude that epidemics have a negative effect on GDP (or its growth trajectory) and often use this indicator to proxy the severity of the economic impact (Barro and Ursúa, 2008; Barro et al., 2020; De Santis and Van der Veken, 2020; Beach et al., 2020; Doan et al., 2020; Keogh-Brown and Smith, 2008; Smith and Keogh-Brown, 2013; McKibbin and Sidorenko, 2006; Keogh-Brown et al., 2010; Carillo and Jappelli, 2020; Lee and McKibbin, 2004; Smith et al., 2011; Ma et al., 2020a; Ma et al., 2020b; Smith et al., 2009; Huber et al., 2018; Kirigia et al., 2015; Rodríguez-Caballero and Vera-Valdés, 2020; Prager et al., 2017; James and Sargent, 2006; Bloom et al., 2005; Kennedy et al., 2006).

In the case of the 1918 pandemic, Barro and Ursúa (2008) estimate its substantial adverse effect on both GDP and consumption across different countries but are constrained in their ability to control for the effects of World War 1 and its end. A subsequent paper from Barro et al. (2020) attempts to better separate the impacts of the pandemic from the effects of the war; the authors estimate that the death rate caused by the pandemic led to declines of 6% in GDP and 8% in private consumption as well as a temporary increase in the inflation rate for the sample of 42 countries for which they have data. De Santis and Van der Veken (2020) expand on the research of Barro et al. by applying a non-linear quantitative model to the same dataset and construct conditional distribution of real GDP per capita growth estimating a cumulative 7% decrease in economic activity.

While investigating the impact of the 1968 H3N2 Influenza pandemic, Jinjarak et al. (2020) estimate a statistically significant GDP decrease (along with productivity, investment and consumption decrease) in a sample of 52 countries. For the 2003 SARS epidemic, Doan et al. (2020) find only a very short-run negative impact on per capita GDP in the four heavily affected countries (China, Hong Kong, Taiwan, and Singapore) followed by a very quick recovery. Similar results are estimated by Smith and Keogh-Brown (2013) who use a computable general equilibrium model calibrated for the 2009 H1N1 influenza pandemic in lower and middle-income countries (Thailand, South Africa and Uganda). Smith and Keogh-Brown find that the economic impact was most severe for Uganda, the country with the lowest income in this group. These results also correspond with the findings of De Santis and Van der Veken (2020), which indicate a higher GDP drop for lower-income countries during the 1918 pandemic. Ma et al. (2020a) use local projections and panel regressions methods for a large set of countries and discover that the GDP growth falls by 3 percentage points on average during the year of the disease outbreak but recovers relatively quickly. Ma et al. (2020b) estimate a real GDP decrease of 2.6 percentage points, on average, analyzing a set of five epidemic and pandemic events of the 21st century preceding the COVID-19 pandemic using data across 210 countries.

From a theoretical perspective, Boucekkine and Laffargue (2010) estimate a permanent negative effect of epidemics on the level of output in the economy using an overlapping generations model.

Short-term consumption reduction is another common phenomenon observed in connection with epidemic occurrence. Researchers estimated this decline for the 1918 pandemic (Barro and Ursúa, 2008; Barro et al., 2020), the 2003 SARS epidemic (Siu and Wong, 2004), the 1968 H3N2 Influenza pandemic (Jinjarak et al., 2020) and for a set of six modern epidemics and pandemics (Ma et al., 2020a). While this seems to be a reliable short-term consequence, there does not seem to be enough evidence to conclude anything about long-run effects on consumption. Even for the medium run (up to 10 years) there are mixed results, with Obrizan et al. (2020) finding a positive effect on per capita consumption in Sweden following the 1918 pandemic and Beutels et al. (2009) estimating only a brief postponement of consumption in the aftermath of the 2003 SARS epidemic.

Using nightlight data as a proxy for economic activity, Doan et al. (2020) discover partial evidence for the relatively more recent 2003 SARS epidemic having a persistent impact on the Chinese economy in the heavily affected regions. However, these results are not conclusive due to the rapid development of the country's economy at the time.

