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Contents lists available at ScienceDirect

Journal of Financial Economics

journal homepage: www.elsevier.com/locate/jfec

In sickness and in debt: The COVID-19 impact on sovereign credit risk[☆]



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ARTICLE INFO

Article history:

Received 17 October 2020

Revised 19 January 2021

Accepted 22 January 2021

Available online 11 May 2021

JEL classification:

E44

F34

G12

G15

H63

Keywords:

COVID-19

Coronavirus

Sovereign credit risk

Debt

Fiscal capacity

ABSTRACT

The COVID-19 pandemic provides a unique setting in which to evaluate the importance of a country's fiscal capacity in explaining the relation between economic growth shocks and sovereign default risk. For a sample of 30 developed countries, we find a positive and significant sensitivity of sovereign default risk to the intensity of the virus's spread for fiscally constrained governments. Supporting the fiscal channel, we confirm the results for Eurozone countries and U.S. states, for which monetary policy can be held constant. Our analysis suggests that financial markets penalize sovereigns with low fiscal space, impairing their resilience to external shocks.

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[☆] We are grateful to the editor, Bill Schwert, and an anonymous referee for their invaluable feedback. We thank Jacob Boudoukh, Mikhail Chernov, Óscar Jordá, Anton Korinek, Justin Leroux, Yukun Liu, Dan Murphy, Simon van Norden, Jean-Paul Renne, Guillaume Roussellet, Michael Schwert, Kirsten Smart, Hendro Sugandi, and the participants of the Virtual Derivatives Workshop, the 2020 International Risk Management Conference, and the Australasian Finance & Banking Conference for valuable comments and suggestions on earlier drafts. All authors thank the Global Risk Institute for supporting this project through research funding. Augustin acknowledges financial support from the Canadian Derivatives Institute. Subrahmanyam thanks the Anneliese Maier Research Award of the Alexander von Humboldt Foundation for their generous support. Tomio thanks the support of the Richard A. Mayo Center for Asset Management at UVA Darden.

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1. Introduction

Since the first reported case of COVID-19 at the end of 2019, the virus has spread rapidly throughout the world and developed into a global pandemic. As of January 18, 2021, there are close to 100 million reported cases and over 2 million deaths, according to the Johns Hopkins University Coronavirus Resource Center.¹ Aside from the tragic medical and humanitarian challenges, the pandemic represents a major shock to economic growth due to the extreme disruptions in global economic activity.

Globally, public debt levels were at record highs, even in the pre-crisis period (Yared, 2019), and they are forecast to increase significantly (IMF, 2020). As tax revenues plummet and expenditures mount, governments around the world will inevitably find themselves saddled with rapidly expanding debt due to ballooning budget deficits. These effects are amplified by the launch of numerous comprehensive stimulus packages, which many governments have swiftly implemented to alleviate the economic effects of pandemic-induced lockdowns. The expected future increases in public debt and fiscal deficits are reflected in real time in the evolution of sovereign credit spreads, which spiked almost universally across the globe in response to the coronavirus news.

The ability to finance additional deficits, whether through the issuance of additional debt or an increase in taxation, varies greatly across countries. Similarly, the borrowing costs incurred for new debt issuances vary considerably between fiscally stronger countries, such as the United States and Germany, and more fiscally constrained countries like Italy or Greece.

In this paper, we ask whether countries' fiscal constraints impair their resilience to economic shocks. Understanding whether fiscal capacity is a key channel in amplifying sovereign default risk is important; an impairment to a country's credit quality may lead to a reduction in economic activity or limit its government's ability to respond to future financial crises and natural disasters. There is empirical evidence that excessive public debt levels may depress economic growth (e.g., Reinhart and Rogoff, 2010; Reinhart et al., 2012; Romer and Romer, 2017), and that the economic costs after a financial crisis are more severe for countries with higher levels of public debt (Jordà et al., 2016; Romer and Romer, 2018; Romer and Romer, 2019). This evidence, however, is viewed with skepticism due to the challenges in identifying the causal effect of debt on growth (e.g., Krugman, 2013) and because the costs of public debt are considered to be low when safe interest rates are below expected growth rates (Blanchard, 2019).

The coronavirus pandemic provides researchers with a unique opportunity to shed new light on a sovereign's resilience to external shocks. First, in contrast to the Global Financial Crisis in 2008 and the European Sovereign Debt Crisis in 2010 (which were triggered by an endogenous build-up of private and public leverage), the coronavirus pandemic represents an external shock to economic growth (and its expectations), which was unantic-

ipated and affected every country around the world, albeit with varying intensity. Second, both the magnitude of the growth shocks and their impact on a country's resilience are quantifiable and available in real time. We approximate the shocks to a country's growth using the incidence of coronavirus cases, and identify the impact on a country's resilience using sovereign default risk indicators. Third, and most importantly, while the dynamics of both the market-based measures of sovereign default risk and the COVID-19 infection rates are available at a daily frequency, a country's fiscal capacity is determined prior to the onset of the crisis. Moreover, measures of economic fundamentals that determine a country's fiscal capacity are measured before any additional debt is issued in response to the coronavirus-induced economic contractions. Finally, little was known about the coronavirus at the start of the crisis, so daily infection rates are especially informative in shaping growth expectations at the pandemic's onset.

For these reasons, we implement our benchmark tests during the first wave of the pandemic, starting on January 1, 2020 (the day the World Health Organization activated its emergency response framework, following reports of clusters of a new form of pneumonia circulating in Wuhan City, Hubei Province), and ending on May 18, 2020 (the day of the unprecedented joint proposal for a € 500 billion European Union recovery fund by the German chancellor, Angela Merkel, and the French president, Emmanuel Macron). In Panel (a) of Fig. 1, we show the dynamics of new COVID-19 infection rates, measured for Europe, the Americas, and the Asia-Pacific region during the first infection cycle as the number of new infections per 1000 citizens. We also show the dynamics of new infections during the second wave of the pandemic, until October 15, 2020, when our sample period ends. We consider the second wave only in our robustness tests because, during the later periods, infections rates are more likely to be influenced by country-specific policies, and the trajectory of the pandemic is better understood. In contrast, during the first wave, infections were essentially randomly dispersed across equally susceptible countries and, thus, represent a more meaningful shock.

