The Unprecedented Stock Market Reaction to COVID-19

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Abstract. No previous infectious disease outbreak, including the Spanish Flu, has affected the stock market as forcefully as the COVID-19 pandemic. In fact, previous pandemics left only mild traces on the U.S. stock market. We use text-based methods to develop these points with respect to large daily stock market moves back to 1900 and with respect to overall stock market volatility back to 1985. We also evaluate potential explanations for the unprecedented stock market reaction to the COVID-19 pandemic. The evidence we amass suggests that government restrictions on commercial activity and voluntary social distancing, operating with powerful effects in a service-oriented economy, are the main reasons the U.S. stock market reacted so much more forcefully to COVID-19 than to previous pandemics in 1918–1919, 1957–1958, and 1968. (*JEL* E44, E65, G12, G18, I18)

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As the novel coronavirus (COVID-19) spread from a regional crisis in China's Hubei Province to a global pandemic, equities plummeted and market volatility rocketed upward around the world. In the United States, volatility levels in the middle of March 2020 rival or surpass those last seen in October 1987 and December 2008 and, before that, in late 1929 and the early 1930s (Figure 1). Volatility began to retreat in the latter part of March 2020 and, by late April, fell sharply but remained well above prepandemic levels. Motivated by these observations, we examine the role of COVID-19 developments in recent stock market behavior and draw comparisons to previous infectious disease outbreaks.

To quantify the role of news about infectious disease outbreaks, we use both automated and human readings of newspaper articles. Looking back to 1985, we find no other infectious disease outbreak that had more than a tiny effect on U.S. stock market volatility. Looking back to 1900, we find not a single instance in which contemporaneous newspaper accounts attribute a large daily market move to pandemic-related developments. That includes the Spanish Flu of 1918–1920, which killed an estimated 2.0% of the world's population (Barro, Ursua, and Weng 2020). It also includes the influenza pandemics of 1957–1958 and 1968, which led to excess mortality rates in the United States greater than the experience to date (as of June 23, 2020) with COVID-19. In striking contrast, news related to COVID-19—both positive and negative—is the dominant driver of large daily U.S. stock market moves from February 24, 2020, through April 2020, when our sample ends. The frequency of large daily stock market moves during this period is also exceptional.

Lastly, we consider potential explanations for the stock market reaction to COVID-19, which is extraordinary in absolute terms and relative to previous pandemics in 1918–1919, 1957–1958, and 1968. The evidence we amass rules out certain seemingly plausible explanations, including those that simply stress the lethality and adverse health effects of the coronavirus. The timing of large stock market moves during 2020 is also difficult to square with explanations that stress disruptions to cross-border supply chains. Our preferred explanation stresses mandatory business closures, other restrictions on commercial activity, and voluntary social distancing, including the powerful effects of these policies and behaviors in a service-oriented economy. Government restrictions on commercial activity in response to COVID-19 are more stringent, broader in scope, more widespread, and lengthier in duration than policy

responses to the Spanish Flu and completely unlike the governmental response to the 1957–1958 and 1968 influenza pandemics.

1. Characterizing Daily Stock Market Jumps

In Baker et al. (2019), we examine next-day newspaper explanations for each daily move in the U.S. stock market greater than 2.5%, up or down. By this criterion, there were 1,143 stock market jumps from January 2, 1900, to April 30, 2020. While these days compose only 3.5% of all trading days in this time period, they are highly impactful in terms of overall market movements, constituting 47% of total squared daily return variation in the past 120 years.

To characterize these jumps, we read the lead article about each jump in next-day newspapers (or the same evening in the internet era) to classify the journalist's explanation into one of 16 categories, which include Macroeconomic News and Outlook, Government Spending, Monetary Policy, Unknown or No Explanation Offered, and Other – Specify. The coding guide in Baker et al. (2018) describes the methodology in detail.

Table 1 draws on our classification effort to underscore the unprecedented impact of the COVID-19 pandemic on the U.S. stock market. In the period before February 24, 2020—spanning 120 years and more than 1,100 jumps—contemporary journalistic accounts attributed not a single daily stock market jump to infectious disease outbreaks or policy responses to such outbreaks.[1] Perhaps surprisingly, even the Spanish Flu fails to register in next-day journalistic explanations for large daily stock market moves. There were 23 daily stock market jumps from March 1918 to June 2020, which spans the three major waves of the Spanish Flu.

If we consider a longer span from January 1918 to December 1920, we find four jumps before Germany signed an armistice agreement with the allies on November 11, 1918, and seven jumps before the signing of the Treaty of Versailles on June 28, 1919. Next-day accounts in the *Wall Street Journal* attribute 4 of these 7 jumps primarily or secondarily to war-related developments. They also attribute jumps on July 21 and November 28, 1919, secondarily to war-

[1] Originally, we did not record whether journalistic accounts attributed specific jumps to policy responses to infectious disease outbreaks, although we allowed for two catchall categories: (a) Other Policy Matters – Specify and (b) Other Nonpolicy Matters – Specify. In preparing this paper, we reread all lead newspaper articles about stock market jumps from January 1918 to December 1920 to confirm we had not overlooked jump explanations attributed to the Spanish Flu.

related developments. From the armistice agreement through the end of 1920, next-day accounts in the *Wall Street Journal* attribute 11 of 28 jumps to Macroeconomic News and Outlook (primarily or exclusively) and the rest to a wide range of categories that include Monetary Policy and Central Banking, Corporate Earnings, Taxes, Trade Policy, and Regulation. For seven jumps during the period, next-day accounts in the *Wall Street Journal* offer no explanation or explicitly state that the reason for the jump is unknown.

Turning to other pandemics, the U.S. Center for Disease Control estimates that the 1957–1958 and 1968 influenza pandemics caused 116,000 and 100,000 excess deaths, respectively, in the United States.[2] Scaling by population yields excess mortality rates of 0.067% in 1957–1958 and 0.050% in 1968. As of 23 June 23, 2020, the estimated U.S. excess mortality rate to date during the COVID-19 episode is (122,300/329 million) = 0.037% of the population.[3] Nevertheless, next-day accounts in the *Wall Street Journal* attribute none of the 10 stock market jumps in 1957–1958 or in 1968 to pandemic-related developments. Sovereign Military and Security Actions account for 3 of these 10 jumps, Elections and Political Transitions Account for 2, Unknown and No Explanation Offered account for 2, and the rest are scattered across several categories. Only one jump occurred in 1968, an unusually tranquil year for the stock market.

