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"LONG GFC"? THE GLOBAL FINANCIAL CRISIS, HEALTH CARE, AND COVID-19 DEATHS

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Abstract

Do financial crises affect long-term public health? To answer this question, we examined the relationship between the 2007-2009 Global Financial Crisis (GFC) and the 2020-2022 COVID-19 pandemic. Specifically, we examined the relationship between the financial losses derived from the GFC, and the health outcomes associated with the first wave of the pandemic. European countries that were more affected by the financial crisis had more deaths relative to coronavirus cases. An analogous relationship emerged across Spanish provinces and US states. Part of the transmission from finances to health outcomes appears to have occurred through cross-sectional differences in health care facilities.

JEL Classification: I10, G21, H1

Keywords: Global financial crisis, Covid-19, Local sovereign debt, Death ratio, Curative beds

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“Long GFC”?

The Global Financial Crisis, Health Care, and COVID-19 Deaths

Antonio Moreno, Steven Ongena, Alexia Ventula Veghazy and Alexander F. Wagner

April 8, 2023

Do financial crises affect long-term public health? To answer this question, we examined the relationship between the 2007-2009 Global Financial Crisis (GFC) and the 2020-2022 COVID-19 pandemic. Specifically, we examined the relationship between the financial losses derived from the GFC, and the health outcomes associated with the first wave of the pandemic. European countries that were more affected by the financial crisis had more deaths relative to coronavirus cases. An analogous relationship emerged across Spanish provinces and US states. Part of the transmission from finances to health outcomes appears to have occurred through cross-sectional differences in health care facilities. (99 words)

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More than a decade apart, the 2007-2009 Global Financial Crisis (GFC) and the 2020-2022 coronavirus-disease-of-2019 (COVID-19) pandemic impacted a similar set of countries, socially and economically challenging households, firms, financial institutions, and policymakers. These two calamities are similar in terms of their global reach and the magnitude of their socio-economic damage.[1] However, are they connected in the sense that the GFC may have compounded the effects of the COVID-19 pandemic?[2]

This study aims to assess the association between the GFC and the COVID-19 pandemic.[3] Costly bank bailouts,[4] small- and medium-sized enterprise (SME) credit that became more constrained, and bank regulation that became stricter in the wake of the GFC all led to a

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[1] Given the extensive literature assessing the path of the COVID-19 pandemic and its economic impact, particularly relevant to this study are studies exploiting the forward-looking nature of financial markets. For example, Gerding, Martin, and Nagler (2021) find that countries with higher debt levels had worse stock price developments in the pandemic, with the presumed channel that investors anticipate that their fiscal capacity is too weak to deal with the pandemic (much like highly indebted companies suffered in the pandemic, as in Ramelli and Wagner (2020)). Second, Andrieș, Ongena, and Sprincean (2021) and Augustin, Sokolovski, Subrahmanyam, and Tomio (2021) show that COVID-19 increased sovereign CDS (thus making it more difficult for a government to finance itself, with possible further health consequences). There are numerous studies on optimal public investment and health responses in pandemics (e.g., Adda (2016); Maher, Hoang, and Hindery (2020); Surico and Galeotti (2020); European Investment Bank (2021); Gourinchas, Kalemli-Özcan, Penciakova, and Sander (2021)). An earlier (but still expanding) literature studies the repercussions of financial crises and policies preventing and dealing with them (e.g., Allen and Carletti (2010)). Further, recent writings that aim to compare the GFC and the COVID-19 pandemic in their financial, economic, and societal outcomes (e.g., Strauss-Kahn (2020); Chen and Yeh (2021); Kumar, Kaur, Tabash, Tran, and Dhankar (2021); Tang and Aruga (2021); Gunay (2022); Gunay and Can (2022); Yu, Guo, and Chang (2022)).

[2] On the compounding of risks, see, for example, Monasterolo, Billio, and Battiston (2020).

[3] A recent report by the OECD (2021) conjectures this connection by stating that "in some countries, the ability of the health care system to respond to the coronavirus crisis was weakened by several years of moderating, or decreasing public expenditure, and investment in health care/hospitals in the aftermaths of the global financial crisis. For example, between 2008 and 2018, the number of hospital beds per capita decreased in almost all OECD countries, declining by 0.7% per year, on average" (op. cit., p.13). And Bouckaert, Galli, Kuhlmann, Reiter, and Van Hecke (2020) posit that "it could be expected that countries that have cut their 'unnecessary' capacity in the past, reducing their health spending as a percentage of gross domestic product (GDP) and/or the number of hospital beds per 1,000 inhabitants, will have to mobilize more resources to recover the capacity needed to handle the crisis, especially if a herd logic was (initially) taken."

[4] "The notion of finance adding value has run increasingly hollow in the long shadow of the global financial crisis that began in 2008. This required governments around the world to rescue major banks whose `net worth' had turned out to be fictitious; with the bailouts continuing to impose heavy social costs ten years on, in the form of squeezed public budgets, heavy household debt and negative real returns for savers" (Mazzucato (2018), p. 102).

slowing of economic growth, fiscal consolidation (e.g., Fatás and Summers (2018)), and an accumulation of sovereign debt relative to GDP. The cuts in public health spending that followed,[5] may have exacerbated the severity of the COVID-19 pandemic in terms of higher overall death rates (e.g., Wagschal (2022)), as well as death rates at impact. However, the greater the expected capacity of the healthcare system, the fewer incentives there may have been to implement hard measures, such as lockdowns, leading to more initial deaths (Bel, Gasulla, and Mazaira-Font (2021)). Therefore, the connection between the GFC, public health, and initial COVID-19 death outcomes is an empirical question; and we aim to answer it in this study.

While the GFC precedes the COVID-19 pandemic by a decade, local (time-invariant) factors can similarly affect both GFC and COVID-19 death outcomes. Therefore, our identification strategy relies on four key components.

First, we analyze the outcomes across 30 European countries, 50 Spanish provinces, and 50 US states, separately. These geographical units not only vary, for example, in their size and level of aggregation,[6] but also differ sharply and in complex ways in their competencies and/or abilities to affect the outcomes of the GFC (despite some common shared crisis factors, e.g., Claessens, Dell'Ariccia, Igan, and Laeven (2010)) and/or the COVID-19 pandemic.[7]

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[5] "European leaders boasted of the superiority of their world-class health systems but had weakened them with a decade of cutbacks" (Kirkpatrick, Apuzzo, and Gebrekidan (2020); see also Mazzucato (2018), p. 152). Complicating the picture is that "many European leaders felt so secure after the last pandemic — the 2009 swine flu — that they scaled back stockpiles of equipment and faulted medical experts for overreacting" (see also Mazzucato and Kattel (2020)). See Moreno, Ongena, Ventula Veghazy, and Wagner (2020) for a discussion, also of other channels such as the transmission within households between young and old, a living arrangement which may have become more prevalent after the financial crisis as unemployed youngsters could not leave the parental home or even had to return to it.

[6] In 2020, the smallest Spanish province Soria had a population of only 88,636, while the population of Germany and California was equal to 85 and 40 million people, respectively.

[7] Both the individual countries and the European Union had competencies in tackling the GFC (e.g., Nieto and Schinasi (2008)), while initially the pandemic was handled mostly nationally. For Spain, most competencies in

Second, we include a set of controls capturing local economic, demographic, and public health conditions. Varying this set does not alter the estimates significantly. Moreover, employing methods following Altonji, Elder, and Taber (2005) and Oster (2019) reveals that the effects appear robust to the influence of unobserved variables.

Third, we analyze several measures of the severity of the financial crisis, namely, output gaps, real GDP growth, and sovereign debt accumulation measures at either the national, provincial, or state levels. A trade-off may exist between the loss in output and the disposition of the sovereign to issue debt, which is also affected by the supervisors' inclination to forebear (e.g., Gropp, Ongena, Saadi, and Rocholl (2021)). While the loss in output may affect both the private and public provision of health services, public debt issuance may impair mostly the future public provision of health services, a channel we directly assess.

Finally, to measure pandemic outcomes, we look at deaths over cases at various points of the immediate impact of the pandemic's first wave in March 2020,[8] before governments had time to implement strict lockdowns or health measures.

Combining these four identification strategy components, it seems unlikely that during this decade, after accounting for a variety of economic and public health controls, a set of confounding (not included) factors correlated with the severity of the GFC would affect the 30 countries, 50 provinces, and 50 states unidirectionally and similarly in terms of COVID-19 deaths to invalidate the results that emerge in our analysis.

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dealing with the GFC were national and/or European, while the pandemic was initially handled at the national level (see, e.g., the Oxford Covid-19 Government Response Tracker). For the US there were both federal and regional/state competencies during both the GFC (e.g., Agarwal, Lucca, Seru, and Trebbi (2014)) and the pandemic.

[8] Mizrahi, Vigoda-Gadot, and Cohen (2021) also study the first wave of the pandemic March/April 2020 in Israel to measure the government's effectiveness (based on the unexpected policy component).

The estimates at the cross-country, -province and -state levels are strikingly similar in sign and in economic magnitude. Considering a two standard deviation increase in the severity of the financial crisis, in the half-decade following the financial crisis, it implies an output gap of 20 percent (across European countries) and/or a negative output growth of up to two percent per year (across all levels). In terms of sovereign debt, for Spanish provinces a local debt tripling or for US states a 50 percent increase in state debt. Roughly speaking, this analysis contrasts Germany with Spain, the Spanish provinces of Alicante with the Baleares, and the US states of Florida with Maryland.

This difference in financial crisis severity results in *one* to *three* more deaths (per 100 cases), across countries, provinces, and states, respectively. This is the case in both the univariate set-up displayed in Figures 1 to 3,[9] as well as in the many multi-variate regressions reported in the tables in the rest of the paper. This is a sizeable effect given that the mean death rate is equal to one and a half deaths across countries, four deaths across provinces, and three deaths across states.

The same difference in GFC severity also results, across Spain or the US in a build-down in the number of curative or hospital beds, with up to a third of a standard deviation in these numbers. This effect may sound modest. However, on the margin this factor may have played a prominent role in worsening the local death rate. We test and confirm this conjecture in a

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[9] On the horizontal axis we feature the output gap or real GDP growth during the relevant financial crisis period for each country, from 2009 to 2013 for Spain, and from 2007 to 2009 for the US, respectively. Notice that estimated output gaps are not available at the province- and state-levels. On the vertical axis we display the number of deaths over the number of cases, in percent, immediately after the number of cases per one million population surpassed one hundred in March 2020 or before for the European countries, the number of deaths per cases at peak for the Spanish provinces, and the number of deaths per cases when the number of cases over the population are higher than hundred per hundred thousand of population for the US states. In later estimations, we involve several other financial crisis severity and death outcome measures and discuss more details.

two-stage estimation. Specifically, the decrease in economic growth or increase in debt in the half-decade following the financial crisis partly explains the local number of beds in Spain and the US in 2018, which in turn explains pandemic death rates in 2020.

We are not the first to link the financial crisis to public health performance.[10] Maruthappu, Da Zhou, Williams, Zeltner, and Atun (2015), for example, link the global economic downturn in 2009, and its increased unemployment and reduced public–sector expenditures, to HIV mortality. They find that a 300 percent increase in unemployment and a ten percent decrease in public sector expenditures,[11] is associated with an increase in male HIV deaths per 100 thousand (K) population by 54 and 5, respectively.[12]

Compared to such extant work, our study contributes as follows. First, we are the first to establish a link between macro-financial deterioration during the 2008 crisis and the subsequent COVID-related health outcomes. Second, as argued before, we take a decisive step towards identifying the impact of a financial crisis on the ensuing public health performance by linking measures of the severity of the GFC to the immediate impact of a later pandemic (before the pandemic itself starts affecting local financial and economic outcomes and before major public health and other policies are implemented). We also study

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[10] For an analysis of this literature, see Stuckler, Reeves, Karanikolos, and McKee (2014). There is also micro evidence studying the financial constraints of individual hospitals (e.g., Calem and Rizzo (1992)), and linking those to clinical choices (e.g., Adelino, Lewellen, and McCartney (2021), Aghamolla, Karaca-Mandic, Li, and Thakor (2021)), and in the case of nursing homes to the spread of COVID-19 (Begley and Weagley (2021)).
[11] In Spain (a focus in the main part of our analysis), the unemployment rate went from 8 percent in 2007 to 18 percent in 2009 to almost 25 percent in 2014, while public expenditure dropped by almost 7 percent from its peak of 502B euro in 2012 to 468B in 2013.
[12] These death rates are not immediately comparable to our findings as we measure deaths over cases (i.e., infected individuals) at impact, not deaths over population over a longer period in the more advanced stages of the pandemic.

the link within single countries, such as Spain and the US, where much is common, except for the financial crisis severity and local public health spending.