3.2. Investment and Labor Markets

Several papers conclude that epidemics and pandemics lead to a decrease in investment. Jinjarak et al. (2020) observe a short-term reduction of investment during the 1968 H3N2 Influenza pandemic and similarly Keogh-Brown and Smith (2008) estimate the same effect for the 2003 SARS epidemic. Obrizan et al. (2020) find a mild negative impact on investment in the medium to long-term for the 1918 pandemic. Ma et al. (2020a) report a sharp drop in investment spending across 6 modern epidemic and pandemic events, and Jordà et al. (2020) uncover a long-term reduction of investment opportunities following a set of historical pandemics of the last millennium. McKibbin and Sidorenko (2006) argue that a pandemic event can lead to a re-evaluation of a country's risk profile, and consequently to a rise in the cost of borrowing that decreases investment.

Multiple studies estimate a negative labor supply shock to be an important mechanism behind the epidemic influence on the economy (Beach et al., 2020; McKibbin and Sidorenko, 2006; Jordà et al., 2020; Ojo, 2020; Garrett, 2009; Bodenhorn, 2020, Jedwab et al., 2020; Kennedy et al., 2006). In the case of the 1918 pandemic, the negative labor supply shock seems to be a primary driver of the subsequent economic contraction, as the virus affected the working age population most severely (Beach et al., 2020; Noy et al., 2020). Apart from the labor force being reduced by the direct health effects of the disease among the population, labor markets can also be negatively affected via behavioral channels. Based on a cross-country panel of historical epidemics from 1970 onwards, Yu et al. (2020) estimate the behavioral response of individuals to have a strong adverse impact on labor force participation in the affected countries. Furthermore, this effect appears to be stronger for countries with high uncertainty avoidance that is typical in lower income settings. Bootsma and Ferguson (2007) find a similar dynamic when they estimate a behavioral shift of individuals to limit interaction during the 1918 pandemic and De La Fuente (2020) report the reluctance to gather into worker groups a primary cause of agricultural labor shortage experienced during the 2014 Ebola epidemic.

Several papers indicate that the reductions in labor supply observed during an epidemic lead to an increase in wage rates in the medium to long-run. Jordà et al. (2020) analyze long-run economic consequences of historical pandemics and observe an increase in wage rates as a consequence of the labor supply decrease caused by pandemic mortality and morbidity. In another historical investigation, Jedwab et al. (2020) also find this to be the case in the aftermath of the Black Death pandemic in the 14th century. Garrett's (2009) findings are along similar lines. Garrett specifically

focuses on the US manufacturing labor market during the 1918 pandemic and estimates that the labor force reduction caused the marginal product of labor and capital per worker to rise, eventually increasing wage rates. Brainerd and Siegler (2003) report similar results of an increase in per capita income in the years following the pandemic.

On the other hand, some studies suggest that a pandemic can lower wages and incomes in the shorter run. Basco et al. (2020) find that in Spain, the excess mortality of the 1918 pandemic led to a significant, and possibly counter-intuitive, short-term decrease in real wages. They estimate this impact was heterogeneous between occupations with jobs like tailors and shoemakers being the most affected, as the demand for their products collapses, while metal workers were relatively unaffected. Similarly, Dahl et al. (2020) find a short-term decrease in household income in the heavily affected municipalities in Denmark.

Epidemics also appear to have a negative effect on labor productivity, either directly due to its adverse health effects or indirectly by impeding human capital acquisition. Jinjarak et al. (2020) estimate that the excess mortality caused by the 1968 H3N2 Influenza led to a substantial decrease in productivity (1.9 percentage points). Guimbeau et al. (2020) study the short and long-term impacts of the 1918 Spanish flu on the demographic, human capital and productivity trajectories in Brazil's Sao Paulo. Using detailed district level historical data on health, productivity and education, Guimbeau et al. report both short and long-run negative impacts on agricultural productivity. Céspedes et al. (2020a) find that an adverse economic shock caused by a pandemic can lead to an unemployment and asset price deflation doom loop, suggesting a cyclical causal chain of decreasing productivity, collateral value and company's borrowing possibility. In a subsequent study the authors estimate unconventional policies such as loan guarantees, wage subsidies or equity injections to be an effective response to preserve a high-productivity economic equilibrium (Céspedes et al., 2020b).