In Panel (b) of Fig. 1, we show the dynamics of the COVID-19 infection rates, measured as the average number of cumulative infections per 1000 citizens, for the same three regions during the first wave of the pandemic. During this period, the figure shows that the timing of the crisis differs vastly across countries, with significant cross-country heterogeneity in the onset, speed of evolution, and intensity of the virus spread. Additionally, in Panel (c) of Fig. 1 we show the increase in sovereign default risk, as measured by the regional averages of cumulative percentage changes in credit default swap (CDS) premiums, i.e., the prices of insurance contracts that protect against sovereign default risk. CDS contracts are particularly well-suited to examine the impact of the pandemic on sovereign credit risk. In contrast to sovereign bonds, the prices of which may be influenced by differences in the currency of denomination, covenants, tenors, and legal jurisdictions, CDS contracts are uniformly comparable across countries, and their prices are available in real time. Surprisingly, the increases in sovereign default risk

¹ See <https://coronavirus.jhu.edu>.

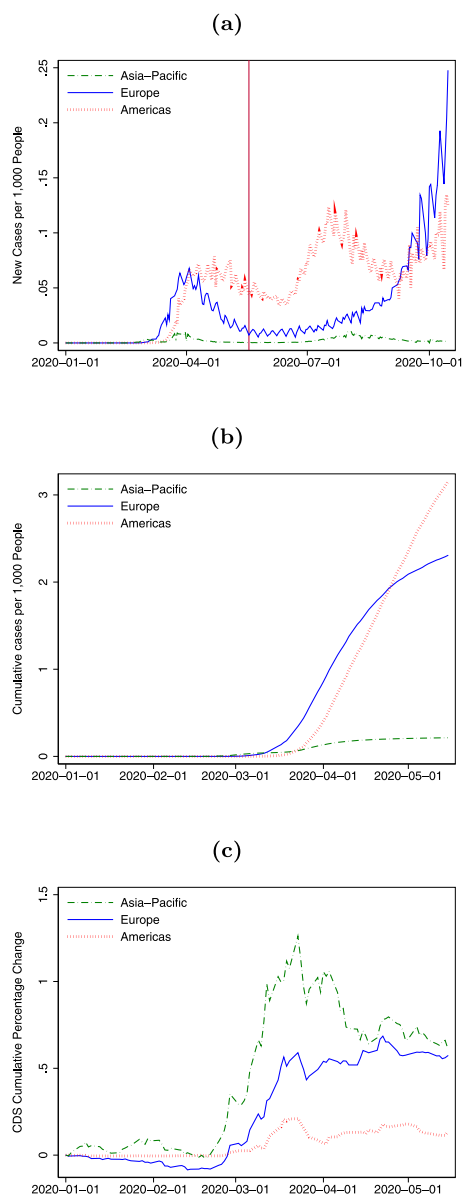


Fig. 1. Sovereign CDS and COVID-19 incidence by geographic area. In this figure, we show the time series evolution of sovereign credit default swap (CDS) spreads and incidence of COVID-19 cases for three geographical regions (Asia-Pacific, Europe, and the Americas), corresponding to a set of 30 developed countries, from the IMF economic database, for which we could obtain reliable information on both CDS spreads and COVID-19 infections. In Panel (a), we show the incidence of COVID-19 cases, measured as the number of infections per 1000 people. The vertical line corresponds to the end of our benchmark period on May 18, 2020. In Panel (b), we show the cumulative incidence of COVID-19 cases, measured as the number of infections per 1000 people. In Panel (c), we show the cumulative percentage changes of CDS spreads. Our sample consists of daily observations for five-year USD denominated CDS spreads with the full restructuring credit event clause. Panel (a) extends from January 1, 2020 to October 15, 2020, while Panel (b) and (c) cover our benchmark period ending on May 18, 2020. CDS data are from Markit. The COVID-19 data are from the European Centre for Disease Prevention and Control. We scale the number of cases by the population of the corresponding country, based on estimates for 2018 provided by the OECD.

are not monotonic in the increase in infection rates. It is this rich, cross-sectional variation, both within and across geographic regions, that we exploit to identify whether fiscal capacity affects a sovereign's resilience to the crisis.

We show that the sensitivity of a country's default risk to adverse external shocks depends largely on its fiscal capacity level, broadly defined as the ability of its government to fund its fiscal policy and service its financial obligations [see Romer and Romer, 2019 for a discussion]. For our analysis, we use a sample of 30 developed economies from the International Monetary Fund (IMF) Economic database, for which we can obtain reliable information on sovereign credit spreads, COVID-19 infection rates, and fiscal and economic indicators, all of which are comparable across countries. We consider a battery of different fiscal capacity measures. In particular, we examine general government debt, aggregate government expenditures, and total interest expenses, all measured as a fraction of GDP. We also consider unemployment, GDP growth, and country credit ratings, as assigned by the three major rating agencies (Moody's, Standard & Poor's, and Fitch). We consider all of these metrics individually, while also aggregating them into a single measure that allows us to rank all countries in terms of their fiscal constraints.