Data since late February 2020 tell a remarkably different story. In the period from February 24 to March 24, 2020, there were 22 trading days and 18 market jumps, more than any other period in history with the same number of trading days. Jump frequency during this period is over 20 times the average pace since 1900. From February 24 through the end of April, there

[2] See www.cdc.gov/flu/pandemic-resources/1957-1958-pandemic.html and www.cdc.gov/flu/pandemic-resources/1968-pandemic.html. Glezen (1996, table 1) reports similar estimates for excess mortality in the 1957–1958 and 1968 pandemics and discusses the concept of excess mortality. According to the Centers for Disease Control and Prevention (CDC, 2020), "excess deaths are typically defined as the difference between the observed numbers of deaths in specific time periods and expected numbers of deaths in the same time periods." Unlike reported deaths attributed to a given disease (e.g., influenza or COVID-19), excess deaths capture disease-related deaths attributed to secondary causes (e.g., pneumonia) and deaths misattributed to unrelated causes. For this reason, epidemiologists usually focus on comparisons of excess deaths over time or across countries, which often involve large differences in the quality and inclusiveness of reported death statistics.

[3] The excess mortality figure of 122,300 in the United States comes from *Financial Times* (2020) and is current as of June 23, 2020. Worldometer (www.worldometers.info/coronavirus) reports 128,152 U.S. deaths due to COVID-19 as of June 27, 2020, and the COVID Tracking Project (https://covidtracking.com/data/us-daily) reports 114,809 as of June 23, 2020. U.S. population data are from the Census Bureau at www.census.gov/programs-surveys/popest.html and www.census.gov/population/estimates/nation/popclockest.txt.

were 27 jumps. Next-day newspaper accounts attribute 23 or 24 of them to news about COVID-19 developments and policy responses to the pandemic.[4]

In short, no previous infectious disease episode led to daily stock market swings that even remotely resemble the response in 2020 to COVID-19 developments. While other periods have seen large declines or increases in equity markets over periods of several weeks or months, the COVID-19 period stands out for an extremely high frequency of large daily stock market moves. And, as we have stressed, there has been no previous episode in the past 120 years in which pandemic-related developments drove *any* large daily stock market moves, let alone the 24 jumps that our newspaper-based analysis attributes to pandemic-related developments in the 10-week period commencing on February 24, 2020.

It's worth stressing that large daily stock market moves during this period were in both directions. Indeed, the S&P 500 index plunged 33% from February 21 to its trough on March 23.[5] It then rose 30% from its bottom by the last trading day in April, the end of our sample period. Our analysis considers both negative and positive jumps in response to news about COVID-19 and policy responses as drivers of the stock market.

2. Quantifying the Contribution of COVID-19 to the Overall U.S. Stock Market Volatility

Following Baker et al. (2019), we now take a mechanized approach to quantify the role of COVID-19 and other infectious diseases in U.S. stock market volatility. In a first step, we calculate the monthly fraction of articles in 11 major U.S. newspapers that contain (a) terms related to the economy, (b) terms related to equity markets, and (c) terms related to market volatility. We multiplicatively rescale this monthly series to match the mean value of the VIX since 1985. Figure 2 plots the resultant newspaper-based Equity Market Volatility (EMV) tracker alongside the VIX itself, with an inset showing recent data at a weekly frequency. As the figure

[4] The *New York Times* offered no clear explanation for the downward jump on March 20, while the *Wall Street Journal* attributed it to pandemic-related policy responses. Both papers attributed the upward jump on March 4 to elections and political transitions (i.e., Biden's strong showing in the primary election) and the downward jump on March 9, 2020, to commodity markets. Both papers attributed all other jumps since February 24 to COVID-19 developments or policy responses thereto.

[5] The S&P 500 index value on February 21 is slightly below the prepandemic peak. We select the closing price on February 21 as the starting point, because it is the last trading day before the first market jump that contemporaneous newspaper accounts attribute to COVID-19.

shows, the EMV tracker performs well in the sense of mirroring the time-series behavior of implied stock market volatility. The same is true with respect to realized stock market volatility, as shown by Baker et al. (2019).

In a second step, we identify the subset of EMV articles that contain one or more terms related to COVID-19 or other infectious diseases. Specifically, we flag EMV articles that mention one of the following terms: epidemic, pandemic, virus, flu, disease, coronavirus, MERS, SARS, Ebola, H5N1, or H1N1. Multiplying the fraction of EMV articles that contain one of these terms by our EMV tracker yields our Infectious Disease EMV tracker displayed in Figure 3. The inset part displays the results of the same quantification exercise at a weekly frequency.

Figure 3 makes three points. First, before the COVID-19 pandemic, no infectious disease outbreak made a sizable contribution to U.S. stock market volatility. The 2003 SARS epidemic and the 2015 Ebola epidemic led to modest, short-lived spikes in volatility, and the Bird Flu and Swine Flu epidemics barely registered. Second, the COVID-19 pandemic drove the tremendous recent surge in stock market volatility. Recall from Figure 1 that this surge led to the third highest realized volatility peak since 1900. So, the volatility peak is extraordinarily high by historical standards (Figure 1), and it's almost entirely triggered by COVID-19 developments, including policy responses to the pandemic. Third, the COVID-19 volatility surge began in the fourth week of January, intensified from the fourth week of February, and began tapering in the fourth week of March. By the last week of April, our Infectious Disease EMV tracker had fallen to less than half its peak levels in March, but it remains far above pre-COVID levels.

Table 2 provides more information about newspaper coverage of various infectious disease outbreaks since 1985. For each episode, we report the mean value of our Infectious Disease EMV tracker, the fraction of EMV articles that contains one of our infectious disease terms (as listed above), and the fraction of articles about Economic Policy Uncertainty (EPU) that contains one of those terms. Here, we use the EPU index developed by Baker, Bloom, and Davis (2016). The bottom row shows averages for the full period from January 1985 to April 2020.