Evidence suggests that adverse economic consequences of epidemics are not limited to the regions directly affected by the contagion itself but can spill over to other countries through trade connections or supply chains. Kostova et al. (2019) analyze the consequences of the 2014 West Africa Ebola outbreak and estimate a negative economic effect on trade partners of affected countries. Based on a difference-in-differences model, Kostova et al. estimate a $1.08 billion relative decrease in US exports to the three Ebola affected West African countries, which is consequently associated with a certain level of job losses in these export sectors. Ma et al. (2020a) similarly estimate a decline in international trade as a consequence of modern pandemics and describe a negative indirect effect of affected trading partners on own-country GDP.

3.3. Financial markets

Several researchers analyze the impacts of epidemics on the stock market, and on financial markets more generally. Barro et al. (2020) find evidence that the 1918 pandemic event caused a significant decrease in real returns on short-term government bills but failed to find a statistically significant effect on the real returns of stocks using annual data. Burdekin (2020) uses higher-frequency monthly data and finds that the pandemic mortality rates are associated with a significant reduction in stock market prices using a panel regression for the US and 9 European countries. On the other hand, Velde (2020) argues that "the US stock market did quite well during the epidemic" (p. 36) and estimates that US stocks were relatively unaffected. Karlsson et al. (2014), in contrast, conclude that the 1918 pandemic led to a decrease in capital returns.

In regard to the 2003 SARS epidemic, Siu and Wong (2004) report that the event had only mild negative consequences based on the 1.8% drop of the Hong Kong Hang Seng Index. Chen et al. (2007) find a temporary but statistically significant decline in hotel stock prices (maybe not surprisingly, given the temporary collapse of international travel in the region). Ma et al. (2020b) estimate a short-run overreaction of stock markets when compared to the severity of the economic impacts, when analyzing a set of recent epidemic events.

4. Microeconomic impacts

In order to understand the impact of pandemics on well-being, it is imperative that one also examines the microeconomic impacts. This literature is significantly sparser, but several papers do examine household consumption and savings, firms' trading activity, and firms' profitability.

Apart from the adverse effects on aggregate consumption in general, discussed above, Norling (2020) and Basco et al. (2020) identify a reduction of household consumption as a consequence of the 1918 pandemic, and Jordà et al. (2020) estimate a behavioral effect in which individuals increase household savings.

For firm level analysis, Fernandes and Tang (2020) focus on the 2003 SARS epidemic's effect on firms' import/export growth rates in the affected countries. Even though the SARS epidemic lasted only a few months, Fernandes and Tang find a medium-term negative effect of 4-6 percentage points decrease in trade from the pre-epidemic trend two years after the epidemic. Furthermore, their results suggest that smaller exporters were more likely to exit the market as a consequence of the economic disruption the epidemic caused. They also conclude that export of goods which are located downstream within the supply chain and are readily substitutable with foreign alternatives were more affected, and also experienced a slower recovery. In terms of other firm-level economic consequences more broadly, Ma et al. (2020b) identify a drop in firms' profitability and firms' debt increase as a consequence of recent epidemics.

4.1. Socio-economic impacts

Besides the standard microeconomic measurements for firms and households, socio-economic indicators related to well-being were also found to be affected by epidemics. These effects include impacts on income inequality, unemployment, poverty and literacy, and public trust.

Currently there does not appear to be a consensus on the way epidemics affect income inequality in general. If an epidemic results in higher mortality among those with low-income - possibly because their general health is frequently worse and access to health care more restricted - this will in theory lower income inequality (of those who survived). On the other hand, if the income of low-income populations is decreased disproportionately more than the income of higher-income populations due to job loss or illness, an epidemic will cause inequality to increase.