Our results paint a stark picture: there is only a weak unconditional relation between the COVID-19 infection rates and increases in sovereign credit spreads during the coronavirus pandemic. However, conditional on having low fiscal capacity, there is a positive and statistically significant relation between the intensity of the virus's spread and sovereign default risk. We find that a one-day 30% increase in the incidence of COVID-19 infections translates to a 1% (3%) increase in CDS premiums for a country ranked at the 25th (75th) percentile of the fiscal constraints distribution. These effects are economically meaningful, especially if accumulated over several days, because the average one-day increase in infection rates is 15% after COVID-19 infections reach a rate of one in a million.

Out of the 30 countries in our sample, 14 pursue independent fiscal and monetary policy, and 16 are constrained in their monetary policy because they belong to a common monetary union, the European Monetary System (Eurozone). While members of the Eurozone conduct independent fiscal policy, they are bound by a common monetary policy conducted by the European Central Bank (ECB). Thus, our results risk being influenced by differential cross-country sensitivity to, and coordination of, fiscal and monetary policies.

To further emphasize that fiscal capacity is an important amplifier of sovereign credit risk dynamics during the pandemic, we repeat our analysis in samples within which we can hold monetary policy constant. Specifically, we examine the relation for the sample of Eurozone countries and find that our results remain unchanged. In a similar vein, we study the 23 U.S. states for which we can obtain continuous information on sovereign CDS premiums. Although all 23 states have experienced varying infection rates, they are bound by a common monetary policy, which is determined at the federal level through the actions of the Federal Reserve System. Therefore, U.S. states represent

a more homogeneous group for studying whether differences in fiscal capacity influence a sovereign's risk exposure to a systemic crisis.

Similar to our country-level results, we find a statistically significant, positive sensitivity of sovereign default risk to COVID-19 infection rates for fiscally constrained U.S. states. In contrast, less fiscally constrained states are not significantly affected by an increase in COVID-19 cases. Specifically, we find that a weekly 30% increase in the incidence of COVID-19 infections translates to an increase in CDS premiums of 0.24% for a state at the 75th percentile of the distribution of our fiscal constraints measure.

An important consideration in our study relates to cross-country differences in governments' preparedness to face a pandemic and in a population's susceptibility to the virus. To verify that our results are not merely driven by confounding factors associated with a country's healthcare quality or the social composition of the population, we verify whether our results on the sensitivity of sovereign risk to COVID-19 infections are preserved once we control for these factors.

First, we consider the strain on a country's healthcare system, which we expect to be higher when there are fewer doctors per 1000 inhabitants and when a smaller fraction of GDP is spent on healthcare. Second, we examine the degree of inherent health risk COVID-19 poses to each country's population, which we measure using the proportion of at-risk population, namely the elderly and the obese. Third, we consider each country's population density, which can be a key factor in fueling the spread of the virus. We find that none of these variables is significant in amplifying the sensitivity between infection rates and sovereign credit risk. However, fiscal capacity remains a key determinant in explaining cross-sectional differences in the response of sovereign risk to the intensity of the virus's spread.

Relatedly, we verify that our results are not explained by cross-country differences in the timing and intensity of government responses to the crisis. We consider school closures, workplace closures, restrictions on public gatherings, and other social distancing measures (such as restrictions on people's movement). We find that the differential impact of COVID-19 infections on sovereign credit risk for fiscally constrained countries is similar during and outside of lockdown policies. Moreover, our analysis suggests that lockdown measures do not directly contribute to cross-sectional variation in the sensitivity of sovereign credit risk to COVID-19 infection rates for fiscally constrained countries. We also consider alternative country characteristics, which are known to relate to sovereign credit risk, as potential drivers of our results. For each country, we evaluate the health of the banking system, the reliance of the economy on tourism, the exposure to the volatility of exports and imports, and the propensity to save. We find that these characteristics do not subsume the statistical or economic significance of fiscal capacity in magnifying the exposure of sovereign risk to COVID-19 infections.

Our last step is to test for the existence of a fiscal threshold that significantly impairs a country's resilience to external shocks. Following Hansen (2000), we implement endogenous threshold regressions to identify cutoff levels

of fiscal capacity, around which there is a shift in the sensitivity of sovereign default risk to the spread of COVID-19 infections. We examine these thresholds for the aggregate fiscal capacity measure and its individual components.

Most notably, we find that the sensitivity of a country's sovereign default risk to the virus's spread increases six-fold above debt-to-GDP ratios of 61%. We identify a second significant, endogenous threshold at a debt-to-GDP ratio of 104%. The estimated elasticity for countries with leverage ratios above the second threshold is 13 times that of countries with the lowest ratios.

The rest of the paper proceeds as follows. In Section 2, we discuss the relevant literature. In Section 3, we present and develop our hypotheses. We provide an overview of our data and preliminary evidence in Section 4. We discuss the main results in Section 5, and conclude in Section 6.

2. Related literature

As we show that fiscally constrained countries are less resilient to economic shocks, our work relates most closely to Jordà et al. (2016), and Romer and Romer (2018, 2019), who show that the economic costs of a financial crisis are more severe when countries have higher levels of public debt. In that context, our work also relates broadly to the debate in the public finance literature on whether public debt represents a burden to society (Ricardo, 1817; Buchanan, 1958; Meade, 1959; Hansen, 1959; Bowen et al., 1960; Diamond, 1965; Tobin, 1965; Barro, 1974; Buchanan, 1976; Barro, 1979).

Using cross-country evidence from more than 200 years of public debt overhangs, Reinhart and Rogoff (2010), Reinhart et al. (2012), and Romer and Romer (2017) provide evidence that greater debt is associated with lower economic growth and output. Liu et al. (2019) suggest that excessive production of safe asset debt may be risky, as it can increase tax income and consumption volatility, while Croce et al. (2020b) show that too much debt can hamper innovation, lower expected growth, and increase uncertainty. For additional evidence on the relation between debt and growth, see Kumar and Woo (2010), Cecchetti et al. (2011), Checherita-Westphal and Rother (2011), Herndon et al. (2013), and Eberhardt and Presbitero (2015).