By these metrics, the early-phase impact of COVID-19 looks similar to the impact of other infectious disease outbreaks in the past 35 years. In January 2020, for example, the Infectious Disease EMV tracker is only modestly elevated, and the percentage of EMV and EPU

articles that discuss COVID-19 developments is roughly in line with previous experiences during the SARS and Ebola epidemics. By February, however, COVID-19 developments began to dominate newspaper coverage of stock market volatility and figure prominently in newspaper discussions of economic policy uncertainty. By March, COVID-19 developments receive attention in more than 90% of all newspaper discussions of market volatility and policy uncertainty, and this pattern persists through April. These data confirm the unprecedented impact of the COVID-19 pandemic as a driver of U.S. stock market volatility.

3. Why Such Powerful Stock Market Effects?

Why have COVID-19 developments powerfully affected the stock market since late February? Clearly, the current pandemic has grave implications for public health. So, part of the answer surely lies in the severity of the COVID-19 pandemic, the apparent ease with which the virus spreads, and the nonnegligible mortality rate among those who contract it. However, this answer is highly incomplete. The excess mortality rate in the United States during the Spanish Flu pandemic was 14 times as large as the excess mortality rate to date (as of June 23, 2020) during the COVID-19 pandemic.[6] Nevertheless, as Table 1 shows, the Spanish Flu triggered not a single daily stock market move of 2.5% or more, while developments related to COVID-19 triggered two dozen such jumps.

The Spanish Flu unfolded in a very different social, political, and economic context than the current pandemic. Agriculture and Manufacturing accounted for 61% of employment then, as compared to 10% now (Velde 2020). The first wave of the Spanish Flu in Spring 1918 occurred during the last stages of World War I, and the deadlier second wave from September 1918 to February 1919 overlapped with the end of the war and the demobilization of troops. These contemporaneous developments complicate efforts to assess the economic effects of the Spanish Flu. Partly to address this challenge, Velde (2020) draws on a variety of high-frequency data to assess the short-term economic impact of the Spanish Flu in the United States. He concludes that "the pandemic coincided with, and very likely contributed to a mild recession from which the economy quickly rebounded" (Velde 2020). Thus, his analysis only sharpens the contrast

[6] Barro, Ursua, and Weng (2020) report a U.S. excess mortality rate of 0.52% of the population from 1918 to 1920, as compared to 0.02% during the COVID-19 pandemic using our calculation above.

between the modest economic fallout of the Spanish Flu and the huge contraction in the wake of the far less lethal COVID-19 pandemic.

As we remarked earlier, U.S. excess mortality rates during the 1957–1958 and 1968 influenza pandemics were greater than the excess mortality rate to date under COVID-19. Yet, as Ferguson (2020) underscores, the 1957–1958 pandemic imparted only a mild impact on aggregate economic activity, and it was not seen as a significant macroeconomic factor by contemporaneous observers. His conclusion is consistent with the absence of large daily stock market moves in reaction to the influenza pandemic in 1957–1958. Similarly, U.S. employment and output grew at a healthy pace during 1968, showing no visible reaction to the influenza pandemic. The stock market was quiescent, experiencing only a single large daily jump in 1968. These more recent pandemics also offer a startling contrast to the enormous stock market reaction and economic contraction triggered by COVID-19.[7]

A second potential answer, particularly in comparison to the Spanish Flu, is that information about pandemics is richer and diffuses much more rapidly now than a century earlier.[8] According to this explanation, the stock market impact of the COVID-19 pandemic is more temporally concentrated and more likely to trigger daily stock market jumps and high stock market volatility than Spanish Flu developments a century earlier. As Velde (2020) discusses, however, the negative stock market impact of the Spanish Flu was fairly modest even over time spans of weeks and months. The Dow Jones index actually rose over most of 1918 and 1919, reaching a peak in October 1919. The index then fell by nearly half, mostly during the recession that unfolded from January 1920 to July 1921.[9] This recession and coincident stock market decline had little to do with the Spanish Flu. In her analysis of the 1920-1921 recession, Romer (1988) does not mention the Spanish Flu. Hence, explanations that stress greater information availability and its more rapid diffusion to market participants cannot rationalize the huge stock

[7] We focus on the U.S. experience, but the size of the COVID-19 mortality shock to date varies greatly among advanced economies. In the United Kingdom, one of the worst-hit countries, COVID-19 has caused an estimated 66,460 excess deaths to date, which implies an excess mortality rate of 0.099% of the population. By way of comparison, Germany has an excess mortality rate of only 0.011%. Excess mortality figures are from *Financial Times* (2020), and population data are from the World Bank at https://data.worldbank.org/indicator/SP.POP.TOTL.

[8] As a related point, the first wave of the Spanish Flu occurred during World War I, when news about the true extent of the outbreak was censored (Honigsbaum 2013).

[9] Here and below, we rely on NBER business cycle dating at www.nber.org/cycles.html.

market reaction to COVID-19, especially as compared to the mild stock market effects of the Spanish Flu.

A third explanation stresses the role of cross-border flows of goods in the modern economy, driven by decades of falling transport costs, falling communication costs and, until recently, falling tariffs. These developments led to heavy reliance on geographically expansive supply chains and the ubiquity of just-in-time inventory systems.[10] Both are highly vulnerable to sudden supply disruptions. Thus, it is natural to ask whether stock markets reacted so forcefully to COVID-19 because of its potential to disrupt cross-border supply chains.

COVID-19 effects on the U.S. stock market were highly muted in the period before significant outbreaks in the United States, despite a major pandemic in several other countries, most notably China. This observation about timing casts doubt on the importance of international supply-chain disruptions as a major force in the powerful U.S. stock market reactions to COVID-19. If imperiled supply chains were a major driver of stock market volatility, we would expect to see strong market reactions sooner, when China and parts of Europe undertook social distancing, quarantine, and market shutdown measures that sharply curtailed their production. While disruptions to international supply chains surely have contributed to a contraction in economic activity, the timing evidence suggests they are not the main driver of U.S. stock market jumps and overall market volatility since late February.[11]

Two other explanations also stress prominent features of the economy circa 2019 that distinguish it from the economy of 1918, 1957, or 1968: high-volume international travel and the predominant role of the service sector. Long-distance travel has become commonplace,

[10] On supply chains, see Baldwin and Tomiura (2020), and on falling trade costs, see Jacks, Meissner, and Novy (2011).