The rest of the paper proceeds as follows. Section I introduces the cross-country analysis, Section II focuses on the impact across Spanish provinces, while Section III analyzes the impact across US states. Both sections clarify the channel with a two-stage estimation. Section IV concludes.

I. Cross-country Evidence

A. Empirical Strategy and Model

Assessing a potential connection between the financial crisis and the COVID-19 pandemic comes with at least two main challenges: (1) Despite the dramatic impact of the financial crisis on economic growth and sovereign debt, it is possible that, with the passing of time stretching for over more than a decade and with many other developments and policy actions occurring, no exacerbation of the pandemic outcomes is discernible. Put differently, it is essential to adequately control for other developments during this time period. Even then the impact-to-noise ratio over such an eventful time period may be simply too small. (2) Once the pandemic was under way, public health and other policy responses were unprecedented and may blur any assessment of the financial crisis – pandemic nexus.

To address the first concern, we must have reliable measures of the impact of the financial crisis and control for other characteristics of the economy that were changing over time. While an omitted variable concern may continue to linger (to be addressed by testing *à la* Altonji et al. (2005) and Oster (2019)), at least we can comfortably argue that the financial crisis predates and hence is well pre-determined to the pandemic. To deal with the second concern, we must measure the immediate impact of the pandemic, before unprecedented public health policy responses such as lockdowns were implemented (the timeliness and the optimal calibration of such policy responses may also have been an outcome of past public health expenditures in expertise).[13]

Hence, we will estimate the following regression:

$$Immediate\ Pandemic\ Deaths_c = \alpha + \beta Financial\ Crisis\ Severity_c + \sum_i \gamma_i Control_{ic} + \varepsilon_c \quad (1)$$

The dependent variable *Immediate Pandemic Deaths*, the main explanatory variable of interest *Financial Crisis Severity*, and the array of *Control* variables i, vary across countries c,[14] and will be defined in the next three subsections. The main coefficient of interest is β. ε is the error term. In addition to this main regression, we also discuss and assess later a potential channel, which is the reduction in public health spending, through which financial crisis severity may affect immediate pandemic death outcomes.

For the analysis in this cross-country section, we collect data from 30 European countries. Table 1 defines all variables. Data Appendix Table D.1 provides all observations employed. Outside Asia, Europe was hit by the spreading virus first.

[13] Aschwanden (2021) for example documents that the overall stringency of the country-level measures seems not to be determined by financial crisis severity, but that individual measures such as international travel controls (which are "cheaper" for the sovereign) or debt and contract relief policies (which are "more expensive") may be determined as such. On the other hand, Dzigbede, Gehl, and Willoughby (2020) for example show that U.S. local governments' preparedness for weather-related natural disasters also inform responses to the pandemic.

[14] In the next two sections the equation will be defined at the Spanish province (p) and US state (s) level but given its close similarity the equation will not be repeated.

B. Dependent Variables: Immediate Pandemic Deaths

Our aim is to assess if the severity of the financial crisis in a country results in a more severe pandemic outcome in terms of deaths per infections a decade later. Hence, our main dependent country variable, which is called *(Deaths / Cases) when (Cases / Population) > 100/1M*, measures the three-day moving average of the number of deaths over the number of cases, in percent, immediately after the number of cases per one million population surpassed 100 in March 2020 or before. Five countries, i.e., Bulgaria, Hungary, Poland, Romania, and Slovakia, surpassed this number only after March and are, therefore, not included in the analysis. We take three-day moving averages throughout our analysis, as pandemic statistics are somewhat "jumpy" due to data reporting and collection issues.[15] We focus on the number of deaths as the measure of the ultimate (and at the individual level, irreversible) measure of failure of a public health system to help and cure its people. And we measure this at the point of the first major impact of the pandemic, i.e., the first "blow". 100 cases per one million is about the number when Italy as the first nation outside of China went into lockdown and many nations followed within a couple of weeks.

C. Financial Crisis Severity Variables

There are four main country-level financial crisis explanatory variables of interest, *Output Gaps* measured over two different periods, *Real GDP Growth* and the *CDS Premium Growth*. Each one measures different aspects of the severity of the financial crisis that took place in the country.

[15] We take the minimum number of days possible that addresses the issue of the volatility of the series without losing our possibility to measure the immediate impact. Taking five- or seven-day outcomes for the same set of countries leaves the main findings we report below unaffected.

Output Gap (2008-13) is the output gap for 2008 to 2013, i.e., the difference between actual and potential Gross Domestic Product accumulated between 2008 and 2013, as a percent of potential Gross Domestic Product, while the Output Gap *(2009-13)* covers the period 2009 to 2013. This measure captures the potential losses in economic activity attributable to the financial crisis in the EU, where a second recession (because of the fiscal-financial doom loop) started in 2011. We can retrieve this series for the 27 European Union countries and for the UK, but not for Norway or Switzerland.

Real GDP Growth (2008:09-2012:06) is the percent growth in real Gross Domestic Product between 2008:09 and 2012:06, while the *CDS Premium Growth (2008:09-2012:06)* is the growth rate in the CDS premium in basis points on the country's five-year maturity sovereign debt between end-of-month 2008:09 and 2012:06.[16]

D. Control Variables

As country-level control variables, we curate the following set. *GDP / Capita 2019* is the Gross Domestic Product per capita in 2019. This variable captures the overall state of the economy just prior to the pandemic.

 # Curative Beds 2007 is the number in curative beds per one thousand population at year-end 2007.[17] We include this variable to capture the state of the public health system just prior

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[16] Recall that on September 15, 2008, Lehman declared bankruptcy and that on July 26, 2012, the President of the European Central Bank, Mario Draghi, delivered his "Whatever it takes" speech. These two dates bracket the most intense period of the financial crisis in Europe. In contrast, in the United States the Dodd–Frank Wall Street Reform and Consumer Protection Act which was enacted in July 2010 (to "promote the financial stability of the United States") marked a definitive end to the financial crisis there.

[17] Total hospital beds are broken down as follows: Curative care (acute care) beds, rehabilitative care beds, long-term care beds (excluding psychiatric care beds), and other hospital beds (Source: Eurostat, Metadata in Euro SDMX Metadata Structure ESMS).

to the financial crisis. In this way, our crisis variables of interest stand for the deterioration in the public health system since then.

The variable *Population Density 2018* measures the population per square kilometer at year-end 2018. This density is expected to play a role in infectious disease transmission.

Tests captures the three-day moving average of the number of COVID-19 tests per one thousand population that were performed prior to reaching the number of cases per one million population surpassing 100 in March 2020 or before. The reason for including this variable is to make sure the number of cases across countries are comparable, in the sense that more intense testing could lead to more cases counted.

The variable *Death Rate 2018* is the death rate per one thousand population in 2018. This is the "normal" death rate in the year prior to the origination year of the pandemic. Including this variable further enhances comparability of the COVID-19 death rate per cases.

Δ Curative Beds 2007-17 is the change in the number of curative beds per one thousand population between 2007 and 2017. This measure narrowly captures the change in curative beds during this period. Controlling for this change ensures that our financial crisis impact variables measure components of the weakening of the public health sector that may have taken place after the financial crisis due to the curtailing of government expenditures on public health, such as the lack in growth in the number and the quality in curative beds, and including the training and compensation of health care workers, the investment in technology and equipment, and the administrative and strategic agility of the public health sector.

Finally, the *% Passengers from China to the Country January 2020* is the percent of airline passengers that are arriving from China to the country in January 2020. This variable controls for the intensity of contacts with China, and therefore the speed and ubiquity of the virus vectoring and spreading into the country.[18]

E. Results

Table 2 then regresses deaths over cases on one of the crisis severity measures and a constant, and depending on the specification a set of control variables. Starting with the six-year output gap in Column (1), the estimated coefficient equals -0.048**,[19] which implies that for an additional minus 20 percentage points (pp) in output gap, which is around two standard deviations, the number of deaths over 100 cases increases by one person.[20] This increase in the death rate by one pp is a sizable effect as the mean death rate was equal to 1.5 percent, and across countries ranges between one and five percent. The financial crisis in countries like Spain, Greece, Lithuania, and Latvia did result in a six-year output gap that was even more negative than that (i.e., minus 26, 44, 24, and 29 pp, respectively).

Next, in Column (2) we add the first control variable, which is per capita GDP,[21] followed in Column (3) by the other control variables.[22] The loading on the output gap remains statistically significant and of a slightly larger size, implying one and a quarter additional

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[18] Another potential control variable is (average) temperature. Because temperatures may vary widely within-country and because the temperature effect on COVID-19-transmission is potentially modest (e.g., Xu, Rahmandad, Gupta, DiGennaro, Ghaffarzadegan, Amini, and Jalali (2021)) and/or modulated by many other factors, including social behavior (e.g., Ganslmeier, Furceri, and Ostry (2021)), we only include it across all specifications in the death-outcome analyses across Spanish provinces and US states where its within-observation-unit dispersion is lower, other factors are more homogenous, and the number of observations we can employ is larger. We find its overall impact to be somewhat varying across analyses. When we do include (in further non-tabulated regressions) the average temperature across the country in January 2020, we find its estimated coefficient to be never statistically significant, while the estimated coefficients on the crisis severity variables of interest to be almost unaffected.

[19] As in the Tables we indicate statistical significance in the text as follows: *** p<0.01, ** p<0.05, * p<0.1.

[20] This is computed as: -20 x -0.048 = 0.96 ≈ one extra *(Deaths / Cases) when (Cases / Population) > 100/1M.*

[21] Taking the natural logarithm of this variable leaves our findings unaffected throughout.

[22] Going from model (2) to (3) we lose two observations because for the UK and Croatia we cannot find the comparable number of curative beds.

deaths (per 100 cases) for an additional minus 20 pp output gap. Despite our judicious curation of controls, none of the estimated coefficients on the controls are statistically significant in Column (3), or across many other models featuring subsets of these variables. The stability of the estimated coefficient on the output gap across all models provides substantive relief about potential biases from omitted variables.

In Column (4) we introduce the second financial crisis measure, which is the five-year output gap between 2009 and 2013. The reason for this shortening of the gap period is that in some countries the financial crisis and the corresponding impact arrived approximately a year later than in other countries. However, the estimated coefficient equals -0.065*** which is very similar to those we estimated for the six-year output gap.

In Columns (5) and (6) we replace # *Curative Beds 2007* and *Δ Curative Beds 2007-17* with the more general variables, *Government Effectiveness 2019* and *Δ Government Effectiveness 2007-19*.[23] The first new variable is defined as capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies as collected by the World Bank in their Worldwide Governance Indicators. The second new variable is the change in *Government Effectiveness* between 2007 and 2019.[24]

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[23] Similarly, in Charron, Lapuente, and Rodríguez-Pose (2022) the total excess deaths across 165 European regions between weeks 1 and 27 in 2020 is explained by local trust and political polarization.

[24] The estimated coefficient on *ΔGovernment Effectiveness 2007-19* in Model 5 equals 2.474*. While it is only marginally statistically significant, its size is not small as for an increase in the change in government effectiveness by two standard deviations there are: 2 x 0.27 x 2.474 = 1.3 extra deaths. The estimated coefficient on *GDP / Capita 2019* in Model 5 implies that for an increase in GDP per capita by two standard deviations there are: 2 x 22.24 x 0.055 = 2.4 extra deaths, though the coefficient for GDP per capita loses significance in other reported specifications. While the inclusion of these two variables leaves the estimated coefficients on the financial severity variables of interest unaffected, the sign of the estimated coefficients is somewhat unexpected.

In Column (7) we include *Real GDP Growth (2008:09-2012:06)* as the financial crisis variable (we have this information also for Norway and Switzerland).[25] The estimated coefficient now equals -0.093*, which implies that for a two standard deviation decrease in growth (which equals minus 13 percent), one-and-a-quarter additional deaths (per hundred cases) occur.

Finally, in Column (8) we feature the crisis variable the *CDS Premium Growth (2008:09-2012:06)*. An increase in this variable captures a deterioration in the solvability of the sovereign, which may correspond to the ability of the sovereign to fund public health, among many other categories of spending. The estimated coefficient equals 0.000127***, which implies that for a two standard deviation increase in premium growth, which equals around 6,500, there is almost one additional death (per 100 cases).[26]

In Appendix Table A.2, Panel A, we assess how big the selection on unobservables would have to be to explain our estimated coefficients (e.g., Altonji et al. (2005); Oster (2019)).[27] Intuitively, the observed variables included in a model are selected because there are good conceptual reasons that suggest that they may influence outcomes in meaningful ways.

One potential explanation is that the positive change in government effectiveness (which is above 0.3 only in Bulgaria, Latvia, and Lithuania for example) effectively stands for the lower level of curative care at impact, and the higher GDP per capita (which is above 75,000 only in Switzerland and Luxembourg for example) captures these rich countries` willingness to introduce softer lockdown measures at impact.

[25] Excluding these two countries does not affect the estimates. In the next two sections we will rely on GDP growth, and not the output gap, as the latter measure is not routinely calculated at the Spanish province and US state level.