Blanchard (2019) argues that high levels of public debt bear little social cost as long as safe interest rates are below long-run expected growth rates. The argument that high debt levels lead to low growth has also been criticized because it is difficult to unequivocally prove the causality of the link (e.g., Krugman, 2013). We circumvent this issue by focusing on a short period of time in which publicly observable measures of fiscal capacity arguably do not change. Thus, we can examine how cross-sectional differences in ex ante fiscal capacity affect the relation between the incidence of COVID-19 cases and sovereign credit risk.

In contrast to previous work, we provide unique evidence regarding the pandemic's implications for sovereign default risk in developed economies. This evidence is of utmost importance in light of the massive stimulus packages implemented by many countries, which are bound to exacerbate their default risk. Increases in

sovereign credit risk are demonstrated to have real economic effects, leading to reductions in credit supply (Adelino and Ferreira, 2016; Bocola, 2016) and investment (Almeida et al., 2017) and an increase in corporate credit risk (Lee et al., 2016; Augustin et al., 2018a). Excessive sovereign default risks may also lead to hazardous doom loops between sovereign and financial balance sheets (e.g., Acharya et al., 2014; Farhi and Tirole, 2018). In the context of the pandemic, Benmelech and Tzur-llan (2020) and Balajee et al. (2020) suggest that countries with lower credit ratings were hindered in implementing stimulus packages. Relatedly, Arellano et al. (2020) study the feedback effects between lockdown policies and sovereign default risk in emerging economies, while Espino et al. (2020) study the optimal fiscal and monetary policy response of developing economies in an equilibrium model with sovereign default.

Our work also relates to the literature on the dynamics of sovereign credit risk, which are driven by global risk factors (Pan and Singleton, 2008; Longstaff et al., 2011; Augustin and Tédongap, 2016; Augustin et al., 2018b), local risk factors (Chernov et al., 2020a; Hilscher and Nosbusch, 2010), or a combination of both (Augustin, 2018). We pinpoint the fiscal channel as an amplification mechanism for sovereign CDS spreads, consistent with Chernov et al. (2020b), who show how U.S. CDS premiums reflect the probability of fiscal default. Pallara and Renne (2019) infer fiscal limits from CDS premiums. By analyzing the credit risk of U.S. states, our work is closely related to the study on systemic sovereign risk by Ang and Longstaff (2013), and to Novy-Marx and Rauh (2012). Duffie et al. (2003) and Zhang (2008) study the default of Russia and Argentina, respectively. There is also evidence that sovereign default risk is tightly linked to the local financial sector (Gennaioli et al., 2014). Additional references are available in the surveys by Augustin (2014) and Augustin et al. (2014).

More broadly, our work relates to the growing literature that examines the impact of the COVID-19 pandemic on economic growth (Gormsen and Kojien, 2020) and financial markets, including corporate fixed income (O'Hara and Zhou, 2020; Haddad et al., 2020; Kargar et al., 2020; Boyarchenko et al., 2020; Fahlenbrach et al., 2020; Falato et al., 2020), Treasury (He et al., 2020; Fleming and Ruela, 2020; Schrimpf et al., 2020), stock (Boudoukh et al., 2020; Ding et al., 2020; Alfaro et al., 2020; Croce et al., 2020a; Gerding et al., 2020; Ramelli and Wagner, 2020; Albuquerque et al., 2020; Bretscher et al., 2020; Schoenfeld, 2020; Acharya and Steffen, 2020), and foreign exchange markets (Bahaj and Reis, 2020). We provide an extended literature discussion in Section A-I of the Internet Appendix.

3. Hypotheses development and empirical setting

First, we discuss our testable hypotheses in Section 3.1. We then explain our empirical specification in Section 3.2.

3.1. Hypotheses

There is overwhelming evidence that the dynamics of sovereign credit spreads are affected by global risk fac-

tors (Pan and Singleton, 2008; Longstaff et al., 2011; Augustin, 2018). Although there is a significant degree of cross-country heterogeneity in the scale and scope of the spread of the disease, the coronavirus crisis is a global phenomenon. Thus, ex ante, it is unclear whether the dynamics of sovereign credit spreads during the development of the pandemic would be affected by country-specific COVID-19 infection rates. This motivates our first hypothesis, which relates to whether sovereign CDS premiums are explained by the incidence of COVID-19 infections, after controlling for established global and country-specific factors of sovereign credit spreads.

Hypothesis 1: Changes in sovereign CDS spreads during the coronavirus pandemic are positively related to country-specific COVID-19 infection rates.

A country's ability to weather the crisis, and potentially respond with fiscal and liquidity stimuli, depends to a large extent on its fiscal capacity prior to the crisis. We therefore examine whether cross-sectional differences in a country's fiscal space change the relation between the dynamics of sovereign credit spreads and those of COVID-19 infections. Specifically, we examine whether the sensitivity of sovereign CDS premiums to the virus's spread is stronger when the fiscal space of a country is limited.

Hypothesis 2: The sensitivity of sovereign CDS premiums to COVID-19 infection rates is stronger for countries with low fiscal capacity.

The effects of fiscal capacity on the resilience, to economic shocks, of a country's credit quality may be affected by the heterogeneity in monetary policy. To test whether a country's fiscal capacity autonomously affects the relation between sovereign credit risk and COVID-19 infections, we revisit the analysis, this time focusing on the members of two monetary unions: Eurozone countries and U.S. states. In both unions, monetary policy is common to all members and determined at the central bank level (i.e., the ECB and the Federal Reserve System, respectively). This analysis relates to our third hypothesis, which is that credit risk is more strongly associated with COVID-19 infection rates when fiscal capacity is low, while monetary policy is held constant.