[11] A separate question is whether reliance on, and disruptions to, international supply chains have been important drivers of heterogeneity in firm-level stock returns during 2020. Hassan et al. (2020), Ramelli and Wagner (forthcoming), and Davis, Hansen, and Seminario (2020) trace the COVID-induced heterogeneity in firm-level stock returns to specific risk exposure categories, such as reliance on global supply chains, exports to China, demand uncertainty, and various regulations. Papanikolaou and Schmidt (2020) find higher returns in the wake of COVID-19 at firms with a larger share of jobs that can be performed at home. Similarly, Pagano, Wagner, and Zechner (2020) find higher returns in the wake of COVID-19 at firms that are more "resilient" to social distancing requirements, where their resilience measure includes capacity to work from home. Ling, Wang, and Zhou (2020) relate returns on listed real estate investment trusts (REITs) in reaction to COVID-19 news events to the characteristics of the underlying commercial real estate properties in their investment portfolios. Unlike the focus of these papers, our focus is on overall market-level moves.

supporting tourism and hospitality sectors and facilitating interactions and commercial activity in business, entertainment, education, and the sciences.[12] The structure of the economy has also shifted over time to consumer and business services, which often involve face-to-face interactions in close physical proximity. An abrupt uptake of voluntary and compulsory social distancing practices brings a sharp drop in demand for such services. We will return shortly to the impact of travel restrictions and the curtailment of face-to-face interactions in the commercial sphere.

That brings us to nonpharmaceutical policy interventions (NPIs) that aim to slow or contain the COVID-19 pandemic. Consider travel restrictions, one type of NPI. As of June 15, 2020, the United States has restricted travel from China since February 2, Iran (March 2), 26 European countries in the Schengen area (March 17), the United Kingdom and Ireland (March 19), Mexico and Canada (May 19), and Brazil (May 24). The restrictions route flights from affected countries to a limited number of designated U.S. airports, and they prohibit entry by most foreign nationals who visited any country on the restricted list within the previous 14 days.[13] Other countries have also imposed extensive restrictions on cross-border travel. In Figure 4, we show that relative to a year earlier, the weekly frequency of international flights fell 75% from mid-March to early May. The global fall is similar, whereas the pattern for China shows a much earlier and steeper drop followed by a considerable recovery. These data *understate* the drop in international air travel, because they do not account for declines in passengers per flight during the coronavirus pandemic.[14]

Gupta et al. (2020b, figure 2.1) quantify several other types of government-mandated NPIs in the United States, which proliferated rapidly from the middle of March 2020. By late March, nearly 100% of U.S. residents lived in counties where state or local officials had closed

[12] For Europe, cross-border commuting has also become an integral part of how economies function (Meninno and Wolf 2020).
[13] See the U.S. Department of Homeland Security announcements at www.dhs.gov/publication/notices-arrival-restrictions-coronavirus and www.dhs.gov/publication/notification-temporary-travel-restrictions-applicable-land-ports-entry-and-ferries, the White House proclamation at www.whitehouse.gov/presidential-actions/proclamation-suspension-entry-immigrants-nonimmigrants-certain-additional-persons-pose-risk-transmitting-novel-coronavirus/, and the Center for Disease Control statement at www.cdc.gov/coronavirus/2019-ncov/travelers/from-other-countries.html.
[14] We can quantify the overall drop in commercial air travel in the United States using TSA data on "Total Traveler Throughput" at www.tsa.gov/coronavirus/passenger-throughput. According to these data, air travel was down 93% from a year earlier on March 31, 2020, and 94% on April 30.

schools and dine-in restaurants, roughly 70% lived in counties with mandatory closures of nonessential businesses, and roughly 90% were subject to stay-at-home orders and bans on public gatherings. Most states began to relax some of their social distancing requirements by early May (Nguyen et al. 2020), but major restrictions remain in place as of early June in much of the country. Finally, generous unemployment benefits under the Coronavirus Aid, Relief, and Economic Security (CARES) Act effectively subsidize social distancing by making it financially costly for most job losers to return to work before August 1.[15]

These interventions to combat COVID-19 are more aggressive, broader in scope, more widespread geographically, and lengthier than NPIs adopted during the Spanish Flu. Markel et al. (2007) consider NPIs in 43 American cities (accounting for 22% of the U.S. population) from September 18, 1918, to February 22, 1919. They group NPIs into three main categories: school closures, cancellation of public gatherings, and isolation and quarantine mandates. The most common NPI regime (34 cities) involved school closures and bans on public gatherings for a median duration of 4 weeks. Bootsma and Ferguson (2007), who consider NPIs in 23 American cities, state that a "range of interventions was tried in the United States in 1918, including closure of schools and churches, banning of mass gatherings, mandated mask wearing, case isolation, and disinfection/hygiene measures." Broad travel restrictions and widespread business closures do not figure in their discussion. Hatchett, Mecher, and Lipsitch (2007) offer a similar account and note that "few cities maintained NPIs longer than 6 weeks in 1918." Only 1 city among the 17 in their sample implemented community-wide business closures.

Governmental authorities in the United States refrained from NPIs in response to the 1957–1958 influenza pandemic (Henderson et al. 2009; Ferguson 2020). As Henderson et al. (2009, p. 270) put it, "measures were generally not taken to close schools, restrict travel, close borders, or recommend wearing masks. Quarantine was not considered to be an effective mitigation strategy." The focus was instead on surveillance, rapid vaccine development, and, once developed, the priority deployment of the vaccine to healthcare workers, persons providing

[15] President Trump signed the CARES Act on March 27, 2020. As part of this relief act, the federal government supplements unemployment benefit levels by $600 per week through the end of July 2020. Ganong, Noel, and Vavra (2020) estimate that the median replacement rate for unemployment benefit recipients is 134% under the CARES Act. They also estimate that two-thirds of eligible workers receive benefits that exceed lost earnings, and one-fifth receive benefits that are at least twice as high as lost earnings.

basic community services, and persons at high health risk from the virus. Those who contracted the virus were encouraged to rely on home health care except in cases involving complications or aggravating conditions. At a special meeting of the Association of State and Territorial Health Officers held in Washington, DC, on August 27 and 28, the members resolved that "there is no practical advantage in the closing of schools or the curtailment of public gatherings as it relates to the spread of this disease" (as quoted in Henderson et al. 2009). Schools experienced high absenteeism rates during the peak of the pandemic, as did healthcare workers and teachers, and some high school and college football games were cancelled or postponed.