A historical perspective from the pre-industrial era is offered by Alfani and Murphy (2017). They find that high mortality crises such as plagues and epidemics led to a decrease in income inequality; the Black Death and the consequent rise of labor income is typically cited as an example. Similarly, Sayed and Peng (2020) find that income inequality decreased as a consequence of four major pandemics of the last century. However, Galletta and Giommoni (2020) report an opposite effect estimating that income inequality has increased as a consequence of the 1918 pandemic in Italian municipalities. Sayed and Peng (2020) indeed note that an epidemic's effect on income inequality may strongly depend on the characteristics of the disease and its differential effects on labor supply, productivity, and consumption.

This heterogeneity is also a function of the nature of labor markets in the epidemic-affected economies. Evidence suggests that epidemic events have a negative effect on employment generally, but they may hit specific sectors especially hard. Ma et al. (2020a) estimate an unemployment rate rise of nearly 1% during the year of an epidemic outbreak and a recovery that lasts two years. They also describe a heterogeneous effect, as it appears that the epidemics they investigated disproportionately affected less educated workers and females. Noy et al. (2020) find exactly that heterogeneity in their investigations of employment of women in the Japanese textile sector during the 1918 influenza pandemic.

Using a conventional difference-in-differences model and regional data from Sweden, Karlsson et al. (2014) conclude that the 1918 pandemic led to an increase in poverty rates in subsequent years. Guimbeau et al. (2020) further expand the analysis of the socio-economic consequences of the 1918 pandemic and estimate it had both short and long-term adverse effects on literacy in Brazil.

There is also some evidence that epidemic events can lead to a decrease of public and social trust in populations; similar evidence exists for disasters more broadly, though this literature is contested. Aksoy (2020) estimates that epidemic exposure since 1970 led to a permanent decrease of public trust

in political institutions and public health systems. Maybe not surprisingly, Aksoy suggests this effect is connected to the public health policies enacted during the epidemic.

Using data from the General Social Survey in the US, an analysis by Aasve et al. (2020) indicates that the 1918 pandemic had a negative effect on social trust of the descendants of the survivors. This finding may have possible economic implications considering that a reduction of social trust in the population can lead to negative long-term consequences for economic development (Tabellini, 2010).

4.2. In-utero exposure

Several papers have examined the connection between in-utero exposure to the influenza virus during the 1918 pandemic, and long-term negative health and economic impacts for these in-utero-exposed individuals (Almond, 2006; Lin and Liu, 2014; Chul Hong and Yun, 2017; Percoco, 2016; Beach et al., 2018). This literature ties in more broadly to the 'fetal origins' hypothesis, which places a strong emphasis on the importance of in-utero experience in determining adult outcomes in various dimensions (Almond and Currie, 2011). Richter and Robling (2013) and Cook et al. (2019) further explore this causal impact and provide evidence that the adverse effects can be multi-generational. Enami (2016) focuses on the in-utero exposure to the 1957 H2N2 pandemic and finds a statistically significant negative effect on the future earnings of non-white females, in contrast with non-white males whose earnings were increased as a consequence of the pandemic.

5. Sectoral impacts

Evidence indicates that the economic repercussions of epidemic and pandemic events are heterogenous across different sectors and vary based on the characteristics of the epidemic, the contagiousness of the pathogen, and the nature of production in each sector (e.g., whether it is labor-intensive in crowded conditions). These heterogenous sectoral impacts can also be distinct since they can originate from changes in demand (which in itself can be heterogeneously impacted by the shock). Using a theoretical framework, McKibbin and Sidorenko (2006) provide an insight into the dynamics of sectoral impacts estimating a behavioral shift of consumer preferences away from the sectors exposed to the risk of infection during a pandemic. Assuming that the most infection-exposed sectors are the ones that are more dependent on the movement and interaction of people, it is possible to connect this finding with the results of Keogh-Brown and Smith (2008), who show that these sectors suffer more severe adverse economic impacts. Several sectors have been investigated in detail to further provide details about these heterogeneities.