Hypothesis 3: The increased sensitivity of sovereign CDS spreads to COVID-19 infection rates for fiscally constrained entities is not driven by differences in monetary policy.

3.2. Empirical setting

We implement a number of tests to examine hypotheses H1 to H3 described above. Our key variable of interest is a measure of a country's or state's default risk. Since we aim to estimate the elasticity between sovereign credit risk and COVID-19 infections, we use, as our dependent variable, percentage changes in sovereign CDS spreads ($\Delta CDS_{i,t}$) for country or state i at time t . To mitigate concerns that our estimates are influenced by cross-country differences in the levels and volatilities of CDS premiums, we use growth rates instead of CDS spread levels to estimate the elasticity between sovereign credit risk and the spread of the virus. In Section 5.5, we nevertheless show that our results are robust to using alternative specifications for the dependent variable. We examine how the

dynamics of sovereign default risk relate contemporaneously to the intensity of the virus’s spread by projecting daily percentage changes in sovereign CDS premiums onto daily percentage changes in COVID-19 infection rates ($\Delta\text{COVID Cases}_{i,t}$), while controlling for standard country-specific and global determinants of sovereign credit risk (denoted by the vector of controls $X_{i,t}$):

$$\Delta\text{CDS}_{it} = \alpha_0 + \beta_1 \Delta\text{COVID Cases}_{i,t} + \delta^\top X_{i,t} + \psi_i + \gamma_t + \varepsilon_{i,t}, \tag{1}$$

where ψ_i captures country or state fixed effects to absorb unobserved time-invariant country or state-level heterogeneity, γ_t represents time fixed effects, and $\varepsilon_{i,t}$ is the i.i.d. residual. The main coefficient of interest is β_1 , which captures the elasticity between the dynamics of sovereign credit risk and COVID-19 infections, and which we expect to be positive. Using percentage changes in the total number of infections is consistent with the approach of forecasting the pandemic’s evolution in epidemiological models, in which infection growth rates are approximately linear in the empirical counterpart of the disease’s reproduction rate, R_0 .²

To examine whether there is a differential relation between sovereign credit risk and the intensity of the virus’s spread across countries or states, we include, as explanatory variables, metrics that measure the fiscal constraints of a country or state. All measures of fiscal constraints are predetermined and can be considered time-invariant during our benchmark sample period, which encompasses the first wave of the pandemic. This allows us to measure ex ante cross-sectional differences in fiscal capacity, which are instrumental for identifying any differential elasticity of sovereign default risk to COVID-19 infections. Specifically, in several of our tests, we interact the growth rate of COVID-19 infection rates with measures of fiscal constraints ($\text{FiscallyConstrained}_i$), so that the regression specification is as follows:

$$\begin{aligned} \Delta\text{CDS}_{it} = & \alpha_0 + \beta_1 \Delta\text{COVID Cases}_{i,t} + \beta_2 \Delta\text{COVID Cases}_{i,t} \\ & \cdot \text{FiscallyConstrained}_i \\ & + \delta^\top X_{i,t} + \psi_i + \gamma_t + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

where the country- or state-specific measures of fiscal constraints are omitted because they are absorbed by the fixed effects, ψ_i .

4. Data, descriptive statistics, and preliminary evidence

We discuss our data in Section 4.1 and present our summary statistics in Section 4.2. We describe cross-country differences in fiscal capacity in Section 4.3, and provide our preliminary evidence in Section 4.4.

4.1. Data

We merge several data sets that encompass country-specific prices of sovereign default insurance, fiscal capacity,

COVID-19 infection rates, and information on demographics and public health preparedness, in addition to global and country-specific macroeconomic and financial indicators. In Table A-1 of the Internet Appendix, we provide a detailed description of all of the variables in our analysis and their corresponding sources.

We focus on developed countries, as defined by the IMF, that are part of the Organization for Economic Cooperation and Development (OECD). Our sample consists of 30 countries for which we can find reliable data for sovereign credit risk, fiscal constraints, and COVID-19 infection rates. These 30 countries cover a broad geographic area, including the Americas (Canada and the United States), Europe (Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom), and Asia-Pacific (Australia, Japan, Korea, and New Zealand). We expand on our country analysis to examine the credit risk of 23 U.S. states: Connecticut, California, Delaware, Florida, Georgia, Illinois, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, North Carolina, Nevada, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Texas, Utah, Virginia, Wisconsin, and Washington.

Our benchmark analysis starts on January 1, 2020, the day the World Health Organization activated its emergency response framework, and ends on May 18, 2020, when the German chancellor, Angela Merkel, and the French president, Emmanuel Macron, jointly announced a proposal for a € 500 billion European Union recovery. May 18, represents a major turning point for the markets’ perception of the European Union’s ability to withstand the crisis, as demonstrated by a significant drop in CDS premiums for most countries in our sample. Around this time, we also observe an easing of the first set of lockdown measures. By excluding the period of the coordinated fiscal policy response, we are more likely to capture the impact of COVID-19 infections on sovereign default risk, without any influence of differential fiscal policy responses. In robustness tests, we extend our sample period to October 15, 2020.

We obtain data on CDS spreads from Markit. CDS contracts are identified by their tenor, currency, and definition of a credit event. For all countries and U.S. states, we consider contracts with a tenor of five years, under the full restructuring clause, denominated in USD, and referencing external debt. We focus on the more liquid EUR-denominated contracts for the U.S. government, but our results remain unchanged if we use the USD-denominated contract. CDS premium data are available at the daily frequency. Since sovereign credit risk is intimately connected to a country’s financial risk (Acharya et al., 2014) and currency depreciation (Reinhart, 2002; Na et al., 2018; Augustin et al., 2020), we obtain the return for each country’s major stock index and exchange rate from Capital IQ.

