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COVID-19 economic impacts in perspective: A comparison to recent U.S. disasters

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ARTICLE INFO

Keywords:
COVID-19
September 11
Macroeconomic impacts
Natural disasters
Comparative analysis

ABSTRACT

This paper places the COVID-19 pandemic into perspective by comparing it to other recent disasters in terms of impacts on the macroeconomy of the U.S. We present a short summary of advances in the state-of-the-art of economic consequence analysis, as well as estimates this approach yields on economic impacts of 9/11, a variety of natural disasters, the Great Recession, and COVID-19. The prevention of these negative impacts represents the benefits of various types of risk management tactics and strategies. In light of the enormously greater economic impact of COVID-19 as compared to natural and man-made disasters, it is reasonable to question whether adequate investments are being made to prevent future pandemics.

1. Introduction

The U.S. economy has been struck by several major shocks during the first two decades of this century. In addition to typical types of natural disasters, it has suffered the September 11, 2001, terrorist attacks, Great Recession, and COVID-19. The pandemic has felt overwhelming in many ways, including hospitalizations and deaths, major slowdowns in economic activity, and dramatic lifestyle changes. It is useful to place the pandemic into perspective by comparing it to other recent disasters in terms of impacts on the macroeconomy, as typically measured by GDP, and on material well-being of the population, as typically measured by economic welfare.

This brief paper provides this comparison. It also serves as a bounding exercise for estimates of potential future economic shocks. The prevention of these negative impacts represents the benefits of various types of risk management tactics and strategies. In the following sections, we present a short summary of advances in the state-of-the-art of economic consequence analysis, as well as estimates this approach yields on economic impacts of 9/11, a variety of natural disasters, the Great Recession, and COVID-19.

2. Economic consequence analysis of disaster

Measuring the economic impacts of disasters has evolved considerably over the past 30 years. Earlier estimates were almost always expressed in terms of property damage, in part because the impacts of disasters were most visible in this form and because the field was dominated by engineers and reinforced by the insurance industry primarily covering property and casualty losses. Economists began pointing out, however, that the well-being of society is not a function of its capital stock, but rather the flow of goods and services that it helps produce [1]. However, these flows, typically measured in terms of GDP, gross output, or employment, and now commonly referred to as business interruption (BI), are more difficult to observe and measure. Over the years, several advances were made in estimating these flow metrics, beginning with incorporating ripple, or multiplier, effects associated with production supply chains and the nexus of production, income payments, and consumption that further stimulate them [2–4].

Recent advances in the measurement of disaster impacts have been of two types [5,6]. The first is resilience, which refers to actions taken by businesses and households once the disaster strikes to mute BI impacts by using the remaining resources as efficiently as possible to maintain the flow of goods and services and to accelerate recovery [7–9]. The second is behavioral linkages, often stemming from fear, which move in the other direction by exacerbating the losses, primarily through avoidance behavior that reduces economic activity [10]. See Botzen et al. [11] for a discussion of other advances in economic consequence analysis of disasters.

Rose et al. [12] and Prager et al. [13] demonstrate how these impacts fit into the broader framework of economic consequence analysis and provide examples of how they vary across various threats to the economy. This framework begins with direct economic impacts of the shock.
to the system, which then radiate throughout the economy through general equilibrium effects (essentially supply-chain price and quantity stimuli coupled with the influence of household income payments and spending). Considerations of resilience and behavioral linkages enhance conventional economic impact analysis (typically applied to such ordinary activities as closing an automobile plant, constructing a new hydroelectric dam, or implementing a new regulation), so as to account for unique features of disasters.