This brief review makes clear that the aggressive, widespread implementation of NPIs during the 2020 coronavirus pandemic is much more severe and far-reaching than measures adopted during the Spanish Flu and completely unlike the U.S. approach during the 1957–1958 influenza pandemic. Indeed, we are unaware of any previous pandemic in U.S. history that prompted such an aggressive use of NPIs. Thus, it appears that the heavy use of NPIs during the 2020 coronavirus pandemic is also unprecedented in U.S. history.

These interventions in combination with voluntary social distancing responses to the pandemic have drastically curtailed economic activity in the United States. As Baldwin (2020) puts it, "COVID-19 and the containment policies have directly and massively reduced the flow of labour to businesses. The result has been a sudden and massive reduction in the output of goods and services." We would add that containment policies have also massively reduced the flow of customers to business premises, bringing huge revenue reductions to other than online businesses and delivery services.

To be sure, government-mandated restrictions are far from the whole explanation for the curtailment of economic activity during the COVID-19 pandemic. Recent research by Maloney and Taskin (2020) and Gupta et al. (2020b) finds that voluntary social distancing—often prompted by first-case announcements, emergency declarations, and other information-oriented government actions—have been at least as important as government mandates in reducing individual mobility, work activity on business premises, and customer visits to restaurants, retail outlets and other businesses. Farboodi, Jarosch, and Shimer (2020) incorporate individual optimizing behavior into a canonical epidemiological model. They argue that the decentralized

equilibrium version of their model yields voluntary declines in social activity similar to the actual declines observed in data for the United States.

Like government-mandated restrictions on commercial activity, voluntary social-distancing actions have potent effects on economic activity. Their effects are especially powerful in a service-oriented economy that involves extensive face-to-face encounters in restaurants, shopping malls, retail outlets, entertainment venues, professional and business services, personal services, educational institutions, and healthcare facilities – as well as among employees in the workplace. See Coibion, Gorodnichenko, and Weber (2020) and Gupta et al. (2020b) for early causal evidence on the negative economic effects of stay-at-home mandates and forced business closures during the 2020 coronavirus pandemic. There remains the question of why voluntary social distancing responses and government-mandated NPIs were so much more extensive in reaction to COVID-19 than the reaction to earlier pandemics.

4. Concluding Remarks

We have shown that the effects of COVID-19 developments and policy responses on the U.S. stock market are without historical precedent. There were more than 1,100 daily stock market moves (up or down) greater than 2.5% from 1900 to 2019. Next-day newspaper accounts attribute not a single one of these jumps to infectious disease outbreaks or pandemic-related developments. From February 24 to April 20, 2020, newspapers attributed two dozen such jumps to coronavirus-related developments. A similar pattern holds for measures of real economic activity. Compared to the 2020 pandemic, even the Spanish Flu of 1918–1919 had modest effects on the U.S. economy. The influenza pandemic of 1957–1958 left weak marks on the economy and the 1968 pandemic left no apparent trace.

Our comparisons to the 1918–1919, 1957–1958, and 1968 show that the unprecedented stock market reaction to COVID-19 cannot be explained simply by the lethality of the virus. To date, as of June 23, 2020, the excess mortality rate from COVID-19 is only 1/14th as large as the rate during the Spanish Flu. The influenza pandemics of 1957–1958 and 1968 also involved greater excess mortality rates than COVID-19 to date. Of course, COVID-19 deaths would be greater if governmental authorities in 2020 had adopted the more laissez-faire approach taken in 1957–1958 and 1968, or even the strategy of relatively limited and localized NPIs pursued in 1918–1919. How much greater is difficult to say. Regardless of the answer to this difficult

counterfactual, our chief empirical message stands: no other pandemic has affected the U.S. stock market in such extraordinary ways.

We also find little support for explanations that stress more rapid information diffusion in today's economy and explanations that stress the role of disruptions to international supply chains. More promising explanations focus on the role of government restrictions on individual mobility and commercial activity plus voluntary social distancing, all of which have powerful effects in a service-oriented economy. Government-mandated NPIs during the COVID-19 pandemic have taken several forms: restrictions on international travel, school closures, stay-at-home orders, bans on public gatherings, closures of nonessential businesses, and mandates to wear masks and maintain social distancing. The earliest stock market jumps attributed to COVID-19 developments in late February and early March mostly involve reactions to news about the course of the pandemic in the United States. Jumps later in March and through the end of April 2020 also reflect policy responses to the pandemic, including news about actual or prospective fiscal and monetary policy actions.

We recognize that our conclusions about the reasons for the extraordinary stock market reaction to COVID-19 are painted with a broad brush. There is much room for further investigation into the relative importance of voluntary social distancing efforts and government restrictions, as well as studies that seek to quantify the role of particular restrictions. There is also much room for research into the stock market reactions to particular fiscal and monetary policy actions during the 2020 pandemic.

As a final remark, we think our evidence offers grounds for reflection on the wisdom of broad, heavy-handed restrictions on commercial activity in efforts to contain the coronavirus pandemic. The healthcare rationale for travel restrictions, business closures, and social distancing mandates is clear. By now, it is also painfully evident that these policies bring great economic damage. There is a compelling need to address the health crisis created by COVID-19, while shifting to less sweeping containment policies that do not strangle the economy, as argued by Cochrane (2020), Dewatripont et al. (2020), Fujita, Moscarini, and Postel-Vinay (2020), Ichino et al. (2020), and Monras (2020), among others.