To understand the relation between the spread of the pandemic and sovereign credit risk, we characterize the incidence of COVID-19 infections in a particular area, using the number of presumptive positive and confirmed cases, in accordance with the Centers for Disease Control and Prevention (CDC) guidelines. For observations at the coun-

² In Section A-II of the Internet Appendix, we explain in more detail the relation between the time-varying reproduction rate R_0 and the growth rate in COVID-19 infections.

try level, we use data made available by the European Centre for Disease Prevention and Control, sourced via Oxford University's "Our World in Data" platform, and the Johns Hopkins University Coronavirus Resource Center. We use data from the *New York Times* for observations at the state level.

Importantly, to characterize a country's fiscal capacity, we obtain data on a government's debt outstanding, interest payments, and expenditures. We capture recent macroeconomic conditions through a country's GDP level and growth, credit rating, and unemployment rate. Many of these variables are available only with a significant delay, leading us to focus on quantities for the 2018 fiscal year. In our robustness tests, we show that the ranking of these variables does not change materially across countries in the course of one year, which suggests that this delay is largely immaterial to our results. These data are obtained from the World Bank, the IMF, the OECD, the U.S. Census, the U.S. Bureau of Economic Analysis, and the Pew Trust.

To control for the development of a sovereign's healthcare system and the ex ante exposure to coronavirus penetration, we also collect information on the number of doctors, the total spending on healthcare goods and services, the fraction of the population that is elderly, the share of the population that is overweight or obese, and the population density. These data come from the Kaiser Family Foundation, the OECD, the World Bank, the World Health Organization, the Centers for Medicare and Medicaid Services, and the CDC.

Finally, we employ global macroeconomic and financial indicators available in the Federal Reserve Bank of St. Louis economic database. We use the returns on the S&P 500 stock market index, the CBOE VIX volatility index, the U.S. (Treasury–LIBOR) TED spread, investment grade (sub-investment grade) credit spreads [defined as the difference between the corporate U.S. BBB (BB) and AAA (BBB) yields], and the Dollar factor, measured as the equally-weighted average exchange rate return relative to USD.

4.2. Descriptive statistics

In [Table 1](#), we provide detailed summary statistics for the variables in our study for our benchmark period, starting with the dynamics of countries' sovereign credit spreads and COVID-19 infections. In [Panel A](#), we show that the average CDS premium is 40 basis points (bps), reflecting the high credit quality of the developed economies in our sample. Nonetheless, there is ample cross-sectional variation, as demonstrated by premiums that range from 10 bps to 370 bps. As for infection rates, out of 1000 people, an average of less than one person (i.e., 0.588) is infected with the coronavirus. Reporting the same information after the virus's spread reached a rate of one in a million, we find that the average daily infection rate increases to 1.066. The maximum number of infected people per 1000 inhabitants is above five. More importantly, the daily change in infection rates is about 15%, on average. Daily equity and exchange rate returns are, on average, close to zero.

In [Fig. 2](#), we illustrate the severity of infections and the deterioration of sovereign risk during the pandemic.

[Panel A](#) shows, for each country, the maximum number of COVID-19 cases per 1000 inhabitants recorded during our sample period. Europe was severely affected. Specifically, Belgium, Spain, and Ireland stand out with more than four infections per 1000 people. On a per-1000 capita basis, Iceland is the most affected country, with more than five cases. In the Americas, the U.S. has more than double the number of cases per 1000 people as Canada, while four developed economies in the Asia-Pacific region all experience low infection rates, compared to countries in Europe and the Americas.

In [Panel B](#) of [Fig. 2](#), we report, for the same countries, the increase in CDS premiums between January 1, 2020 and their peak during our benchmark sample period. While CDS spreads increased across all countries, they evolved quite heterogeneously. For example, the lowest increase, about 1 bp, is recorded for Switzerland, while Spain, Portugal, Italy, and Greece witness increases of 95 bps, 97 bps, 124 bps, and 285 bps, respectively. The cross-country differences in CDS spread increases are noteworthy because they do not align with the intensity of COVID-19 infections documented in [Panel A](#). While Greece experienced the largest increase in sovereign credit spreads, it is among the countries with the lowest coronavirus incidence. In stark contrast, the sovereign credit risk of Switzerland, a country with a particularly high infection rate, did not change significantly relative to its pre-crisis level.

In [Panel B](#) of [Table 1](#), we document the magnitude of total central government gross debt, government expenditures, and central government interest payments. We scale these variables by the countries' corresponding GDP to make them comparable across countries. The average debt-to-GDP level is 71.82%. The large standard deviation of 48.82% is indicative of the vast cross-country differences in public debt levels, which range from a low of 8% for Estonia to a high of 237% for Japan. Total government expenditures represent, on average, 33% of a country's GDP, while interest expenses are, on average, 1.60% (ranging up to 3.82%). The average unemployment level in our sample is 5.84%, and mean GDP growth is 2.78%. Sovereign credit ratings are another metric of fiscal capacity. We use the average rating of foreign currency long-term sovereign debt ratings among the three most popular rating agencies (Moody's, Standard & Poor's, and Fitch), as provided by the World Bank ([Kose et al., 2017](#)). The ratings of each agency are converted to a numerical scale, with 1 representing the least creditworthy and 21 the most creditworthy country. The average rating, 17.77, corresponds roughly to an AA-rating.

To control for the potential confounding effects due to the state of a country's healthcare system, we collect measures of the development of each system. Specifically, we consider the density of doctors in the population, and each nation's expenditure on healthcare-related goods and services as a fraction of GDP. [Petrilli et al. \(2020\)](#) show that obesity and old age are factors associated with hospitalization and critical illness due to COVID-19. Thus, we also collect information on the fraction of inhabitants aged over 65, the fraction of the population considered obese, and the population density. Most of these variables point to-

Table 1

Descriptive statistics.