Several studies have measured resilience to actual and simulated major disasters and have generally found it to be relatively large. For example, Kajitani and Tatano [14] found extensive resilience possibilities among Japanese manufacturing firms surveyed in response to utility lifeline disruptions caused by potential disasters by using such tactics as input substitution, conservation, stockpiling and relocation. In the aftermath of the 2012 Northern Italy Earthquakes, Dona et al. [15] found that the optimal relocation strategy can reduce total losses by up to 50% in the case of rented factories and by about 40% in the case of an owned factories. Koks and Thissen [16] simulated major flooding in the Rotterdam, Netherlands region and projected that import substitution could reduce losses in the EU economy by around 25% following such a disaster. Resilience to the September 11 attacks is discussed in the following section. The previous examples pertain to what Rose [7] refers to as static economic resilience—using remaining resources as efficiently as possible. Dynamic economic resilience refers to the time-path and duration of the recovery [7] and can be enhanced significantly by such factors as expediting insurance payments and public assistance and by prioritizing key sectors to facilitate importation of needed goods [17]. Hynes et al. [18] have suggested that the complexity/interconnectedness of the world economy and its emphasis on efficiency have made the world economy more vulnerable to financial crises and also undercut dynamic resilience. Kurth et al. [19] noted the dynamic economic resilience deficit (vulnerability) in many American cities in the face of transportation network disruptions by disasters.

Several studies have measured the effects of behavior linkages, primarily fear. Giesecke et al. [10]; in their study of a dirty bomb attack in the financial district of Los Angeles, found that behavioral linkages, working through employees requiring wage premiums, consumers requiring price discounts, and investors requiring high rates of return in the affected area, could increase the size of conventional BI estimates, stemming from damage to buildings and quarantine of the affected area during decontamination, by 14-fold. Rose et al. [20] found that the behavioral effects of a terrorist attack on a commercial airliner or airport could increase ordinary impacts, acting through fear of flying, by one to two orders of magnitude. Nagamatsu et al. [21] found that fear of lingering contamination was a major factor causing people to return to the Fukushima area after the 2011 accident. Gertz et al. [22] posit that even after improvements in flood hazard mitigation, extreme risk aversion could cause disorderly evacuation and declines in tourist activity. The major effect of fear in the case of 9/11 is discussed immediately below.

3. September 11

The September 11, 2001, terrorist attacks were a terrible blow to the U.S. They signaled the country’s vulnerability to a small band of people capable of doing great harm. Numerous estimates of the impacts of 9/11 have been offered, ranging from almost zero to trillions of dollars [23]. The former emphasize the resilience of the American people and of the economy as a whole. The latter include such factors as the temporary decline in the stock market and the cost of not only the war in Afghanistan but also the Second Iraq War. These estimates identify key problems associated with this area of inquiry: Overly optimistic assessments of economic recovery with inadequate attention to GDP losses in the interim, failure to distinguish paper losses from real resource losses, and extending the costs to an unwarranted degree on the basis of political considerations.

The author had the honor of coordinating eight studies, including one of his own, on the economic impacts of the World Trade Center (WTC) attacks [24]. Five of these studies focused on the macroeconomic impacts, four of which developed estimates ranging from $70 to $167 billion (in 2019$). The econometric studies were not able to decompose these results into elements such as direct business interruption (BI) and resilience. However, a computable general equilibrium (CGE) analysis by Rose et al. [25] did so in terms of measuring direct BI, general equilibrium effects, resilience, and behavioral linkages. This analysis estimated that 72% of the potential direct GDP losses were prevented by the rapid relocation of the vast majority of businesses and government agencies housed in the WTC. At the same, time more than 80% of the remaining GDP losses were attributable to the almost 2-year reduction in airline travel and related tourism stemming from fear of flying (even after accounting for substitution of other travel modes).

4. Natural disasters

Numerous case studies of disaster impacts have been undertaken, but, for the sake of consistency, we refer the reader to a compilation by Moody’s Analytics [26], based on their own estimates and those of the Verisk Insurance Services Office and the Insurance Information Institute. We note, however, that these estimates are likely to omit some aspects of two considerations. First, they are likely to omit the multiplier or general equilibrium component of business interruption and other aspects and are thus likely to be biased on the downside. These indirect effects are typically on the order of two to three times the direct effects at the national level. On the other hand, the estimates are likely to be biased on the upside because most do not factor in resilience, which studies have found to have the potential to reduce GDP losses from major disasters by anywhere from 25 to 75% [13]. However, the two sets of effects are often likely to cancel each other out. Note also, that behavioral linkages are not typically significant in the case of natural disasters, in contrast to terrorism.1 The current pandemic is an exception, primarily because of the extensive fear and avoidance behavior, as well as government regulations that mandate business closures and stay-at-home orders.