5.1. Leisure and hospitality sector

Behavioral change by consumers and mandatory restrictions introduced during an epidemic typically lead to significant demand-driven negative impacts on the leisure and hospitality sector. Steep but

temporary declines in tourism were estimated for the 2003 SARS epidemic (Beutels et al., 2009; Siu and Wong, 2004; Keogh-Brown and Smith, 2008; Kuo et al., 2008; Cooper, 2006; Zeng et al., 2005; Au et al., 2005), the 2009 H1N1 pandemic (Rassy and Smith, 2013; Page et al., 2012; Haque and Haque, 2018), and using a generic epidemic modelling (Dixon et al., 2010). International travel in particular was negatively affected during the 2003 SARS epidemic (Beutels et al., 2009; Noy and Shields, 2019; Siu and Wong, 2004) and the hotels and restaurants sector experienced a decline both during the 2003 SARS and 2014 Ebola epidemics (Keogh-Brown and Smith, 2008; Bowles et al., 2016; Chen et al., 2007, Kim et al., 2005) in the affected countries.

5.2. Insurance and finance

A sudden increase in mortality and morbidity rates caused by an epidemic results in possibly unanticipated large losses for the life insurance sector. Weisbart (2006) speculates that a moderate pandemic (similar to the 1957 H2N2 or 1968 H3N2 pandemics) could lead to additional insurance claims of $15 billion and a severe pandemic (similar to the 1918 pandemic) could cause $155 billion in additional life insurance claims in the US. Weisbart further argues that financially weaker life insurance companies would not survive a severe pandemic event and would be taken over by their state's insurance regulator. Similar bailouts will probably occur even in countries in which there is no explicit obligation of the state to take over the liabilities of insolvent insurers.

Negative repercussions for the insurance sector are also estimated by Keogh-Brown et al. (2010), who simulate a pandemic using a multi-sector computable general equilibrium model and find a significant reduction in domestic output for the insurance sector.

Researchers, however, failed to find significant impacts on the insurance sector in the aftermath of the 1918 pandemic. Cortes and Verdickt (2020) analyze the pandemic's effect on the insurance industry in the US and find no change in insurers' profitability before and after the pandemic. Similarly, Phillips (1984) finds that the insurance sector was not negatively affected in South Africa. Both studies report the post-pandemic increase in demand to be the primary explanation for this relatively surprising finding. However, the demand increase in the US does not appear to be directly caused by the pandemic mortality itself, but potentially by the increasing rates of income, to which the pandemic may have partially contributed through reductions in labor supply (Short, 2019).

Anderson et al. (2020) estimate a short-term impact on the financial sector during the 1918 pandemic and report that the banks in the heavily affected regions in the US experienced deposit withdrawals. Furthermore, Anderson et al. find that the banks that were members of the Federal Reserve were able to access its liquidity and sustain lending, in contrast with the non-member banks which did not borrow on the inter-bank market and were forced to consequently suspend lending. Gong et al. (2020) identified a short-run increase in the cost of bank loans and a decrease in bank loan volumes during

the 2009 H1N1 influenza pandemic based on a sample of 37 countries and their differential exposure to the influenza shock.

5.3. Other sectors

Apart from economic sectors directly associated with face-to-face interactions, a severe epidemic can cause disruptions to many other industries. Partial insight into sector-specific impacts is provided by studies based on modeled pandemics. In this regard, Keogh-Brown et al. (2010) estimate severe impacts for labor-intensive sectors such as health, social services, and education. Smith and Keogh-Brown (2013) report similar findings, predicting significant impact on the service sector with capital-intensive sectors relatively less affected.

Several papers attempt to differentiate between the sectoral impacts of the 1918 pandemic. As a consequence of relatively short time during which non-pharmaceutical interventions were implemented, the dislocation associated with the end of the war, and the contagion affecting primarily the working-age population, these effects appear to be different from more recent epidemics. Although some of the impacts were significant in scale, the majority of researchers conclude that they were mostly fairly temporary, and industries were able to recover quickly once the pandemic subsided.

Velde (2020) estimates an industrial output drop of 20% in the US during a period of several months of the pandemic's peak. Similarly, Correia et al. (2020) find a reduction in manufacturing output by 18%. Garrett (2008), Bodenhorn (2020) and Velde (2020) find a demand-driven short-run decrease in retail sales in the US. Bodenhorn also observes declines in the coal, lumber and textile industries' outputs, further estimating that the effects on the lumber industry were both supply and demand driven while the coal and textile industries were primarily affected through a negative labour supply shock. The effects on the textile industry were also investigated for Japan by Noy et al. (2020), and they report similar findings.