In this table, we report the descriptive statistics for the variables that we employ in our analysis. Panel A reports country-specific time-varying variables, such as the country's CDS spread, CDS_{it} , the return of the country's major stock index, $Equity_{it}$, the foreign exchange rate, FX_{it} , and the number of COVID-19 cases per 1000 people, $CovidCases_{it}$. $CovidCases_{it}^{1/million}$ ($\Delta COVICases_{it}^{1/million}$) is the number of COVID-19 infections per 1000 people (percentage change in $CovidCases_{it}$) following the initial spread of the virus, which we define as more than one case per one million people. Panel B includes the cross-sectional variables, which, in our setting, are not time-varying. $Debt/GDP_t$ is the ratio of total central government gross debt to GDP. $Expenditures/GDP_t$ measures the government expenditures as a fraction of a country's GDP, while $Interest/GDP_t$ is the ratio of central government interest payment to GDP. $Unemployment_t$ and $GDPGrowth_t$ capture a country's economic conditions. $Rating_t$ represents the credit rating for a given country and ranges from zero (the lowest rating) to 21 (the highest rating). $DocDensity_t$ is the number of doctors per 1000 people. $HealthExp/GDP_t$ is the overall economy expenditure in health-related goods and services as a fraction of GDP. $PopElderly_t$ is the fraction of the population aged 65 and older. $ShareObese_t$ is the share of adults that self-report as obese based on their body mass index. $PopDensity_t$ is the number of people living in a country divided by the country's area in square kilometers. Panel C shows time-varying global variables, such as the daily percentage changes in the VIX index, VIX_t ; the TED Spread, TED_t ; the BBB (BB) minus AAA (BBB) Bank of America U.S. investment grade (speculative) corporate bond indices, $BBB - AAA_t$ ($BB - BBB_t$); and the Dollar factor, $USDollar_t$. Our benchmark sample covers the period between January 1, 2020 and May 18, 2020. Further details on the variables and their sources are provided in Table A-1 of the Internet Appendix.

Panel A: Time Series Variables								
	N	Mean	Std	Min	P25	Median	P75	Max
CDS_{it}	2970	0.004	0.004	0.001	0.001	0.003	0.006	0.037
$CovidCases_{it}$	2970	0.588	1.101	0.000	0.000	0.008	0.600	5.109
$CovidCases_{it}^{1/million}$	1638	1.066	1.299	0.001	0.119	0.481	1.674	5.109
$\Delta COVICases_{it}^{1/million}$	1638	0.150	0.672	-0.072	0.008	0.036	0.135	18.000
$Equity_{it}$	2794	-0.001	0.025	-0.169	-0.009	0.001	0.009	0.129
FX_{it}	2970	0.000	0.007	-0.038	-0.003	0.001	0.003	0.080
Panel B: Cross-Sectional Variables								
	N	Mean	Std	Min	P25	Median	P75	Max
$Debt/GDP_t$	30	71.820	48.816	8.265	37.923	60.022	97.092	237.130
$Expenditures/GDP_t$	30	33.007	8.935	16.442	26.117	35.519	39.004	47.512
$Interest/GDP_t$	30	1.603	1.007	0.076	0.960	1.403	2.385	3.820
$Unemployment_t$	30	5.836	3.459	2.000	3.867	4.912	6.433	18.567
$GDPGrowth_t$	30	2.777	1.493	0.774	1.725	2.519	3.454	8.170
$Rating_t$	30	17.772	3.328	6.952	15.667	18.500	21.000	21.000
$DocDensity_t$	28	3.534	0.707	2.340	3.120	3.400	3.995	5.180
$HealthExp/GDP_t$	30	9.329	2.178	5.866	7.846	9.175	10.470	16.937
$PopElderly_t$	30	18.627	3.239	11.654	16.026	19.152	19.861	28.137
$ShareObese_t$	30	22.477	6.247	4.300	20.400	22.150	26.000	36.200
$PopulationDensity_t$	30	147.282	152.104	3.249	30.386	104.923	215.521	529.652
Panel C: Common Control Variables								
	N	Mean	Std	Min	P25	Median	P75	Max
$UsRet_t$	91	-0.000	0.033	-0.120	-0.016	0.002	0.012	0.094
ΔVIX_t	91	0.015	0.129	-0.234	-0.068	-0.013	0.066	0.465
ΔTED_t	88	0.011	0.211	-0.286	-0.087	-0.013	0.049	1.533
$\Delta BBB - AAA_t$	95	0.011	0.057	-0.137	-0.013	0.000	0.016	0.381
$\Delta BB - BBB_t$	95	0.021	0.110	-0.198	-0.056	-0.004	0.080	0.382
$\Delta USDollar_t$	99	0.001	0.006	-0.020	-0.002	0.001	0.003	0.029

ward large cross-country differences in countries' vulnerability to the virus. Finally, in Panel C of Table 1, we report statistics for the macroeconomic and financial control variables.

In Table 2, we show that the 23 U.S. states in our sample are mostly comparable to the countries in terms of their characteristics, although they have significantly smaller amounts of government debt, interest payments, and expenditures, measured as a fraction of state GDP. As we only compare credit risk across U.S. states, we do not adjust state-level debt for federal government debt. In terms of sovereign default risk, the distribution of CDS premiums for U.S. states, reported in Panel A of Table 2, is remarkably similar to that reported for countries in Panel A of Table 1. For example, the least creditworthy state, Illinois, has a maximum CDS spread of 400 bps during our sample period, compared to the 370 bps reported during

that same period for Greece. Infection rates per capita are higher for states than for countries, ranging up to about 35 infections per 1000 inhabitants. Because we measure the dynamics for states at a weekly frequency, the spread of the disease appears more dramatic, with a 96% average weekly increase in infections, corresponding to a daily increase of 10%.