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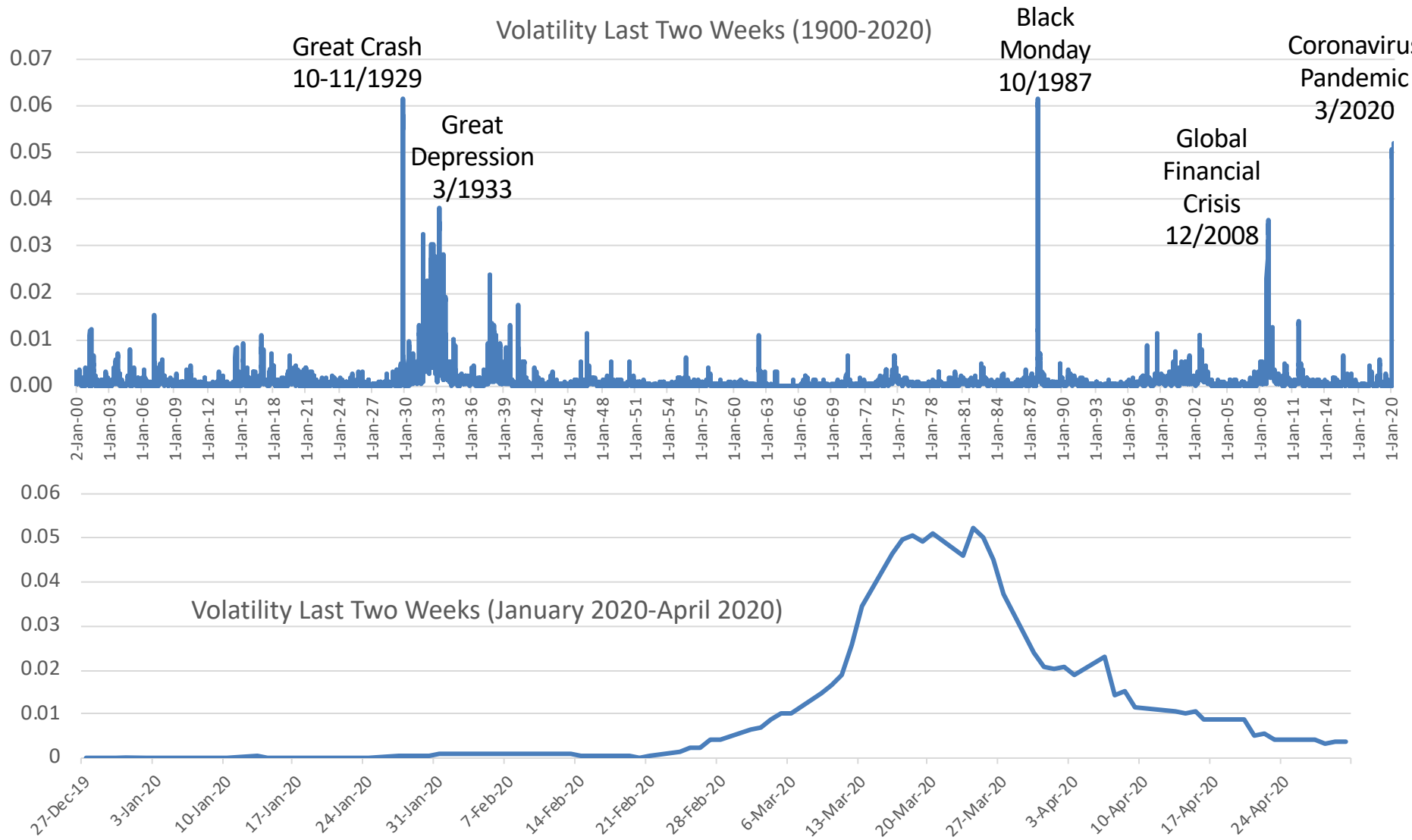
Figure 1. Realized U.S. stock market volatility, January 1900 to April 2020



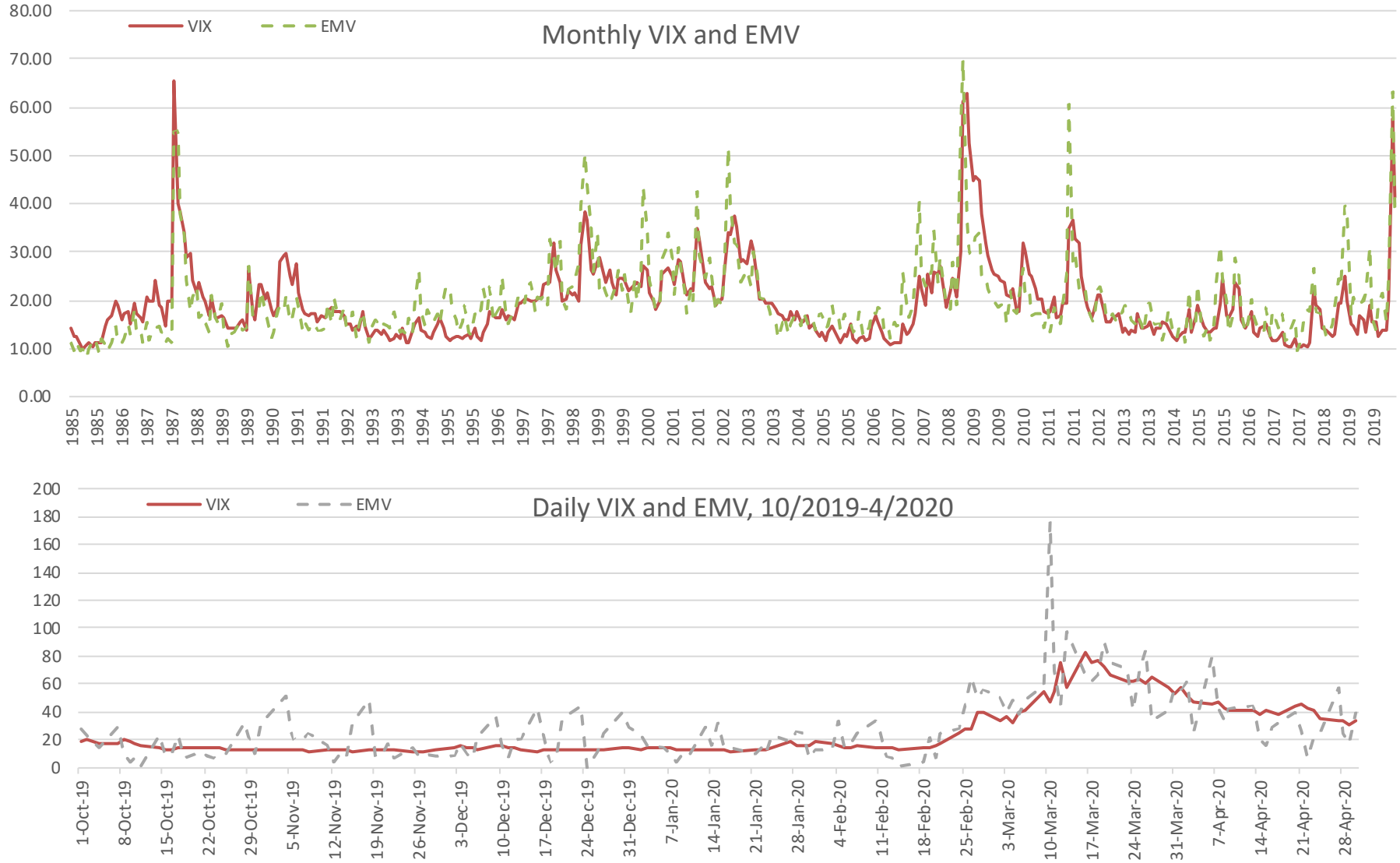
The sample period runs from January 2, 1900, to April 30, 2020. From December 1925 onward, returns are computed using Yahoo Finance's "adjusted close" series for the S&P 500 (^GSPC). Before that, returns are from the Global Financial Data extension of the Dow Jones index. In both panels, we calculate realized volatility as the sum of squared returns over the past 10 trading days.