There also appears to be some evidence that epidemics can negatively impact agricultural production. In the case of the 2014 Ebola epidemic, De La Fuente et al. (2020) estimate a negative effect on rice production caused mainly by behaviorally induced labor shortage. De Kadt (2020) provides suggestive evidence for the 1918 pandemic event to cause a mild but prolonged decrease in maize production in South Africa. Guimbeau et al. (2020) report a decrease in agricultural productivity in both short and long-run as a consequence of the 1918 pandemic.

6. Longer-term impacts

Estimating the long-term economic consequences of epidemics is challenging due to the difficulty of constructing an appropriate and reliable counterfactual and the necessity to focus on relatively non-

recent historical events, for which there can be limited data availability. In this regard, several researchers turn their focus onto the 1918 pandemic and a small set of other historical pandemics.

For the case of the 1918 pandemic, many researchers describe a V-shaped recovery, in which the economy was able to return to its previous level of activity and subsequent growth trajectories relatively shortly after the pandemic subsided (Velde, 2020; Beach et al., 2020; Dahl et al., 2020; Bodenhorn, 2020; Garret, 2007; Carillo and Jappelli, 2020). As discussed in the "in-utero exposure" section, Almond (2006), Lin and Liu (2014), Chul Hong and Yun (2017), Percoco (2016) and Beach et al. (2018) all find negative socio-economic impacts for in-utero exposed individuals (identified by their date of birth). Richter and Robling (2013) and Cook et al. (2019) expand on this by identifying the transmission of these adverse impacts on subsequent generations.

Using aggregate data, Guimbeau et al. (2020) estimate a long-term decrease in agricultural productivity and literacy as a consequence of the same pandemic in Brazil. Obrizan et al. (2020) use an overlapping generations model to identify plausible long-term pandemic repercussions in a version of the model calibrated with data from Sweden. Gao (2020) studies whether the 1918 pandemic had an effect on the tax revenue in the US. Based on two difference-in-differences models, Gao does not find a lasting impact of the pandemic on tax revenue growth in the medium-term (7 years). Blickle (2020) discovers that, in the most heavily affected regions of Germany, the pandemic caused a reduction in per capita public spending and increased the share of votes for the extremist political parties in the following decade.

In a more ambitious investigation, going back centuries, Jordà et al. (2020) attempt to assess medium and long-run economic consequences of pandemics using the rates of return on assets for several major pandemics in the last 700 years. They focus on the UK, Spain, Germany, France, Italy and the Netherlands. Jordà et al. were able to estimate that these historical pandemics were followed by low returns on assets as well as lower investment opportunities persisting, possibly, for several decades. Similarly, Rodríguez-Caballero and Vera-Valdés (2020) study the long-run economic consequences of historical pandemics using time-series data from the UK. They discover a long-lasting negative effect on growth and unemployment. As discussed previously, the central hypothesis in this literature is that epidemics can cause wage rates to increase as a consequence of labor supply reductions associated with a pandemic (Jordà et al., 2020; Jedwab et al., 2020).

7. The determinants of impacts

Economic consequences of epidemics are determined by various factors. While reviewing the evidence on the macroeconomic effects of epidemics of the late 20th and 21st centuries, Bloom et al. (2020) find that the economic consequences are generally dependent on three main dimensions: (i) The pathogen's characteristics (e.g., mortality, morbidity and infectiousness); (ii) population attributes

(e.g. susceptible demographics, socio-economic stratification); and (iii) country-level attributes (e.g. public health capacity, governance). Other studies provide more specific insights into the factors that influence the degree to which the economy is affected and are discussed below.

Even though epidemic events can have economic implications even in countries unaffected by the disease itself, evidence suggests that the countries/regions most affected by the pathogen are typically those that experience the most severe economic consequences, too (Keogh-Brown and Smith, 2008; Doan and Noy, 2021).