Table 1 presents estimates of the GDP impacts and lives lost for 7 major disasters between the years 2000 and 2017. The GDP estimates range from a low of $2.7 billion for Hurricane Irene in 2011 to $80.6

| Disaster            | Year | GDP Impacts | Deaths | Death Valuation |
|---------------------|------|-------------|--------|-----------------|
| Hurricane Harvey    | 2017 | 11.5        | 89     | 0.9             |
| Hurricane Matthew   | 2016 | 4.3         | 49     | 0.5             |
| Superstorm Sandy    | 2012 | 27.3        | 159    | 1.6             |
| Hurricane Irene     | 2011 | 2.7         | 45     | 0.5             |
| Hurricane Katrina   | 2005 | 32.2        | 1833   | 18.7            |
| Hurricane Ivan      | 2004 | 8.4         | 57     | 0.6             |
| September 11        | 2001 | 80.6        | 3004   | 30.6            |

Source: Moody’s Analytics (2017) for GDP Impacts. NCDC [27] for deaths from hurricanes and START [28] for September 11 deaths. Death valuation based on value of statistical life estimates from DOT [29]; EPA [30]; FAA [31].

1 There are, of course, exceptions in the case of especially large disasters and those with a high probability of reoccurrence within a short amount of time, in which case fear is likely to continue at significant levels and affect general purchasing patterns, expenditures on mitigation, and location decisions.
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The number of injuries is also relatively minor for all but Hurricane Katrina (7,543) and September 11 (21,871), obtained from the same sources as the estimates of deaths. The injuries are likely to have been more severe from the September 11 attacks, and contributed to premature deaths at a later date not captured in the statistics on fatalities.

Again, these estimates omit the value of mortality and morbidity. They also treat unemployment in relation to the decline in GDP without considering any broader societal costs.

We have validated many of the estimates against other studies. For example, the impacts of 9/11 were compared to the estimates in Rose and Blomberg [24] which are a synthesis of four studies of just the WTC impacts (the vast majority of impacts for all of 9/11). At the same time, we note that this range is likely to be an underestimate because it does not quantify additional drivers over a two-year time horizon. They estimated a 19% reduction in GDP at the trough of the economic downturn at the end of the first quarter of 2020 and 12% decline by the end of the second quarter. CBO (2020) estimated that Real GDP contracted by 11% in the second quarter of this year, resulting in the number of people employed being almost 26 million lower than in the fourth quarter of 2019.

A more recent study by Walmsley et al., [37] which examined the influence of several causal factors in three scenarios distinguished by the severity and timing of infections, extent of business closings, pace of reopenings, influence of telework, increased demand for communication goods and services, shifts in expenditures on health care, and various types of avoidance behavior (with regard to public transportation, public gatherings, the workplace and schools), predicts between a 15% and 23% net impact on U.S. GDP. This large negative impact takes place even after the offsetting effect of pent-up demand, which reduces the gross impacts by one-third for the lower-bound scenario and two-thirds for the upper-bound scenario. These impacts range between $3.2 trillion in GDP losses for the lower bound and nearly $5 trillion in losses for the upper bound. They do not include the effect of countervailing fiscal stimulus packages. However, this is more consistent with the presentation for other types of shocks in this paper, which are gross effects and also do not include offsetting effects of spending on repair and reconstruction or of assistance to businesses, households, and other institutions.

Moreover, if we examine the loss of life from COVID-19, the impacts become even more enormous. An average of four major projections is on the order of 600,000 deaths in the U.S. before the pandemic has run its course [28–41]. Multiplied by the VSL estimate, this comes to $6.12 trillion, dominating even the highest GDP impacts.

Most revealing is that the projections of GDP impacts even exceed those for the Great Recession in the U.S. Adapting figures provided by Christiano [42], Great Recession GDP impacts over the five years until its recovery were on the order of $2.8 trillion. However, these figures include the offsetting effect of very strong countervailing policies, while the studies cited above omit them. However, preliminary estimates of the offsets to GDP losses factoring in various stimulus packages implemented during the first four months of the pandemic reduce the upper-bound estimates of COVID-19 presented above by about 50% [43], thus lowering the upper-bound estimate noted above to the level of the Great Recession. However, once we factor in the deaths in the pandemic, compared to zero or relatively very low levels of the Great Recession, the pandemic still continues to be the dominant disaster of this century, and the second largest over the last 100 years of U.S. history.