[26] As robustness check, we remove the countries with zero deaths in the beginning of the pandemic, i.e., countries where the pandemic arrived later, alters the estimates. We find that this removal does not change the estimates by much.

[27] As a consistency check, to capture the current government capacity to intervene and thus to reduce the number of immediate pandemic deaths, we also add national Public Debt / GDP in 2019 to all specifications reported so far. As expected, this additional variable robs all financial crisis severity variables of their statistical significance, likely because the financial crisis caused a large portion of the so-called third wave of (public) debt (e.g., Kose, Nagle, Ohnsorge, and Sugawara (2021)), motivating our replacement in the subsequent sections of the growth in the CDS premium by provincial and state debt growth.

Therefore, the extent to which varying these observed variables influences the size of the coefficient for an effect (in our case, the coefficient on GFC severity) can be used to approximate the extent to which that coefficient would likely be affected by unobserved variables. Following the implementation recommendations of Oster (2019), we report two important statistics. First, we compute the range between the upper and lower value for the estimated coefficient of interest when positing that unobservable variables either influence the effect to the same degree and in the same direction as the observed variables or that they influence the effect to the same degree and in the opposite direction as the observed variables. Second, we report the additional importance ("δ") needed on the unobservables to "explain away" the result. The larger δ, the more strongly omitted variable concerns are mitigated.

The estimates we obtain in Panel A are comforting: The ranges of the bias-corrected estimates around the actual estimates of interest are narrow, and the calculated δs are typically substantially above one. For example, in Table 2, the model where we had included the full set of controls, Column (3), had yielded a coefficient of -0.065 on the output gap. Table A.2 Panel A shows that in this case the two coefficients obtained under proportional unobservable selection (once in the same direction and once in the opposite direction), are -0.048 and -0.085, respectively. The table also shows that the effect of the GFC output gap could be expected to be zero only if omitted variables were almost four (3.94) times as important for COVID-19 deaths as the included control variables.

Overall, the evidence suggests that the financial crisis may have worsened the initial blow of the pandemic. However, and despite our testing *à la* Oster (2019) of the potential importance of omitted variables in this cross-country analysis yielding reassuring statistics, lingering concerns about country-specific variables that are omitted determining our findings make us turn to a within-country analyses, i.e., of Spain and the US.

II. Within-country Evidence: Spain

A. Motivation

We turn to Spain for multiple reasons. First, following a real-estate boom before 2007, fueled by low interest rates and money from abroad, Spain was hit hard by the financial crisis, with an output gap between 2008 and 2013 of minus 26 percent, and importantly a severe worsening of government public finances, with the ratio of government debt to GDP increasing from 37% in 2007 to 100% in 2014. Hence, the crisis possibly led to a weakening of the public health sector in the ensuing decade.[28]

Second, there are 50 provinces in Spain and substantial autonomy at the regional level when it comes to public finance and spending on public health, among other categories.

Finally, Spain was one of the countries hit hardest by the initial wave of the pandemic. In this respect, we assess the impact at the initial stages, but also after the Spanish national lockdown on March 14 and other public health measures were put in place. If such measures are successful, the flow of the pandemic should become increasingly disconnected from the severity of the financial crisis.

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[28] For example, on March 22nd, 2020, in a prominent article in the newspaper *El Pais*, Boi Ruiz, MD, who was formerly in charge of the Health Department of Cataluña, was quoted as saying: "Not only have public (health) resources not grown at the pace of needs, but they still suffer from the previous economic crisis, as does the whole public sector" (https://elpais.com/espana/catalunya/2020-03-22/la-gestion-de-una-pandemia.html).

B. Dependent Variables: Pandemic Deaths

In our preceding country analysis, we selected as our main dependent country-level variable *(Deaths / Cases) when (Cases / Population) > 100/1M*, which measures the three-day moving average of the number of deaths over the number of cases, in percent, immediately after the number of cases per one million population surpassed 100 in March 2020 or before. For Spain, we assess the role of the financial crisis variables in more detail across different points of the impact curve of the pandemic wave, because now the lockdown was set nationally for all provinces that may be in different stages of the wave build-up. The pandemic also hit Spain much earlier and harder than many countries so far analyzed.

Therefore, we redefine the dependent variable as *(Deaths / Cases) when (Cases / Population) = X/100K*, which measures the three-day moving average of the number of deaths over the number of cases, in percent, immediately after the number of cases per one hundred thousand population equals *X* situated in the range]30,50],]50,70],]70,90], or]90,110]. We also assess the three-day moving average of *(Deaths / Cases) At Peak*, and *On 14.03* which is the national lockdown date in Spain and fifteen days later *On* 28.03 beyond which date the lockdown will have started to alter death rates (given the known infection and disease progression periods of COVID-19). Table 3 defines all variables. Data Appendix Table D.2 provides all observations employed.

C. Financial Crisis Severity Variables

We focus on four main financial crisis severity measures, with the periods of measurement covering the main crisis impact period in Spain, which is occurring between 2009 and 2013.[29] *Provincial Real GDP Growth (2009-2013)* is the percent growth in real provincial Gross Domestic Product between 2009 and 2013. We also feature a similar variable starting one year earlier. We alternate these two GDP growth variables with *Provincial Debt Growth (2008-2013),* which is the percent growth in per-capita nominal provincial debt, and a similar one ending one year earlier.[30]

D. Control Variables

The first control variable, *GDP / Capita 2019*, which is the Gross Domestic Product per capita in the province in 2019, in thousands of Euros, was already motivated in the cross-country analysis.

A key control variable for our purposes here is *# Curative Beds 2018*, which is the number in curative beds per one thousand population at year-end 2018, in percent. This variable captures the capacity of the local hospitals to deal with the pandemic. In a later step we will regress this variable in a first stage on the financial crisis severity measures and then employ the predicted value of this variable to assess if indeed part of the effect of the financial crisis went through the cross-province build-down in the number of beds.

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[29] In the next section, we construct financial crisis severity variables for the period between 2007 and 2009, the main crisis period in the US.

[30] The impact period of debt growth precedes the impact period of GDP growth by one year given the immediacy of the debt growth response (which then may last for a longer period also given further debt buildup). Estimates remain quite similar if we also vary the starting year.

We include four control variables that capture potential differences in the local intensity of the pandemic: *Temperature* is the average yearly temperature in the province, in °Celsius (as temperature may play a role in the spreading of the virus); *Population Density 2020* is the population per square kilometer at year-end 2020 (a higher density speeds transmission);[31] *Population Age 2018* is the average age of the population in the province, in years (older people will die more frequently when contracting the virus);[32] and *Population Exposed to Infection* is the percent of the population that is working in sectors exposed to infection by the virus (branches of activity G-J) including hostelry, shopping, and commerce, in percent (before lockdown transmission occurred more often in these sectors). In sum, lower temperatures, and higher population density, age, and exposure may lead to a stronger impact of the pandemic. Finally, we control for the total size of the *Population* in the province in 2020 as well.

E. Results

In Table 4 in Column (1) we regress *(Deaths / Cases) when (Cases / Population) = X/100K*, with X situated in the range]30,50] on the five-year GDP growth, without controls. The estimated coefficient equals -0.285**. This implies that for a decrease in growth by 5.6 pp, which is two standard deviations, the number of deaths over 100 cases increases by 1.6

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[31] We acknowledge this measure is not perfectly pre-determined to the pandemic outbreak in March 2020, but we conjecture that the still relatively low number of deaths the pandemic caused leaves the cross-province variation in density mostly unaltered.

[32] We could not obtain this variable for the Spanish provinces in 2019, in contrast to the next section for the US states where this variable is available in that year. Population age, exposure and totals should capture similar variation as the number of tests and past death rate in the cross-country analysis. In general, our control variable selection across countries, provinces and states is partly constrained by data availability. But given the overall lack of significance of the estimated coefficients on control variables and given how big the selection on unobservables would have to be to explain our estimated coefficients, we think these constraints do not undermine the reliability of our analysis.

persons. This is a very similar, though slightly higher impact compared to what we estimated across countries.

In Columns (2) to (7), we then assess the results along the impact curve,[33] and at peak, March 14 and 28. The estimate ranges between -0.334*** and -0.082, implying between 1.9 and 0.5 extra deaths. The latter smaller and insignificant impact occurs on March 28 when the national lockdown had been in place for fifteen days, which indicates that this lockdown may have started to alter the trajectory of the pandemic.[34] But the impact is imprecisely estimated and for the debt-based severity measures discussed below we estimate similarly sized impacts across all studied brackets and days.

In Columns (8) to (14) we add in all control variables across all so far reported brackets and dates and find that the estimated coefficients are mostly unaffected, though at times somewhat less significant. The estimated coefficients on the control variables are hardly ever significant, except for temperature in some specifications. A temperature that is higher by five extra degrees (which is two standard deviations) decreases the number of deaths by over five persons per 100 cases. This is a large impact, broadly in line with the large impact of

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[33] To make estimates comparable along the entire curve, only the 38 provinces which have a COVID-19 measure for all brackets are included in the threshold specifications (1) to (4). Estimates are similar if we also retain those provinces that appear in a few brackets. For Peak measurement, we include those provinces that peak before or in May, as afterwards the impact of the many public health policies and confounding events surely set in. For the March 14 and 28 measurement dates, and for the (more demanding) two-stage estimation in Section F, we use the maximum number of provinces available. When employing restricted samples, the results are often correspondingly weaker.

[34] We surmise that the imprecision of the estimates is because the impact of lower GDP growth on the number of curative beds and immediate deaths is somewhat indirect, and arguably less direct than the impact of the deterioration in governmental finances assessed in Table 5. We will observe this difference in precision also in Table 6.

temperature on the number of cases documented across countries and across the US (e.g., Ganslmeier et al. (2021), Ghirelli, González-Piñero, Herrera, and Hurtado (2021)).[35]

In Table 5 we turn to the growth in provincial debt over six- and five-year periods, respectively, as an alternative measure for the severity of the financial crisis. We now at once include controls (without controls estimates are similar). The estimates range between 0.015** and 0.007, implying that a doubling of provincial debt (which is shy of two standard deviations in growth of debt) results in up to three additional deaths (over 100 cases). Once more these estimates are comparable in size to those found for the other financial crisis severity measures.

In Appendix Table A.2, Panel B, we again assess how big the selection on unobservables would have to be to explain our estimated coefficients. Again, the results obtained following Oster (2019) are comforting, as the estimates on the coefficients of interest obtained with proportional selection on unobservables form a narrow range around the actual estimates, and the calculated δs that lead to a zero effect of the GFC on COVID-19 deaths are far above one.

F. Potential Channel: Reduction in Public Health Spending

In the final part of our analysis on Spain we want to shed some light on a potential channel through which the financial crisis may have affected the pandemic outcomes. What we have foremost in mind is that slowing or reductions in public health care spending on curative beds causes hospitals to have a limited ability to care for the COVID-19 infected patients.[36]

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[35] In Appendix Table A.1, we replicate the entire analysis for the *six*-year real GDP growth between 2008 and 2013. We focus our reporting on the core impact brackets between 50 and 90 cases per 100,000 people. Estimates for this financial crisis severity measure are similar, though somewhat less precisely estimated.

[36] In a different setting, but similar in objective, Hasan, Liu, Saunders, and Zhang (2022) for example conduct a two-stage assessment on how deposit insurance affects bank deposits and thereby lending during the crisis.

To investigate this channel, in Table 6 in a first stage we regress the number of curative beds in 2018 in the province on financial crisis measures. We then use the explained part of this number to explain pandemic deaths over cases.[37]

The first stage estimate equals 0.026 for real GDP growth and -0.002*** for debt growth, implying that for a decrease in growth by 5.6 pp, which is two standard deviations, the number of curative beds in 2018 per one thousand population at year-end 2018 drops by 0.15 (or 5 percent of the mean), and for a doubling of provincial debt (which is shy of two standard deviations in growth of debt) the number of curative beds drops by 0.4 (or 12 percent of the mean).

The second stage estimates of the coefficients on the predicted part of # *Curative Beds 2018* with GDP as predictor are imprecisely estimated (and vary between 0.082 and -6.042), while for debt as predictor the estimates vary between -3.691* and -8.975***. The latter estimates imply that the drop in beds by 0.4 explained by a doubling in provincial debt results in 1.5 to 3.6 extra deaths (per 100 cases), so possibly a substantial portion of the extra deaths that we documented in the previous section.