Table 1. The unprecedented stock market impact of the coronavirus

	Number of daily U.S. stock market jumps greater than |2.5%|	Number attributed to economic fallout of pandemics	Number attributed to policy responses to pandemics
January 2, 1900, to February 21, 2020	1,116	0	0
February 24, 2020, to April 30, 2020	27	13.4	10.4

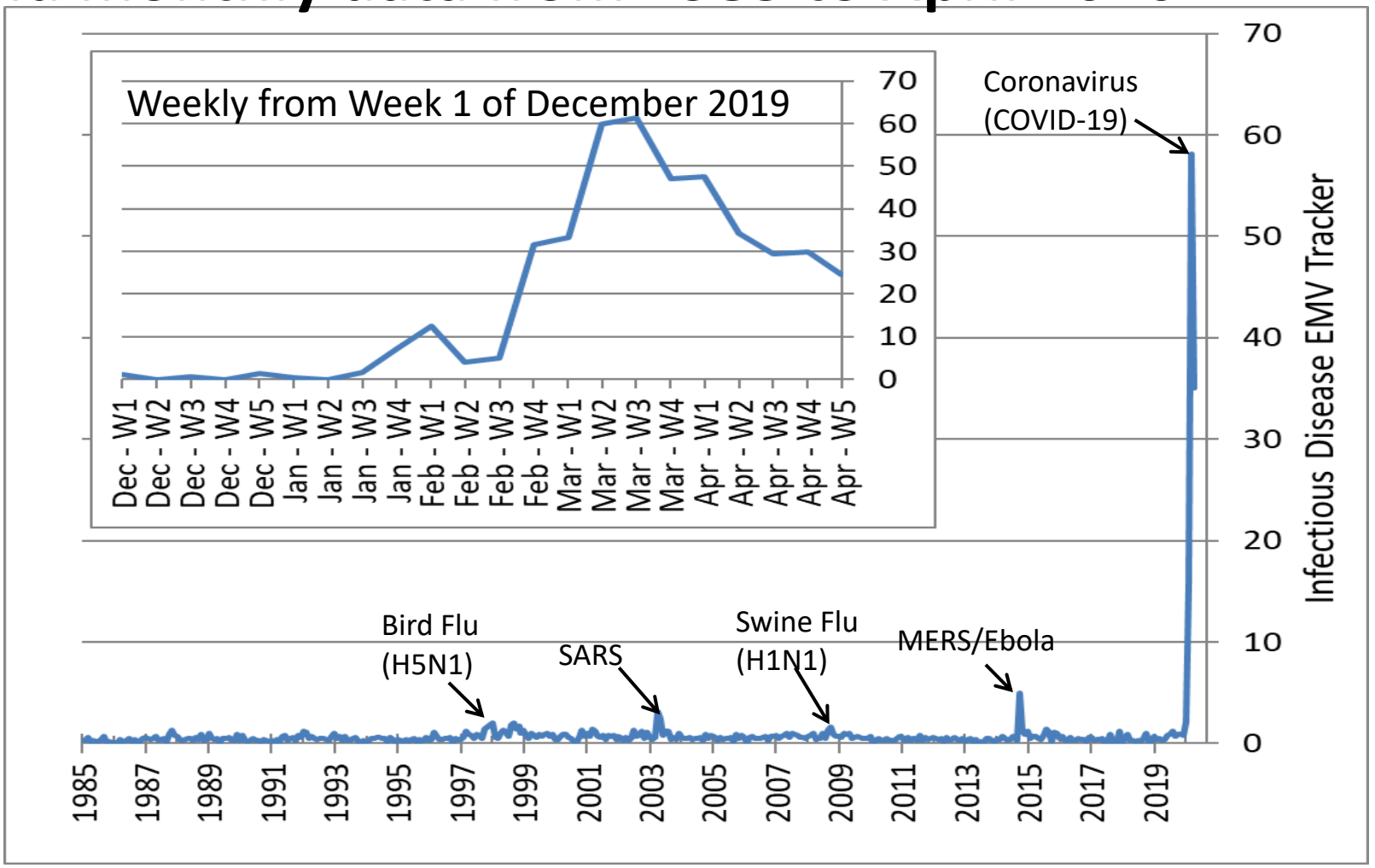
Tabulated from results in Baker et al. (2020), who consider all daily jumps in the U.S. stock market greater than 2.5%, up or down, since 1900. They classify the reason for each jump into 16 categories based on human readings of next-day (or same-evening) accounts in the *Wall Street Journal* (and *New York Times* in 2020). Fractional counts arise when newspapers differ in their jump attribution or human readers differ in their classification of the attribution. Number attributed to economic fallout of pandemics includes jumps on March 12th and March 16th that a subset of coders classified as Macroeconomic Outlook. It's clear from reading these articles that the journalist regarded the deterioration in the Macroeconomic Outlook as due to the spread of the coronavirus.