6 Walmsley et al. (2001a) have provided a decomposition of the results as follows for their mid-range estimates: Mandated closures and slow reopenings, −37.5%; avoidance behavior, −4%; pent-up demand, +17.8%.

7 We apply the VSL cited earlier as $10.2 million to each death. Some researchers have suggested that this should be modified according to age, since older workers have much lower earning capacities (see, e.g., Ref. [44] for details). Even if we made this adjustment, despite 80% of the COVID deaths to date being people 65 years or older, the valuation would still exceed $1 trillion.

8 The literature on the Great Recession and net health effects is ambiguous, but one can confidently draw the conclusion that it generated nowhere near the number of deaths as COVID-19 if any at all on net. In fact, it suggests that the economic downturn actually reduced overall short-term deaths, while also increasing deaths from some causes and worsening some health outcomes Burgard et al. [45]. Strumpf et al. [46] found that a one percentage point increase in unemployment was associated with a 0.5% decrease in mortality in U.S. cities. Fewer deaths from heart disease drove the reduction in mortality, although declines in motor vehicle accidents and homicides also contributed to lower death rates. Higher unemployment, however, was associated with an increase in accidental drug overdoses. Other studies have found that the Great Recession was associated with suicides [47]. In addition, other studies have linked the Great Recession to higher incidences of various health problems (see, e.g., Ref. [48].

9 The Spanish flu of 1918–19 and 1920–21 was estimated to have killed 675,000 people in the U.S [49]. This represents 0.64% of the population at that time, compared to 0.18% for COVID-19. We do not offer a comparison of GDP impacts, because the estimates for the Spanish Flu are considered so unreliable.
largest geophysical/meteorological disaster types in terms of areal extent—hurricanes and droughts. Even the ability of the direct impacts to ripple throughout the economy is typically limited to a two-fold to three-fold increase. Few economic shocks are capable of impacts of more than $1 trillion, primarily because this would require they be more national in scope, such as a cyber-attack on the banking industry, a terrorist attack that could result in a national psychological and financial malaise, a major recession, and the current COVID-19 pandemic. It appears that the pandemic is likely to be by far the largest disaster to beset the U.S. in first two decades of the century.

No doubt the huge economic impacts of COVID-19 are due in part to the invisible nature of the pathogen and its ability to spread rapidly in a highly interconnected world. At the same time, the situation was exacerbated by policy decisions, such as the lack of preparation and inability to devise a clear message to communicate the effectiveness of countermeasures, as well as various avoidance behaviors, including not only those that reduce economic activity directly but also those that relate to countermeasures such as mask wearing and vaccinations. Overall, COVID-19 is likely to be more than two orders of magnitude higher than most natural disasters, 30 to 50 times higher than 9/11, and even larger than the Great Recession.

We anticipate several uses of the aforementioned estimates of the economic consequences of various shocks to the U.S. economy and that of its various sub-regions. They provide an upper bound on estimates of these types of shocks in their own right and for use in elements of benefit-cost analyses of mitigation and resilience risk management strategies. The analysis is also intended to provide some perspective on the economic impacts of the potential influence of various preventative and remedial policies by placing them in a broader context. In light of the huge negative impacts of COVID-19, it would appear that more attention on prevention of pandemics is warranted.

Endnotes

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

I would like to thank Scott Farrow, Terrie Walmsley, Bryan Roberts, and three anonymous reviewers for their helpful comments, and Juan Machado and Konstantinos Papaefthymiou for their helpful research assistance. The research contained in this paper was supported by funding from the U.S. Department of Homeland Security Center for Accelerating Operational Efficiency (CAOE) under grant award number 17STQAC00001-03-00 and by Samsung Electronics Co., Ltd. However, the views expressed are solely those of the author, who is responsible for any errors and omissions.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijdrr.2021.102317.

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