III. Within-country Evidence: USA

A. Motivation

Finally, we turn to the US, for multiple reasons. First, the US was ground zero for the Global Financial Crisis, with losses in subprime bank lending, the Lehman bankruptcy, and house

[37] Reverse causality does not strike us as a major challenge, as it seems unlikely that death rates in 2020 influence the number of curative beds in 2018 across Spanish provinces, even in expectation. Very few people worried about an upcoming pandemic (except for public health officials, or philanthropists with a public health interest like Bill Gates) and even those that did could not foresee its eventual timing, spreading and path.

price and stock market drops as defining elements. US households lost almost 10 trillion US Dollars in wealth. Importantly, there was also a severe worsening of government public finances, with the ratio of US government debt to GDP increasing from 63% at year-end 2007 to 92% at year-end 2010. Hence, the crisis also led in the US to a weakening of the public health sector in the ensuing decade.

Second, there are 50 states in the US and once again substantial autonomy at the state level when it comes to public finance and spending on public health, among other categories.

Finally, despite having observed for weeks how the pandemic had shuttered first Italy then the rest of Europe, and despite its January 31 ban on travel from China by foreign nationals, the US seemed ill-prepared,[38] and parts of its government were almost in denial when the pandemic wave crashed on its shores. In this respect, assessing the impact of the initial stages in the US is still meaningful, as federal and state public health measures were put in place late.

B. Dependent Variables: Pandemic Deaths

For the US too, we want to assess the performance of the explanatory variables carefully across different points of the impact curve of the pandemic wave, at peak after the number of cases per one hundred thousand population surpassed one hundred, and on March 13 when Trump declared a national emergency under the Stafford Act and fifteen days later on March 27. Table 7 defines all variables. Data Appendix Table D.3 provides all observations employed.

[38] Alfonso, Leider, Resnick, McCullough, and Bishai (2021) document that state level spending on public health had been flat or declining, leaving states ill-prepared for the pandemic.

C. Financial Crisis Severity Variables

We focus on five main financial crisis severity measures, with the periods of measurement covering the main crisis impact period in the US. *State Real GDP Growth (2007-2009)* is the percent growth in real state Gross Domestic Product between 2007 and 2009. We also feature a similar variable starting one year later. We alternate these two GDP growth variables with three *State Debt Growth* variables, covering *2007-2011, 2007-2012* and *2007-2013*, respectively, and which is defined as the percent growth in per-capita nominal state debt during the respective period.

D. Control Variables

As control variables, we feature *GDP / Capita 2019* and # *Curative Beds 2018*, which are defined and motivated as in the analysis for Spain.

We further include five control variables that capture potential differences in the local intensity of the pandemic with rationales like those already included in the analysis for Spain: *Temperature*,[39] *Population Density 2019*, *Population Age 2019*, *Population Obesity 2019*,[40] and *Population Tested*. In sum, lower temperatures, and higher population density, age, obesity, and testing may lead to a stronger impact recognition of the pandemic shock hitting.[41]

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[39] Equals the logarithm of the average yearly temperature in the state, in °Fahrenheit. Featuring this variable in levels leaves estimates unaffected.

[40] Equals the percent of the population that is obese as obesity is a major COVID-19 risk factor and may exacerbate outcomes (e.g., Yang (2022)).

[41] We have also controlled for 1918 influenza mortality rates across states. Such data are available for about half of the states. Un-tabulated results indicate that the impact of this variable on COVID-19 death outcomes seems insignificant, while leaving our main findings unaffected.

E. Results

In Table 8 in Column (1) we regress *(Deaths / Cases) when (Cases / Population) = X/100K*, with *X* situated in the range]30,50] on the three-year GDP growth, immediately with all controls.[42] The estimated coefficient equals -0.124***. This implies that for a decrease in growth by 9.2 pp, which is two standard deviations, the number of deaths over 100 cases increases by 1.1 persons. This is a very similar compared to what we estimated across European countries and within-Spain.

In Columns (2) to (7), we then assess the results along the impact curve, when peaking after breaching 100, and on March 13 and 27. The statistically significant estimates range between -0.128** and -0.081*, implying between 1.1 and 0.7 extra deaths. The latter smaller yet still statistically significant impact occurs on March 27 when the national lockdown had been in place for fifteen days,[43] which indicates that this lockdown altered the trajectory of the pandemic also in the US.

In Columns (8) to (14) we replicate the entire analysis for the two-year real GDP growth between 2008 and 2009. Estimates for this financial crisis severity measure are similar, though somewhat less significant.

In Table 9 we turn to the growth in state debt over a seven-year period from 2007 to 2013 as our measure for the severity of the financial crisis.[44] We now again at once include controls (without controls estimates are similar). The estimates for the impact brackets vary between

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[42] Removing some or all controls leave all estimates of interest mostly unaffected. The coefficients on the controls are hardly ever significant.
[43] On March 13 the estimate is positive but insignificant. Presumably this date is too early for the impact to be felt at the state level with the pandemic moving "east to west" and peaking in immediate deaths after that date.
[44] In Appendix Table A.3, we check for one- and two-year shorter time periods to account for different state debt issue speed and procedures. The results prove robust.

0.027* and 0.020 (with again the March dates having somewhat disparate results), implying that an increase in state debt of 40 percent (which is around two standard deviations) results in more than one additional death (over 100 cases). Once more these estimates are comparable in size to those found for the other financial crisis severity measures, across states, and across countries and Spanish provinces.

In Appendix Table A.2, Panel C, we assess how big the selection on unobservables would have to be to explain our estimated coefficients for the US (e.g., Altonji et al. (2005); Oster (2019)). Also, in this case the estimates are comforting, as the range around the actual estimates of interest is narrow, and the calculated δ multiples of one.

F. Potential Channel: Reduction in Public Health Spending

In the final part of our analysis on the US, we want to check once more the potential channel through which the financial crisis may have affected the pandemic outcomes, which was shown to be operational in Spain, where the slowing or reductions in public health care spending on curative beds was causing the hospitals to have a limited ability to care for the COVID-19 infected patients.

As in Table 6 in a first stage we regress the number of curative beds in 2018 in the state on financial crisis measures, then use the explained part of this number to explain pandemic deaths over cases. However, although the relevant estimates are economically meaningful, in no cases are the coefficients of interest statistically significant.

Next, we replace the number of curative beds with the number of (general) hospital beds (in 2019). The latter number of beds may be more meaningful (in the US) and binding for a part of the population that lives in remote areas and/or without health insurance.[45]

Now in Table 10 the first stage estimate on GDP growth equals 0.673** and on debt growth -0.082*, implying that a two-standard deviation "deterioration" in either one reduces the number of hospital beds (per one thousand people) by between six and three hospital beds,[46] respectively, which is between almost one full and a half standard deviation of the number of hospital beds.

The second stage estimates of the coefficients on the predicted part of *# Hospital Beds 2019* with GDP vary between 0.001 and -0.002***, while for debt as predictor the estimates vary between 0.000 and -0.003*. These estimates imply that for a drop in beds by six explained by GDP up to 1.25 extra deaths (per 100 cases) may occur, while for the drop in beds by three explained by debt almost one extra death results, so possibly once again a substantial portion of the extra deaths that we documented before.

IV. Conclusion

Financial crises tend to produce economic hysteresis, with output permanently wandering away from previous output trend (Jordà, Schularick, and Taylor (2011)). This has widespread negative implications for an economy, with lower public investment in a wide range of

[45] In general, across developed countries, rural regions field far fewer hospital beds than metropolitan areas (and their adjacent regions), and this gap has grown significantly since 2000 (OECD (2021)). There are also relevant differences between private and public hospital beds, and their relative proportions vary by state (Jovanovska (2021)). This supply of private beds makes GDP growth possibly a more salient explanatory factor for beds in the US than in Spain.

[46] $2 \times -4.61 \times 0.673 = -6.21$ hospital beds; and $2 \times 18.74 \times -0.082 = -3.07$ hospital beds.

sectors, such as research and development (e.g., Abbritti and Weber (2019)), education, and health, among others. In the context of an unexpected pandemic, the initial health response has proven to be the key to the fight against the coronavirus pandemic. However, this response depends crucially on the initial health capacity of different countries, provinces, and states. In this respect, this study empirically shows that the 2008 financial crisis loomed large during the initial 2020 coronavirus shock, as the EU countries, Spanish provinces and US states that were more affected economically and financially by the 2008 crisis experienced significantly more immediate life losses relative to the number of cases.

Both the Spanish and US cases reveal that the provinces or states that lost significantly more output or saw their debt levels increase more in the aftermath of the 2008 crisis, experienced a more significant shortage of curative or hospital beds and, in turn, a higher ratio of deaths per case during the initial COVID outbreak.

While a full-fledged cost-benefit analysis of maintaining hospital capacity versus various lockdown responses is undoubtedly well beyond the scope of this focused analysis (see, e.g., Cutler and Summers (2020); Allen (2022); Lewis (2022)), it is interesting to consider the following back-of-the-envelope calculations, conducted for the US case as an illustration.

We find that the drop in the number of hospital beds dropping by five (per one thousand people) following the financial crisis,[47] resulted in around five extra deaths (per one thousand cases).[48] The US Federal Emergency Management Agency (FEMA) places the value of

[47] We define the financial crisis at the state level to be a two-standard deviation deterioration in growth and/or accumulation in debt. This shock involved a build-down of between three to six hospital beds in 2019 (Table 10, first stage), which we round to five beds for expositional purposes.

[48] The estimated coefficients in Table 10 equal between -0.001** and -0.003*, imply that for five extra hospital beds in 2019, deaths per cases drops by between 0.005 and 0.015, which for 1,000 cases equals 0.5 and 1.5 fewer deaths, which we round to one fewer death (per one thousand cases) for expositional purposes.

statistical life (per person) at USD 7,500,000. Hence, without any lockdown and a swift 100 percent infection rate (making the number of cases equal to the number of people), the resultant value of extra human lives lost would have been five extra deaths times USD 7,500,000 which equals USD 37.5 million (per one thousand cases, which without lockdown equals people). Other costs, in particular Long-COVID costs, were not incorporated into this calculation. We can call this the "*no idle beds / no lockdown*" option (see Table 11).

We now consider the following two policy options. The first is the "Idling beds" option in Table 5. This option involves having five idle beds (per thousand people) in place from the financial crisis in 2009 onwards. Idling five beds at USD 100,000 per year would have cost USD 5.5 million (which is five beds times USD 100,000 times eleven years).[49] Of course, it is ex ante unclear how long idle beds would be needed until a pandemic arrives. We also neglect discounting (i.e., the time value of money) here.

The second option is to implement a lockdown, that is assumed to last one year. The cost of a year of lockdown in the US was calculated to be approximately USD 2.5 million (per one thousand people).[50] Posit first (arguably heroically) that with such a lockdown the infection rate can be lowered sufficiently so that no extra deaths occur (as no extra beds are needed). We label this Lockdown Scenario A in Table 11. In this scenario, no extra human costs occur

[49] The idling cost for one bed, based on contingent valuation, equals around USD 250 / day or USD 100,000 / year in Australia (Page, Barnett, and Graves (2017)). To put this in perspective, the cost for an inpatient day at a hospital in the US in 2019 was calculated to be around ten times more, i.e., USD 2,500 / day or USD 1 million / year (*Source*: Frédéric Michas, on January 17, 2022, on *de.Statista.com*).

[50] The costs of lock-down in the US were calculated to equal USD 65.3 billion / month (Zhang, You, Zhang, Chen, Hu, Liu, Liu, Yuan, and Tan (2022)), which for 331.9 million people in 2021 equals USD 197 / person-month or USD 2,360,952 / 1,000 persons-year. In this context it is maybe interesting to note that the total US bank bailout cost in, e.g., Lucas (2019), is calculated to equal USD 498 billion, which for 305 million people in 2009 in the US equals USD 1,632,786 / 1,000 people.

(although the lockdown-driven health consequences, or consequences for the long-term development of children, for example, are not considered here).

As an alternative, consider Scenario B in Table 11: A lockdown with a non-zero infection rate high enough to require one extra bed. This scenario would result in one extra death and a total cost of USD 10 million (= USD 2.5 million plus one time USD 7.5 million). Two missing beds would result in two extra deaths and a total cost of USD 17.5 million (= USD 2.5 million plus two times USD 7.5 million; Scenario C in Table 11).[51] In terms of break-even, notice that already with 0.4 beds needed (but not present) due to non-zero infections, resulting in 0.4 extra deaths, the cost would equal USD 5.5 million (= USD 2.5 million plus 0.4 time USD 7.5 million), which is equal to the cost of idling five beds since the end of the financial crisis in 2009.

Overall, these back-of-the-envelope calculations may suggest the importance of maintaining a certain level of public investment in health facilities and personnel during recessions to hedge against potentially disruptive disease sprouts.

[51] Three missing beds would result in three extra deaths and a total cost of USD 25 million (= USD 2.5 million plus three times USD 7.5 million); four missing beds would result in four extra deaths and a total cost of USD 32.5 million (= USD 2.5 million plus four times USD 7.5 million); five missing beds would result in five extra deaths and a total cost of USD 40 million (= USD 2.5 million plus five times USD 7.5 million).