The main characteristics of the transmission pathways of the pathogen define another set of important determinants. Especially problematic in this context are pathogens that can transmit through aerosols from asymptomatic or pre-symptomatic individuals. It is in these cases that the social disruption is greatest. A counter example is the Ebola virus, which is infectious through bodily contact only in violently symptomatic patients. In this case, the economic dislocation associated with social distancing requirements is much more relaxed compared to a pathogen which allows for a relatively easier environmental spread and may cause a significantly more severe economic shock affecting export-related sectors as well as e-commerce or tourism – e.g., SARS (Rassy and Smith, 2013; Noy and Shields, 2019).

The location of a country's production in the global value chains is important in shaping the impact of an epidemic; both Fernandes and Tang (2020) and George et al. (2020) estimate that the importance of China in the global value chains is positively correlated with the severity of the economic impacts of the 2003 SARS epidemic as it was felt in the affected countries (all directly tied to China's supply chains).

Equally important is a country's fiscal space – i.e., its ability to aggressively respond by increasing government spending (Ma et al., 2020b). This finding aligns well with other research that examines the role of fiscal space in a government's ability to buffer a variety of shocks.

Government public health mandates and prohibitions can also play a role, but Correia et al. (2020) find that these non-pharmaceutical interventions imposed in some US cities did not exacerbate the economic impacts compared to cities where no such restrictions were put in place (Noy et al., 2020a, provide a similar finding for Japanese prefectures). Using higher-frequency data, Velde's (2020) results fall along similar lines as he estimates that the limited economic cost of these restrictions was outweighed by their positive impact through a reduction in the labor supply shock associated with the disease itself. In contrast, both Chapelle (2020) and Barro (2020) fail to find any link between the impositions of these restrictions and the economic performance of the cities in the US during the same 1918 pandemic.

8. Conclusion

This review summarized the contemporary state of knowledge regarding the economic impacts of past epidemics and pandemics, pre COVID-19, with particular focus on highly infectious rapidly spreading diseases such as Influenza and Ebola. One catastrophic pandemic which we excluded from our analysis is the HIV/AIDS pandemic that has extracted a very heavy toll globally, but in particular in Southern Africa. The main reason for this exclusion is that in important ways, the AIDS pandemic is different in its persistent economic impact than the sudden onset (and eventual dissipation) of the epidemics we examined.

We examined the macroeconomic, microeconomic, socio-economic, sectoral, and long-term impacts of these events, and also provided some descriptions of the possible pathways and determinants of these impacts. Considering that epidemics mainly represent a significant negative health shock for the populations affected, the resulting economic consequences are predominantly adverse; though certain sectors, and certain demographics might benefit from them.

The aggregate behavioral response of the population to the threat of infection appears to be one of the primary determinants of the economic damages. However, other factors such as the severity of the epidemic, transmission pathway of the pathogen, or the specific forms of non-pharmaceutical interventions that are implemented also play an important role in determining the economic repercussions. Ultimately, many of these factors are interdependent.

To summarize, most researchers suggest that epidemics and pandemics negatively affect economic output, investment, consumption, international trade and employment rate as well as other economic aggregates and consequently they decrease both local and, in the case of pandemics, global GDP. The intensity of the impacts is heterogeneous across different sectors and demographics, and disproportionately affects sectors dependent on the movement and interaction of individuals, such as tourism or hospitality, and more vulnerable demographic groups.

The existing research also indicates that an epidemic can cause long-lasting disruptions, especially in the case of severe events such as the 1918 pandemic. Acknowledging the complexity of a reliable estimation of long-run consequences, further analysis of these questions may prove a promising and valuable area of future research.

In particular, more detailed economic analyses of 1957 H2N2 and 1968 H3N2 influenza pandemics appear both feasible and useful for assessing any potential future impact of similar events. Surprisingly, these events have been studied a lot less than one would have expected. These events occurred in circumstances that are more similar to our current global economy than the 1918

pandemic, so understanding their impact may be more helpful in assisting us in dealing with our current COVID-19 catastrophe.

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