Figure 2. Newspaper-based equity market volatility tracker and the 30-day VIX, January 1985 to April 2020



The Equity Market Volatility Tracker reflects the frequency of articles about stock market volatility in leading U.S. newspapers, as quantified by Baker et al. (2019). The 30-Day VIX is constructed as the monthly average of daily closing VIX values collected from Yahoo Finance. Bottom panel displays daily data for each series.

Figure 3. Infectious disease EMV index, weekly and monthly data from 1985 to April 2020



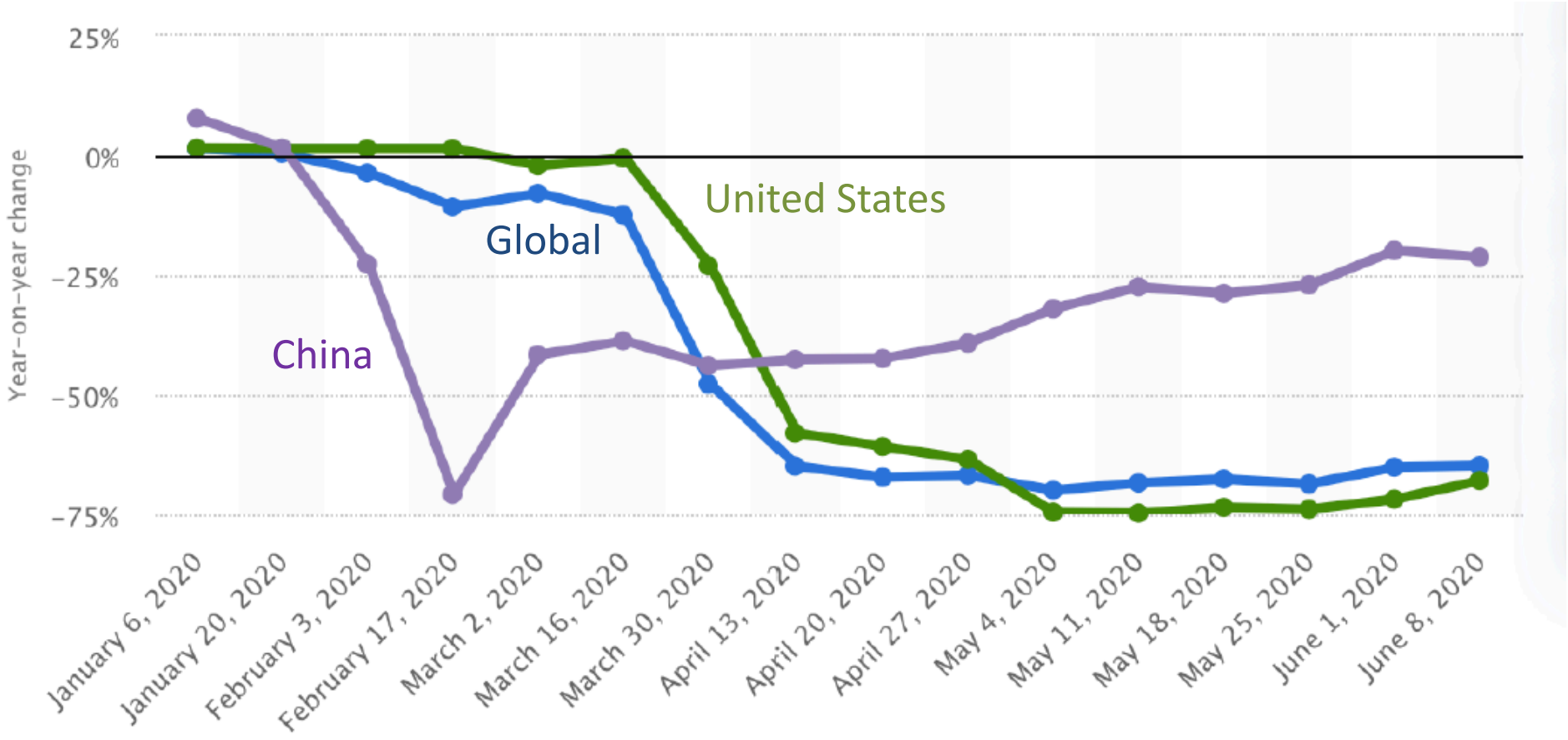
The Infectious Disease EMV Tracker is computed as the overall EMV tracker value multiplied by the share of EMV Articles that contain one or more of the following terms: epidemic, pandemic, virus, flu, disease, coronavirus, mers, sars, ebola, H5N1, and H1N1.

Table 2. Stock market volatility in selected infectious disease episodes

		Average values for the indicated time period		
	Time period	(1) Infectious disease EMV tracker level	(2) % of EMV articles with infectious disease terms	(3) % of EPU articles with infectious disease terms
Bird Flu (H5N1)	Nov 1997 to Nov 1998	1.36	4.52	8.00
SARS	Apr to Aug 2003	1.75	8.10	9.79
Swine Flu (H1N1)	Mar to May 2009	0.99	3.60	4.58
Ebola & MERS	Oct 2014 to Jan 2015	2.06	10.62	12.80
Coronavirus (COVID-19)	Dec 2019	0.79	3.68	6.42
	Jan 2020	2.11	13.45	7.43
	Feb 2020	15.74	64.38	32.62
	Mar 2020	58.13	91.73	94.33
	April 2020	35.01	92.13	98.65
Full period	Jan 1985 to Apr 2020	0.84	3.58	5.89

The Infectious Disease term set is {epidemic, pandemic, virus, flu, disease, coronavirus, mers, sars, ebola, H5N1, H1N1}. We use the following newspapers in the analysis: *Wall Street Journal*, *NY Times*, *Chicago Tribune*, *Washington Post*, *LA Times*, *Boston Globe*, *Miami Herald*, *USA Today*, *SF Chronicle*, *Dallas Morning News*, and *Houston Chronicle*. We selected periods with relatively high levels of our Infectious Disease EMV tracker and labelled the time periods based on the prevalence of specific terms (e.g., SARS) in the EMV articles. Both "Ebola" and "MERS" appear in EMV articles from October 2014 to January 2015, but references to "Ebola" are much more frequent.

Figure 4. Year-on-year change of weekly flight frequency by global airlines, January 6 to June 8, 2020



We obtained these data from Statista. The original source is the OAG Schedules Analyzer, published by OAG.com.