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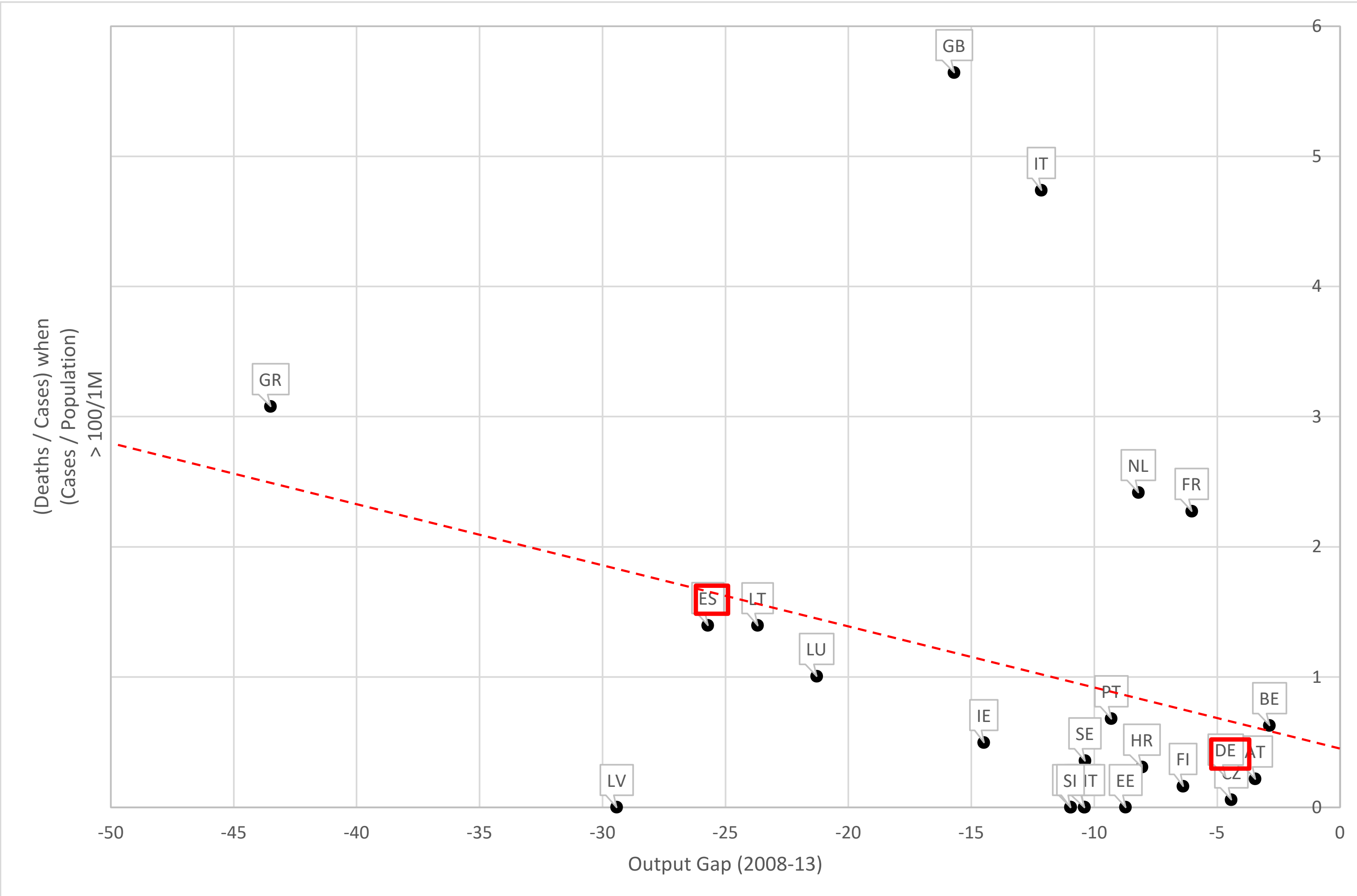
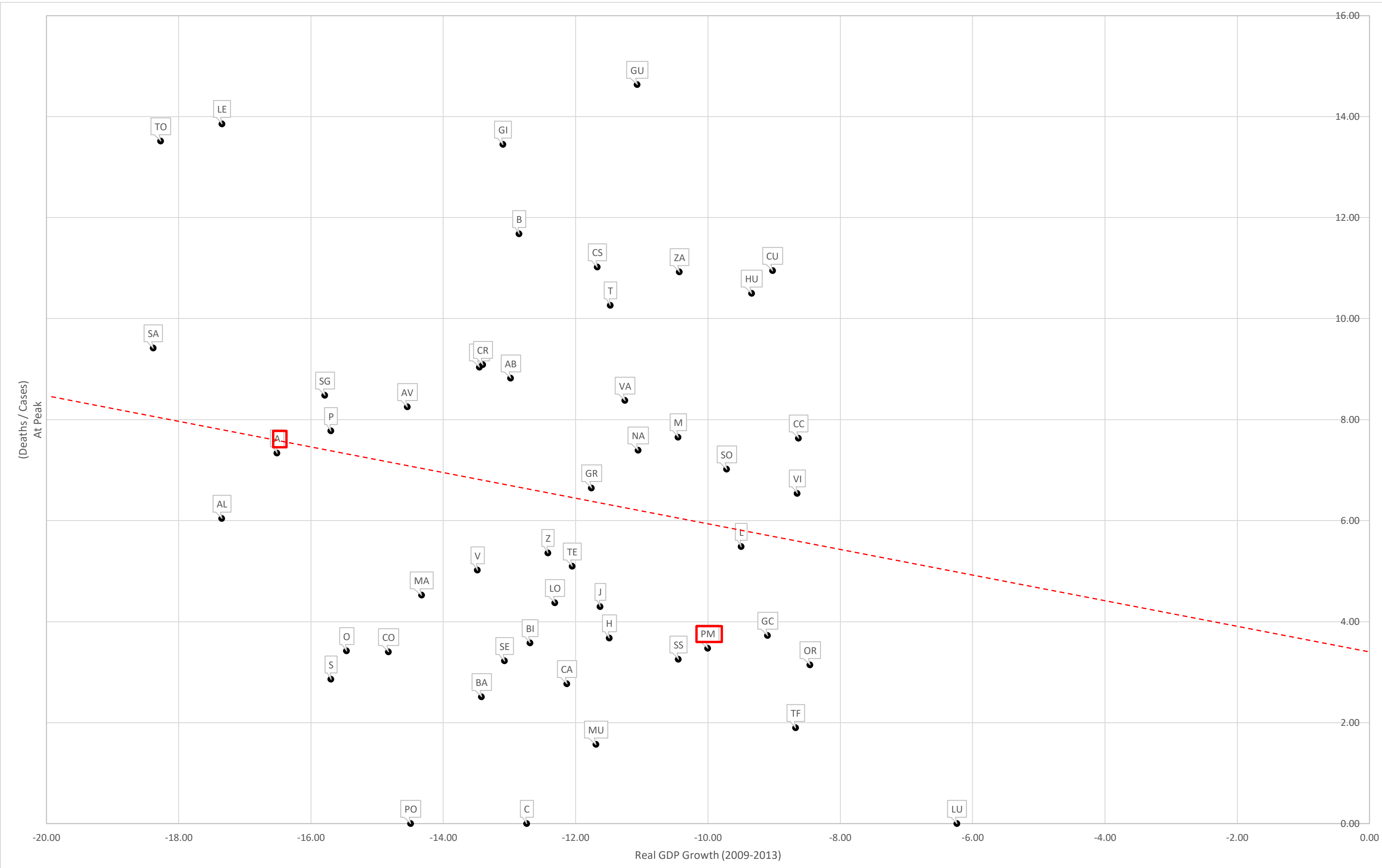


Code	Country Name
AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romania
SE	Sweden
SI	Slovenia
SK	Slovakia

Figure 1. Financial Crisis Severity and COVID-19 Death Rate: European Countries

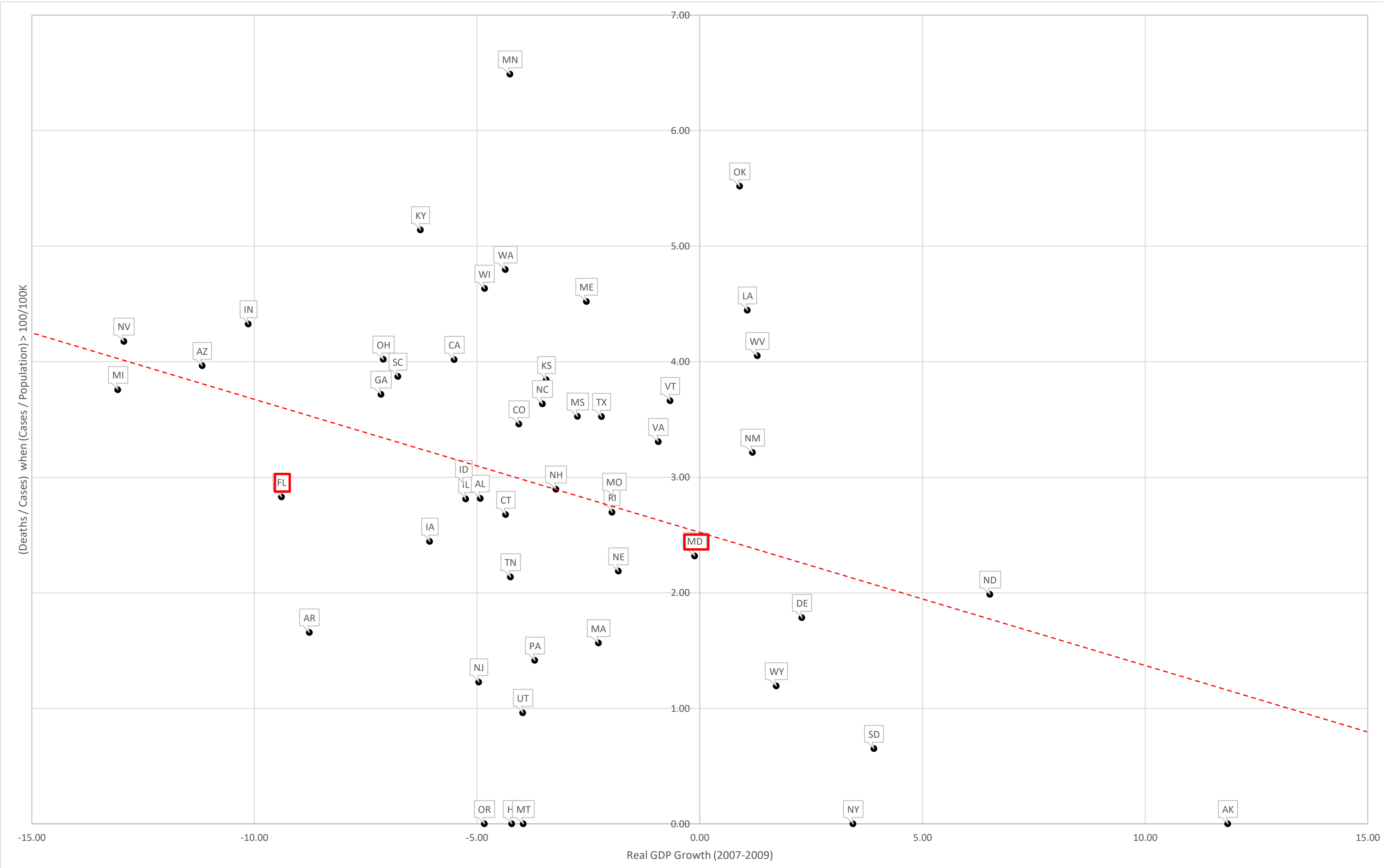
Notes. The figure plots the output gap accumulated between 2008 and 2013 and the number of deaths over the number of cases, in percent, immediately after the number of cases per million of population surpassed 100 in the country. When the death rate is not available, it is set equal to zero in the graph. The two-letter country codes (ISO 3166-1 alpha-2) are explained in the two columns adjacent to the figure. Spain and Germany are encircled in red as these countries are mentioned in the text as being two standard deviations, i.e., around twenty percentage points, in outgap gap apart. The estimated regression (for available death rates) equals: Y = 0.62 - 0.06 X.



Code	Province Name
A	Alicante
AB	Albacete
AL	Almería
AV	Ávila
B	Barcelona
BA	Badajoz
BI	Bizkaia
BU	Burgos
C	La Coruña
CA	Cádiz
CC	Cáceres
CO	Córdoba
CR	Ciudad Real
CS	Castellón
CU	Cuenca
GC	Las Palmas
GI	Girona
GR	Granada
GU	Guadalajara
H	Huelva
HU	Huesca
J	Jaén
L	Lleida
LE	León
LO	La Rioja
LU	Lugo
M	Madrid
MA	Málaga
MU	Murcia
NA	Navarra
O	Asturias
OR	Ourense
P	Palencia
PM	Baleares
PO	Pontevedra
S	Cantabria
SA	Salamanca
SE	Sevilla
SG	Segovia
SO	Soria
SS	Gipuzkoa
T	Tarragona
TE	Teruel
TF	Santa Cruz de Tenerife
TO	Toledo
V	Valencia
VA	Valladolid
VI	Álava
Z	Zaragoza
ZA	Zamora

Figure 2. Financial Crisis Severity and COVID-19 Death Rate: Spanish Provinces

Notes. The figure plots real GDP growth between 2009 and 2013 and the number of deaths per cases, in percent, in the province at peak. When the death rate is not available, it is set equal to zero in the graph. The one or two-letter province codes are explained in the two columns adjacent to the figure. Alicante and the Baleares are encircled in red as these provinces are mentioned in the text as being two standard deviations, i.e., around two percent, in real GDP growth per year apart. The estimated regression (for available death rates) equals: Y = 3.75 - 0.25 X.



Code	Province Name
AK	Alaska
AL	Alabama
AR	Arkansas
AZ	Arizona
CA	California
CO	Colorado
CT	Connecticut
DE	Delaware
FL	Florida
GA	Georgia
HI	Hawaii
IA	Iowa
ID	Idaho
IL	Illinois
IN	Indiana
KS	Kansas
KY	Kentucky
LA	Louisiana
MA	Massachusetts
MD	Maryland
ME	Maine
MI	Michigan
MN	Minnesota
MO	Missouri
MS	Mississippi
MT	Montana
NC	North Carolina
ND	North Dakota
NE	Nebraska
NH	New Hampshire
NJ	New Jersey
NM	New Mexico
NV	Nevada
NY	New York
OH	Ohio
OK	Oklahoma
OR	Oregon
PA	Pennsylvania
RI	Rhode Island
SC	South Carolina
SD	South Dakota
TN	Tennessee
TX	Texas
UT	Utah
VA	Virginia
VT	Vermont
WA	Washington
WI	Wisconsin
WV	West Virginia
WY	Wyoming

Figure 3. Financial Crisis Severity and COVID-19 Death Rate: US States

Notes. The figure plots real GDP growth between 2007 and 2009 and the number of deaths per cases in percent when the number of cases over the population are higher than hundred per hundred thousand of population in the state. When the death rate is not available, it is set equal to zero in the graph. The two-letter state codes are explained in the two columns adjacent to the figure. Florida and Maryland are encircled in red as these states are mentioned in the text as being two standard deviations, i.e., around two percent, in real GDP growth per year apart. The estimated regression (for available death rates) equals: Y = 2.88 - 0.08 X.

Table 1. Variable Names and Definitions and Data Sources for Cross-Country Regressions

Variable Name	Units	Variable Definition	Data Source
Dependent Variable: Pandemic Deaths			
(Deaths / Cases) when (Cases / Population) > 100/1M	%	The three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one million population surpassed 100 in March 2020 or before	OWID
Financial Crisis Severity Variables			
Real GDP Growth (2008:09-2012:06)	%	The percent growth in real Gross Domestic Product between 2008:09 and 2012:06	AMECO
Output Gap (2008-13)	%	The output gap for 2008 to 2013, i.e., the difference between actual and potential Gross Domestic Product accumulated between 2008 and 2013, as a percent of potential Gross Domestic Product	AMECO
Output Gap (2009-13)	%	The output gap for 2009 to 2013, i.e., the difference between actual and potential Gross Domestic Product accumulated between 2009 and 2013, as a percent of potential Gross Domestic Product	AMECO
CDS Premium Growth (2008:09-2012:06)	%	The growth rate in the CDS premium in basis points on the country`s five-year maturity sovereign debt between end-of-month 2008:09 and 2012:06	Refinitiv
Control Variables			
GDP / Capita 2019	000 Euros	Gross Domestic Product per capita in 2019	ECB-SDW
# Curative Beds 2007	‰	The number in curative beds per one thousand population at year-end 2007	Eurostat
Population Density 2018	-	The population per square kilometer at year-end 2018	Eurostat
# Tests	-	The three-day moving average of the number of COVID-19 tests per one thousand population that were performed prior to reaching the number of cases per one million population surpassing 100 in March 2020 or before	OWID
Death Rate 2018	‰	The death rate per one thousand population in 2018	Eurostat
Δ Curative Beds 2007-17	‰	The change in the number of curative beds per one thousand population between 2007 and 2017	Eurostat
% Passengers from China to the Country January 2020	%	The percent of airline passengers that are arriving from China to the country in January 2020	Eurostat
Government Effectiveness 2019	-2.5 to + 2.5	Captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility	WB
Δ Government Effectiveness 2007-19	-	The change in Government Effectiveness between 2007 and 2019	WB

Notes. The table provides the variable names, definitions and data sources for the cross-country regressions. AMECO = the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs; ECB-SDW = European Central Bank - Statistical Data Warehouse; Eurostat = the statistical office of the European Union; IATA = International Air Transport Association; OWID = https://ourworldindata.org/coronavirus-source-data; Refinitiv = https://www.refinitiv.com/; WB = Worldbank Worldwide Governance Indicators.

Table 2. Cross-Country Regression Estimates of Pandemic Mortality Rate on Financial Crisis Severity Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Samples	European Union Countries (EU)						EU+ CH+NO	EU
Dependent Variable	*(Deaths / Cases) when (Cases / Population) > 100/1M*							
Output Gap (2008-13)	-0.048**	-0.048**	-0.065***		-0.067**			
	(0.020)	(0.021)	(0.021)		(0.030)			
Output Gap (2009-13)				-0.057**		-0.058**		
				(0.025)		(0.026)		
Real GDP Growth (2008:09-2012:06)							-0.093*	
							(0.050)	
CDS Premium Growth (2008:09-2012:06)								0.000127***
								(0.000)
GDP / Capita 2019		0.002	0.019	0.025	0.055*	0.062*	0.023	0.005
		(0.009)	(0.017)	(0.018)	(0.031)	(0.030)	(0.015)	(0.022)
# Curative Beds 2007			-0.106	-0.156			-0.161	-0.264
			(0.303)	(0.306)			(0.264)	(0.245)
Population Density 2018			0.000	0.000	0.002*	0.002*	0.001	0.001
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# Tests			-0.280	-0.291	-0.683**	-0.715**	-0.207	-0.699
			(0.218)	(0.227)	(0.280)	(0.277)	(0.198)	(0.387)
Death Rate 2018			0.173	0.211	-0.041	-0.033	0.181	0.366
			(0.156)	(0.157)	(0.116)	(0.116)	(0.150)	(0.238)
Δ Curative Beds 2007-17			0.588	0.599			0.508	0.436
			(0.588)	(0.596)			(0.495)	(0.567)
% Passengers from China to the Country January 2020			0.377	0.322	0.650	0.601	0.217	0.244
			(0.383)	(0.403)	(0.379)	(0.390)	(0.332)	(0.312)
Government Effectiveness 2019					-1.558	-1.631		
					(1.117)	(1.099)		
Δ Government Effectiveness 2007-19					2.474*	2.620*		
					(1.293)	(1.261)		
Observations	23	23	21	21	23	23	23	19
Adjusted R-squared	0.0457	-0.00123	-0.162	-0.186	0.0157	-0.0269	-0.168	-0.0429

Notes. The table reports cross-country regression estimates of the pandemic mortality rate on financial crisis severity measures. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one million population surpassed 100 in March 2020 or before. The other variables are defined in Table 1. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 3. Variable Names and Definitions and Data Sources for Spanish Province Regressions

Variable Name	Units	Variable Definition	Data Source
Dependent Variables: Pandemic Deaths			
(Deaths / Cases) when (Cases / Population) = X/100K	%	The three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population equals X	E19d
(Deaths / Cases) when (Cases / Population) At Peak	%	The three-day moving average of the number of deaths over the number of cases immediately after the number of new cases peaks before May 2020	E19d
(Deaths / Cases) on 14.03 (or 28.03)	%	The three-day moving average of the number of deaths over the number of cases on March 14 (or 28)	E19d
Financial Crisis Severity Variables			
Provincial Real GDP Growth (2009-2013)	%	The percent growth in real provincial Gross Domestic Product between 2009 and 2013	INE
Provincial Real GDP Growth (2008-2013)	%	The percent growth in real provincial Gross Domestic Product between 2008 and 2013	INE
Provincial Debt Growth (2008-2013)	%	The percent growth in per-capita nominal provincial debt between 2008 and 2013	DME
Provincial Debt Growth (2008-2012)	%	The percent growth in per-capita nominal provincial debt between 2008 and 2012	DME
Control Variables			
GDP / Capita 2019	000 Euros	Gross Domestic Product per capita in the province in 2019	INE
# Curative Beds 2018	‰	The number in curative beds per one thousand population at year-end 2018	MdS
Temperature	°Celsius	The average yearly temperature in the province	INE
Population Density 2020	-	The population per square kilometer at year-end 2020	W-INE
Population Age 2018	Years	The average age of the population in the province	INE
Population Exposed to Infection	%	The percent of the population that is working in sectors exposed to infection by the virus (branches of activity G-J) including hostelry, shopping-commerce	INE
Population	-	The total size of the population in the province in 2020	INE

Notes. The table provides the variable names, definitions and data sources for the Spanish province regressions. DME is the Datos Macro Expansión; E19d is the Escovid19data dataset which can be found in the following repository: https://github.com/montera34/escovid19data; INE is the Instituto Nacional de Estadística / National Bureau of Statistics; MdS is the Ministerio de Sanidad (España) / Health Ministry of Spain; W-INE is Wikipedia but based on the Instituto Nacional de Estadística / National Bureau of Statistics.

Table 4. Spanish Province Regression Estimates of Pandemic Mortality Rate on Provincial Real GDP Growth (2009-2013)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Dependent Variable	*(Deaths / Cases)*													
	When (Cases / Population) = X /100K					*On 14.03*	*On 28.03*	*When (Cases / Population) = X /100K*					*On 14.03*	*On 28.03*
X =	*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*At Peak*			*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*At Peak*		
Provincial Real GDP Growth (2009-2013)	-0.285**	-0.334***	-0.258**	-0.191*	-0.349*	-0.086	-0.082	-0.283*	-0.321**	-0.263*	-0.211	-0.260	-0.096	0.026
	(0.140)	(0.095)	(0.105)	(0.106)	(0.183)	(0.222)	(0.229)	(0.156)	(0.117)	(0.139)	(0.136)	(0.190)	(0.241)	(0.248)
GDP / Capita 2019								-0.131	-0.075	0.009	0.029	-0.042	-0.086	-0.047
								(0.077)	(0.062)	(0.086)	(0.082)	(0.099)	(0.074)	(0.090)
# Curative Beds 2018								-0.100	-0.096	0.166	0.570	0.419	-0.188	-1.561
								(0.917)	(0.855)	(0.805)	(1.007)	(1.259)	(1.043)	(1.742)
Temperature								-0.197	-0.210	0.075	0.236	-1.095**	-0.267	-1.614***
								(0.393)	(0.315)	(0.320)	(0.323)	(0.407)	(0.332)	(0.583)
Population Density 2020								0.002	0.000	-0.003	-0.006**	-0.004	0.005	-0.001
								(0.003)	(0.002)	(0.003)	(0.002)	(0.004)	(0.004)	(0.003)
Population Age 2018								-0.031	-0.010	0.040	-0.044	-0.370	0.137	-0.276
								(0.210)	(0.175)	(0.253)	(0.263)	(0.327)	(0.252)	(0.305)
Population Exposed to Infection								0.057	0.048	0.027	0.005	0.188	0.028	0.408*
								(0.123)	(0.098)	(0.118)	(0.108)	(0.143)	(0.134)	(0.234)
Population								0.000	0.000	0.000	0.000*	0.000	0.000	0.000
								(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	38	38	38	38	44	45	47	38	38	38	38	44	45	47
Adjusted R-squared	0.0756	0.183	0.0825	0.0317	0.0484	-0.0173	-0.0190	0.00236	0.0782	-0.112	-0.0826	0.189	0.00401	0.208

Notes. The table reports Spanish province regression estimates of the pandemic mortality rate on provincial real GDP growth between 2009 and 2013. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, at peak within March or April 2020 , or on March 14 or 28, respectively. Only provinces which have a covid measure for all brackets are included in the threshold specifications. All independent variables are defined in Table 3. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Spanish Province Regression Estimates of Pandemic Mortality Rate on Provincial Debt Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable	*(Deaths / Cases)*									
	When (Cases / Population) > X /100K			*On 14.03*	*On 28.03*	*When (Cases / Population) > X /100K*			*On 14.03*	*On 28.03*
X =	*]50,70]*	*]70,90]*	*At Peak*			*]50,70]*	*]70,90]*	*At Peak*		
Provincial Debt Growth (2008-2013)	0.007*	0.007	0.008*	0.009*	0.015**					
	(0.003)	(0.004)	(0.004)	(0.005)	(0.007)					
Provincial Debt Growth (2008-2012)						0.007***	0.007*	0.008*	0.009*	0.011*
						(0.003)	(0.004)	(0.004)	(0.005)	(0.006)
GDP / Capita 2019	-0.132*	-0.046	-0.050	-0.090	-0.053	-0.138**	-0.046	-0.042	-0.075	-0.030
	(0.066)	(0.092)	(0.088)	(0.080)	(0.086)	(0.065)	(0.090)	(0.088)	(0.078)	(0.087)
# Curative Beds 2018	-0.427	-0.052	0.690	0.817	0.093	-0.516	-0.168	0.644	0.487	-0.716
	(0.848)	(0.797)	(1.242)	(1.057)	(0.865)	(0.854)	(0.797)	(1.221)	(1.006)	(1.358)
Temperature	-0.419	-0.106	-1.081***	-0.065	-1.257***	-0.439	-0.118	-1.062***	-0.122	-1.421***
	(0.354)	(0.332)	(0.357)	(0.347)	(0.360)	(0.342)	(0.327)	(0.350)	(0.349)	(0.481)
Population Density 2020	-0.000	-0.003	-0.005	0.004	-0.002	-0.001	-0.003	-0.006*	0.003	-0.002
	(0.002)	(0.002)	(0.003)	(0.005)	(0.003)	(0.002)	(0.002)	(0.003)	(0.005)	(0.003)
Population Age 2018	-0.036	0.016	-0.290	0.172	-0.193	-0.062	-0.006	-0.296	0.177	-0.221
	(0.189)	(0.263)	(0.317)	(0.250)	(0.239)	(0.190)	(0.272)	(0.315)	(0.254)	(0.248)
Population Exposed to Infection	0.078	0.051	0.213	-0.030	0.321**	0.077	0.050	0.211	0.003	0.381*
	(0.109)	(0.122)	(0.140)	(0.118)	(0.149)	(0.107)	(0.122)	(0.139)	(0.122)	(0.205)
Population	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	38	38	44	45	47	38	38	44	45	47
Adjusted R-squared	-0.0622	-0.160	0.216	0.141	0.425	-0.0481	-0.171	0.228	0.131	0.312

Notes. The table reports Spanish province regression estimates of the pandemic mortality rate on provincial debt growth. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, at peak within March or April 2020, or on March 14 or 28, respectively. Only provinces which have a covid measure for all brackets are included in the threshold specifications. All independent variables are defined in Table 3. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 6. Spanish Province Regression Estimates of Pandemic Mortality Rate on Changes in the Number of Curative Beds as Predicted by Provincial GDP or Debt Growth as the Financial Crisis Severity Measure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st Stage		2nd Stage							
Financial Crisis Severity Measure as Predictor			*GDP*	*Debt*	*GDP*	*Debt*	*GDP*	*Debt*	*GDP*	*Debt*
Dependent Variable	*# Curative Beds 2018*		*(Deaths / Cases)*							
			When (Cases / Population) > X /100K				*On 14.03*		*On 28.03*	
			]90,110]		*At Peak*					
Provincial Real GDP Growth (2009-2013)	0.026									
	(0.87)									
Provincial Debt Growth (2008-2013)		-0.002***								
		(-2.94)								
# Curative Beds 2018			0.082	-6.665**	-6.042	-3.691*	-3.236	-4.469*	-0.674	-8.975***
			(0.01)	(-2.14)	(-1.01)	(-1.91)	(-0.48)	(-1.65)	(-0.10)	(-2.60)
GDP / Capita 2019	-0.015	-0.010	0.115	0.024	-0.139	-0.107	-0.142	-0.163	-0.033	-0.148
	(-0.85)	(-0.63)	(0.64)	(0.22)	(-1.00)	(-1.30)	(-0.94)	(-1.64)	(-0.21)	(-1.07)
Temperature	-0.150***	-0.163***	-0.042	-1.051	-2.131**	-1.791***	-0.659	-0.822*	-1.485*	-2.683***
	(-2.78)	(-3.30)	(-0.04)	(-1.51)	(-2.17)	(-4.83)	(-0.74)	(-1.76)	(-1.86)	(-3.90)
Population Density 2020	0.001	0.001	-0.009	0.000	0.003	-0.000	0.008	0.010*	-0.002	0.009
	(1.18)	(1.30)	(-0.74)	(0.06)	(0.35)	(-0.06)	(0.89)	(1.74)	(-0.22)	(1.40)
Population Age 2018	0.053	0.032	0.051	0.395	-0.032	-0.157	0.386	0.477	-0.324	0.116
	(1.29)	(0.84)	(0.11)	(1.06)	(-0.07)	(-0.45)	(0.56)	(1.12)	(-0.66)	(0.28)
Population Exposed to Infection	0.036	0.036	0.206	0.436**	0.502	0.407***	0.162	0.216	0.372*	0.708***
	(1.45)	(1.57)	(1.04)	(1.99)	(1.57)	(2.62)	(0.50)	(1.24)	(1.75)	(2.95)
Population	-0.000	-0.000	0.000	-0.000	-0.000	0.000	0.000	-0.000	0.000	-0.000
	(-1.00)	(-1.28)	(0.63)	(-0.27)	(-0.24)	(0.11)	(0.01)	(-0.19)	(0.54)	(-0.57)
Observations	47	47	46	46	47	47	45	45	47	47

Notes. The table reports Spanish province regression estimates of the pandemic mortality rate on the changes in the number of curative beds in 2018 as predicted by provincial GDP or debt growth as the financial crisis severity measure and indicated control variables. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into the]90-110] bracket, at peak within March or April 2020, or on March 14 or 28, respectively. All independent variables are defined in Table 3. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 7. Variable Names and Definitions and Data Sources for US State Regressions

Variable Name	Units	Variable Definition	Data Source
Dependent Variables: Pandemic Deaths			
(Deaths / Cases) when (Cases / Population) = X/100K	%	The three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population equals X	CDC
(Deaths / Cases) when (Cases / Population) at Peak	%	The three-day moving average of the number of deaths over the number of cases at peak after the number of new cases surpasses 100	CDC
(Deaths / Cases) on 13.03 (or 27.03)	%	The three-day moving average of the number of deaths over the number of cases on March 14 (or 28)	CDC
Financial Crisis Severity Variables			
State Real GDP Growth (2007-2009)	%	The percent growth in real state Gross Domestic Product between 2007 and 2009	BEA
State Real GDP Growth (2008-2009)	%	The percent growth in real state Gross Domestic Product between 2008 and 2019	BEA
State Debt Growth (2007-2011)	%	The percent growth in per-capita nominal state debt between 2007 and 2011	CB
State Debt Growth (2007-2012)	%	The percent growth in per-capita nominal state debt between 2007 and 2012	CB
State Debt Growth (2007-2013)	%	The percent growth in per-capita nominal state debt between 2007 and 2013	CB
Control Variables			
GDP / Capita 2019	000 Dollars	Gross Domestic Product per capita in the state in 2019	BEA
# Curative Beds 2018	‰	The number in intensive care unit beds per one thousand population at year-end 2018	KFF
Temperature	°Fahrenheit	The logarithm of the average yearly temperature in the state	NOAA
Population Density 2019	-	The population per square mile at year-end 2019	CB
Population Age 2019	Years	The average age of the population in the province	CB
Population Obesity 2019	%	The percent of the population in the state that is defined to be obese, i.e., when their body mass index which is obtained by dividing a person's weight by the square of the person's height is over 30 kg/m2	CDC
Population Tested	%	The percent of the population tested in the state at the moment the dependent variable is defined (immediately after the number of cases per one hundred thousand population equals X)	Github

Notes. The table provides the variable names, definitions and data sources for the US State regressions. BEA is the U.S. Bureau of Economic Analysis. CB is the Census Bureau Survey of States Government Finances. CDC is the Centers for Disease Control and Prevention. Github is the set of spreadsheets located at https://github.com/govex/COVID-19/blob/master/data_tables/testing_data/tests_combined_total_source.csv. KFF is the Kaiser Family Foundation, sourcing from the American Hospital Association and American Hospital Directory. NOAA is the National Oceanic and Administration's National Centers for Environmental Information.

Table 8. US States Regression Estimates of Pandemic Mortality Rate on Financial Crisis Severity Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Dependent Variable	*(Deaths / Cases)*													
	When (Cases / Population) = X /100K					*On 13.03*	*On 27.03*	*When (Cases / Population) = X /100K*					*On 13.03*	*On 27.03*
X =	*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*At Peak*			*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*At Peak*		
State Real GDP Growth (2007-2009)	-0.124***	-0.117***	-0.128**	-0.118**	-0.100*	0.036	-0.081**							
	(0.039)	(0.043)	(0.049)	(0.048)	(0.054)	(0.070)	(0.031)							
State Real GDP Growth (2008-2009)								-0.117**	-0.119**	-0.131**	-0.116**	-0.091	-0.079	-0.058*
								(0.046)	(0.054)	(0.062)	(0.053)	(0.056)	(0.075)	(0.034)
GDP / Capita 2019	0.014	0.011	0.004	-0.000	-0.000	0.006	0.006	0.010	0.008	0.001	-0.003	-0.003	0.017	0.003
	(0.011)	(0.012)	(0.014)	(0.012)	(0.012)	(0.020)	(0.011)	(0.011)	(0.013)	(0.015)	(0.012)	(0.012)	(0.019)	(0.011)
# Curative Beds 2018	0.012	0.005	-0.004	0.001	0.001	-0.003	0.008	0.007	0.000	-0.009	-0.004	-0.003	0.000	0.005
	(0.019)	(0.020)	(0.019)	(0.015)	(0.014)	(0.011)	(0.016)	(0.019)	(0.021)	(0.020)	(0.016)	(0.014)	(0.012)	(0.016)
Temperature	0.014	0.001	-0.005	-0.008	-0.005	0.020	-0.003	0.016	0.003	-0.002	-0.005	-0.004	0.013	-0.001
	(0.013)	(0.020)	(0.022)	(0.020)	(0.018)	(0.014)	(0.013)	(0.014)	(0.020)	(0.022)	(0.020)	(0.018)	(0.016)	(0.013)
Population Density 2019	0.003	0.001	-0.001	0.000	-0.000	0.000	0.002	0.002	0.000	-0.002	-0.001	-0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Population Age 2019	-0.001	0.000	0.001	0.001	0.001	-0.001	-0.001	-0.001	0.000	0.001	0.001	0.001	-0.002	-0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Population Obesity 2019	0.106*	0.118*	0.114*	0.086	0.050	0.085	0.096	0.093	0.108*	0.102	0.074	0.037	0.133	0.082
	(0.060)	(0.063)	(0.065)	(0.058)	(0.056)	(0.111)	(0.063)	(0.061)	(0.063)	(0.066)	(0.058)	(0.056)	(0.143)	(0.062)
Population Tested	0.014	0.009	0.008**	0.004**	0.003	0.180***	0.015	0.014	0.010	0.008**	0.004**	0.003	0.170**	0.015
	(0.008)	(0.006)	(0.004)	(0.002)	(0.003)	(0.066)	(0.014)	(0.009)	(0.006)	(0.004)	(0.002)	(0.003)	(0.064)	(0.014)
Observations	47	47	47	47	45	50	50	47	47	47	47	45	50	50
Adjusted R-squared	0.0189	-0.0363	0.0423	0.0593	-0.0294	-0.0890	-0.0313	-0.0188	-0.0532	0.0252	0.0341	-0.0557	-0.0787	-0.0730

Notes. The table reports US state regression estimates of the pandemic mortality rate on financial crisis severity measures. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, at peak, or on March 13 or 27, respectively. All independent variables are defined in Table 7. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 9. US States Regression Estimates of Pandemic Mortality Rate on State Debt Growth from 2007 to 2013 as Financial Crisis Severity Measure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable	*(Deaths / Cases)*						
	When (Cases / Population) = X /100K					*On 13.03*	*On 27.03*
X =	*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*At Peak*		
State Debt Growth (2007-2013)	0.020	0.027*	0.027*	0.023*	0.026**	-0.009	0.008
	(0.012)	(0.014)	(0.014)	(0.012)	(0.012)	(0.013)	(0.008)
GDP / Capita 2019	-0.003	-0.007	-0.017	-0.019	-0.015	0.012	-0.003
	(0.012)	(0.013)	(0.014)	(0.012)	(0.010)	(0.015)	(0.011)
# Curative Beds 2018	0.008	0.001	-0.008	-0.003	-0.002	-0.002	0.005
	(0.018)	(0.019)	(0.018)	(0.015)	(0.013)	(0.011)	(0.017)
Temperature	0.006	-0.007	-0.015	-0.015	-0.015	0.022	-0.001
	(0.013)	(0.019)	(0.022)	(0.019)	(0.017)	(0.016)	(0.013)
Population Density 2019	0.002	0.000	-0.002	-0.001	-0.001	0.001	0.001
	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Population Age 2019	-0.001	0.000	0.001	0.001	0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Population Obesity 2019	0.045	0.054	0.050	0.028	-0.005	0.111	0.046
	(0.055)	(0.052)	(0.057)	(0.055)	(0.052)	(0.123)	(0.059)
Population Tested	0.008	0.007	0.004	0.002	0.000	0.184***	0.012
	(0.009)	(0.006)	(0.004)	(0.002)	(0.002)	(0.063)	(0.014)
Observations	47	47	47	47	45	50	50
Adjusted R-squared	-0.0274	0.00525	0.0604	0.0647	0.0529	-0.0877	-0.0963

Notes. The table reports US state regression estimates of the pandemic mortality rate on state debt growth from 2007 to 2013. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, at peak, or on March 13 or 27, respectively. All independent variables are defined in Table 7. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 10. US State Regression Estimates of Pandemic Mortality Rate on Changes in the Number of Beds as Predicted by State GDP or Debt Growth as the Financial Crisis Severity Measure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1st Stage		2nd Stage							
Financial Crisis Severity Measure as Predictor			*GDP*	*Debt*	*GDP*	*Debt*	*GDP*	*Debt*	*GDP*	*Debt*
Dependent Variable	*# Hospital Beds 2019*		*(Deaths / Cases)*							
			When (Cases / Population) > X /100K				*On 13.03*		*On 27.03*	
			]90,110]		*At Peak*					
State Real GDP Growth (2007-2009)	0.673**									
	(0.279)									
State Debt Growth (2007-2013)		-0.082*								
		(0.041)								
# Hospital Beds 2019			-0.002***	-0.003*	-0.001**	-0.003*	0.001	0.000	-0.001	-0.001
			(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
GDP / Capita 2019	-4.263	3.906	-0.007	-0.002	-0.007	-0.003	0.013	0.014	0.002	0.004
	(6.525)	(6.365)	(0.014)	(0.020)	(0.013)	(0.020)	(0.018)	(0.019)	(0.012)	(0.013)
Temperature	-16.008*	-13.167	-0.035*	-0.060	-0.029	-0.056	0.034	0.029	-0.000	-0.007
	(8.831)	(8.858)	(0.021)	(0.046)	(0.020)	(0.042)	(0.022)	(0.036)	(0.017)	(0.019)
Population Density 2019	-0.39	-0.148	-0.001	-0.001	-0.001**	-0.001	0.002	0.002	0.001	0.001
	(0.317)	(0.408)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Population Age 2019	0.057	-0.011	0.001	0.001	0.001	0.001	-0.002	-0.002	-0.000	-0.000
	(0.467)	(0.500)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Population Obesity 2019	93.186***	124.180***	0.239***	0.414*	0.187**	0.389*	-0.021	0.014	0.102	0.150
	(33.063)	(36.473)	(0.081)	(0.227)	(0.080)	(0.213)	(0.144)	(0.218)	(0.091)	(0.126)
Population Tested	-0.880	0.932	0.002	0.003	0.002	0.003	-0.002	-0.002	-0.002	-0.002
	(1.179)	(1.014)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
Observations	47	47	47	47	45	45	47	47	47	47

Notes. The table reports US state regression estimates of the pandemic mortality rate on the changes in the number of beds in 2019 as predicted by state GDP or debt growth as the financial crisis severity measure and indicated control variables. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into the]90-110] bracket, at peak, or on March 13 or 27, respectively. All independent variables are defined in Table 3. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Table 11. Back-of-the-envelope Cost Calculations for the US Case as a Representative Illustration

	Baseline: no idle beds / no lockdown	Idling beds (intervention ex-ante)	Lockdown (intervention ex-post)		
			Scenario A fully effective	Scenario B partially effective	Scenario C partially effective
Hospital beds	5 beds missing	0 beds missing	0 beds missing	1 bed missing	2 beds missing
Infection rate	Very high	Very high	Very low	Low	Medium
Intervention cost	0	USD 5.5m	USD 2.5m	USD 2.5m	USD 2.5m
Human life cost	USD 37.5m	0	0	USD 7.5m	USD 15m
Total	**USD 37.5m**	**USD 5.5m**	**USD 2.5m**	**USD 10m**	**USD 17.5m**
Other health cost elements	Long COVID	Long COVID	Lockdown-driven health consequences	Some Long COVID, somewhat fewer lockdown-driven health consequences	Some more Long COVID, even fewer lockdown-driven health consequences

Appendix

Appendix Table A.1. Spanish Province Regression Estimates of Pandemic Mortality Rate on Real GDP Growth (2008-2013)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable	*(Deaths / Cases)*									
	When (Cases / Population) > X /100K		*At Peak*	*On 14.03*	*On 28.03*	*When (Cases / Population) > X /100K*		*At Peak*	*On 14.03*	*On 28.03*
X =	*]50,70]*	*]70,90]*				*]50,70]*	*]70,90]*			
Provincial Real GDP Growth (2008-2013)	-0.275**	-0.225*	-0.119	0.041	0.120	-0.278*	-0.246	-0.103	0.025	0.145
	(0.102)	(0.117)	(0.167)	(0.136)	(0.218)	(0.138)	(0.153)	(0.184)	(0.162)	(0.218)
GDP / Capita 2019						-0.057	0.028	-0.047	-0.094	-0.066
						(0.068)	(0.091)	(0.105)	(0.075)	(0.091)
# Curative Beds 2018						-0.140	0.160	0.227	-0.290	-1.677
						(0.878)	(0.841)	(1.290)	(0.975)	(1.701)
Temperature						-0.277	0.028	-1.176***	-0.265	-1.619***
						(0.308)	(0.320)	(0.399)	(0.329)	(0.551)
Population Density 2018						-0.001	-0.003	-0.005	0.004	-0.002
						(0.002)	(0.002)	(0.004)	(0.004)	(0.003)
Population Age 2018						0.012	0.061	-0.349	0.170	-0.276
						(0.199)	(0.269)	(0.337)	(0.281)	(0.302)
Population Exposed to Infection						0.075	0.048	0.225	0.027	0.399*
						(0.093)	(0.113)	(0.149)	(0.126)	(0.213)
Population						0.000	0.000	0.000	0.000	0.000
						(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	38	38	44	45	47	38	38	44	45	47
R-squared	0.166	0.099	0.010	0.002	0.008	0.260	0.133	0.312	0.179	0.356

Notes. The table reports Spanish province regression estimates of the pandemic mortality rate on real GDP growth between 2008 and 2013. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, at peak within March or April 2020 , or on March 14 or 28, respectively. Only provinces which have a covid measure for all brackets are included in the threshold specifications. All independent variables are defined in Table 3. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A.2. Testing for the Potential Importance of Omitted Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Panel A																
	Table 2 Model (3)				*Table 2 Model (6)*				*Table 2 Model (7)*				*Table 2 Model (8)*			
	Upper	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ
Cross-Country	*-0.04843*	-0.06465	*-0.08547*	3.944	*-0.04236*	*-0.05696*	*-0.0753*	6.936	*-0.07349*	*-0.09333*	*-0.14249*	1.438	*0.00014*	*0.000127*	*0.00012*	3.806
		***				**				*				***		
Panel B																
	Table 4 Model (8)				*Table 4 Model (12)*				*Table 5 Model (1)*				*Table 5 Model (3)*			
	Upper	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ
Spain	*-0.28128*	*-0.28292*	*-0.28431*	5.660	*-0.21959*	*-0.25983*	*-0.29676*	4.112	*0.0075*	*0.0065*	*0.0055*	4.290	*0.00845*	*0.00812*	*0.00783*	24.840
		*								*						
Panel C																
	Table 8 Model (1)				*Table 8 Model (8)*				*Table 9 Model (1)*				*Table 9 Model (5)*			
	Upper	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ	*Upper*	*Actual*	*Lower*	δ
US	*-0.08839*	*-0.124*	*-0.15252*	1.367	*-0.09127*	*-0.117*	*-0.14059*	2.088	*0.02504*	*0.023*	*0.02194*	13.186	*0.02799*	*0.026*	*0.02307*	12.343
		***				**								**		

Notes. The table reports the results of tests for the potential importance of omitted variables following Oster (2019). For each model, we report three numbers in addition to the actual coefficient obtained in the respective model. First, we report the bias-corrected estimate of the coefficient of interest if unobservable variables influence the effect to the same degree and in the same direction as the observed variables (i.e., $\delta = 1$ in the Oster (2019) terminology). Second, we show the coefficient estimate obtained with the same degree of selection on unobservables but in the opposite direction as the observed variables (i.e., $\delta = -1$). These two numbers are reported as the upper and lower, estimates, respectively. Third, we report the (absolute) value of δ needed to "explain away" the result, that is, to imply a zero coefficient on the variable of interest. In these analyses, we follow recommendations of Oster (2019) to set the maximum R2 explained by the variable of interest, observed control variables, and unobserved variables to 1.3 times the R2 from the corresponding model. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Appendix Table A.3. US States Regression Estimates of Pandemic Mortality Rate on State Debt Growth from 2007 to 2011 or 2012

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Dependent Variable	*(Deaths / Cases)*													
	When (Cases / Population) = X /100K					*On 13.03*	*On 27.03*	*When (Cases / Population) = X /100K*					*On 13.03*	*On 27.03*
X =	*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*> 100*			*]30,50]*	*]50,70]*	*]70,90]*	*]90,110]*	*> 100*		
State Debt Growth (2007-2011)	0.021	0.030	0.032*	0.033*	0.034**	-0.014	0.009							
	(0.014)	(0.018)	(0.019)	(0.017)	(0.016)	(0.017)	(0.010)							
State Debt Growth (2007-2012)								0.017	0.023*	0.024*	0.023*	0.025**	-0.011	0.008
								(0.010)	(0.013)	(0.013)	(0.012)	(0.011)	(0.013)	(0.007)
GDP / Capita 2019	-0.002	-0.006	-0.017	-0.020	-0.016	0.012	-0.003	-0.003	-0.007	-0.017	-0.020	-0.016	0.012	-0.003
	(0.012)	(0.013)	(0.015)	(0.012)	(0.011)	(0.015)	(0.011)	(0.012)	(0.013)	(0.014)	(0.012)	(0.011)	(0.015)	(0.011)
# Curative Beds 2019	0.006	-0.001	-0.011	-0.005	-0.004	-0.001	0.004	0.006	-0.001	-0.010	-0.004	-0.004	-0.001	0.004
	(0.018)	(0.020)	(0.019)	(0.016)	(0.014)	(0.011)	(0.017)	(0.018)	(0.020)	(0.018)	(0.015)	(0.013)	(0.011)	(0.017)
Temperature	0.006	-0.008	-0.016	-0.017	-0.016	0.022	-0.000	0.006	-0.007	-0.015	-0.016	-0.016	0.022	-0.001
	(0.014)	(0.021)	(0.024)	(0.020)	(0.019)	(0.015)	(0.013)	(0.014)	(0.020)	(0.023)	(0.020)	(0.018)	(0.016)	(0.013)
Population Density 2019	0.002	-0.000	-0.002	-0.001	-0.002	0.001	0.001	0.002	-0.000	-0.002	-0.001	-0.002	0.001	0.001
	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)
Population Age 2019	-0.001	0.001	0.002	0.001	0.001	-0.001	-0.001	-0.000	0.001	0.002	0.001	0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Population Obesity 2019	0.051	0.062	0.057	0.032	0.002	0.110	0.049	0.045	0.054	0.049	0.025	-0.007	0.111	0.047
	(0.054)	(0.052)	(0.058)	(0.055)	(0.052)	(0.126)	(0.058)	(0.055)	(0.052)	(0.058)	(0.055)	(0.051)	(0.124)	(0.058)
Population Tested	0.006	0.005	0.003	0.001	-0.001	0.183***	0.012	0.007	0.005	0.003	0.001	-0.000	0.183***	0.012
	(0.009)	(0.006)	(0.004)	(0.002)	(0.002)	(0.062)	(0.015)	(0.009)	(0.006)	(0.004)	(0.002)	(0.002)	(0.062)	(0.015)
Observations	47	47	47	47	45	50	50	47	47	47	47	45	50	50
R-squared	0.119	0.137	0.204	0.230	0.214	0.091	0.077	0.124	0.140	0.202	0.222	0.211	0.091	0.080

Notes. The table reports US State regression estimates of the pandemic mortality rate on state debt growth from 2007 to 2011 or 2012. The dependent variable is the three-day moving average of the number of deaths over the number of cases immediately after the number of cases per one hundred thousand population falls into a bracket, surpasses 100, or on March 13 or 27, respectively. All independent variables are defined in Table 7. A constant is included but not reported. Robust standard errors are listed in parentheses below the coefficient estimates. *** p<0.01, ** p<0.05, * p<0.1