4.3. Measuring fiscal capacity

For each metric of fiscal capacity, we calculate a country's rank, such that the country with the largest fiscal constraint (e.g., the highest debt-to-GDP ratio) has a value of one, and the country with the lowest fiscal constraint has a value of zero. As higher GDP growth corresponds to fewer fiscal constraints, we sign this variable so that the rankings are comparable across metrics.

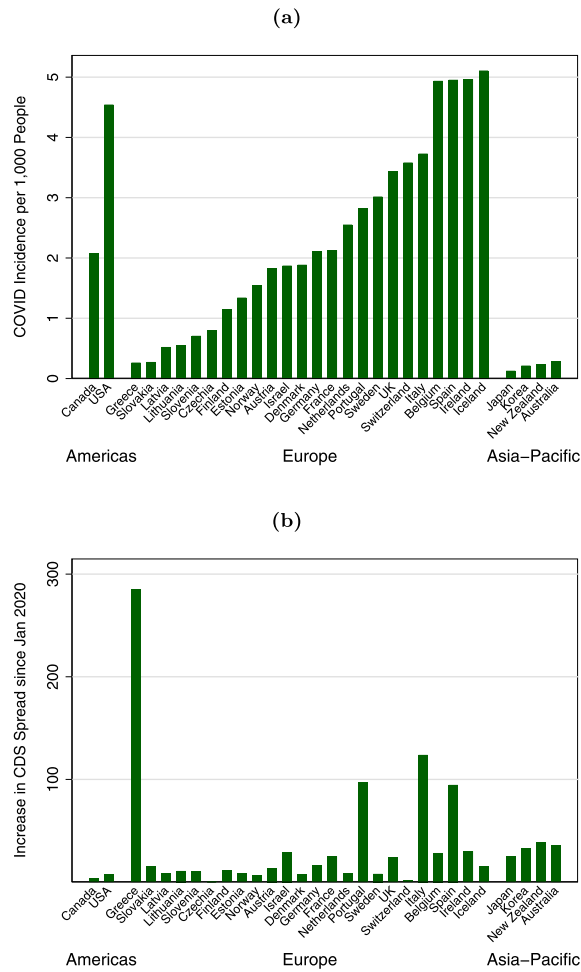


Fig. 2. Sovereign credit risk and COVID-19 infections. In Panel (a) of this figure, we show for each country in our sample the maximum number of registered COVID-19 infections per 1000 people. In Panel (b), we show for each country the change (in bps) in five-year sovereign CDS spreads from January 1, 2020 to their peak values before May 18, 2020. Our sample consists of 30 developed countries from the IMF economic database for which we could obtain reliable information on both CDS spreads and COVID-19 infections. For CDS contracts, we use five-year USD denominated CDS contracts on senior foreign debt with the full restructuring credit event clause. CDS data are from Markit. The COVID-19 data are from the European Centre for Disease Prevention and Control and cover the period from January 1, 2020 to May 18, 2020. We scale by the population of the corresponding country, based on estimates for 2018 provided by the OECD. We group countries into three regions: the Americas, Europe, and Asia-Pacific.

We construct a single measure of fiscal constraints, $FiscallyConstrained_i$, rescaled to a range from zero to one, by averaging across the ranks of all six metrics. We find ranking to be a particularly powerful method with which to compare and interpret results across measures of fiscal and economic constraints, as it is less sensitive to outliers. In robustness tests, we show that employing rank variables rather than the underlying numerical values does not alter the regression parameters' statistical significance.

Fig. 3 shows the distribution of the variable $FiscallyConstrained_i$ and, hence, the fiscal capacity rank for the 30 countries in our sample. The most fiscally constrained countries among our sample of developed economies belong to Southern Europe, while Australia, Germany, and Switzerland are among the least constrained. We report the individual values of the fiscal constraints measure in Table A-2 in the Internet Appendix, together

with the values of its components. Relying on a measure of fiscal capacity that summarizes the multiple dimensions of fiscal and economic health into a single variable allows us to identify fiscal capacity more completely than if we were to rely on any one of the six indicators.³

4.4. Preliminary evidence

In Fig. 4, we provide preliminary evidence on the disparate evolution of sovereign default insurance premiums

³ One interesting example to consider is the classification of Japan. While its debt-to-GDP ratio is the largest in the sample, Japan is able to raise new debt with ease. This is due to its low cost of debt, its relatively high credit rating, and the fact that it ranks 12th out of 30 countries in terms of overall fiscal constraints. Japan underscores the challenges associated with capturing a country's fiscal capacity by any single metric (e.g., Kose et al., 2017).

Table 2

Descriptive statistics for U.S. states.

In this table, we report the descriptive statistics for the variables we employ in our analysis of the U.S. states sample. Panel A reports state-specific time-varying variables, such as the state's CDS spread, CDS_{it} , and the number of COVID-19 cases per 1000 people, $CovidCases_{it}$. $CovidCases_{it}^{1/million}$ ($\Delta COVIDCases_{it}^{1/million}$) is the number of COVID-19 infections per 1000 people (percentage change in $CovidCases_{it}$) following the initial spread of the coronavirus, which we define as there being more than one case per one million people. Panel B includes the cross-sectional variables, which, in our setting, are not time-varying. $Debt/GDP_i$ is the ratio of total state debt to GDP. $Expenditures/GDP_i$ measures the state's expenditures as a fraction of the state's GDP, while $Interest/GDP_i$ is the ratio of state interest payment to GDP. $Unemployment_i$ and $GDPGrowth_i$ capture a state's current economic conditions. $UnfundedPension_i$ is the fraction of the state's pension plan that is not funded by the plan's current assets. $Rating_i$ represents the credit rating for a given state and ranges from one (the lowest rating) to seven (the highest rating). $DocDensity_i$ is the number of doctors per 1000 people. $HealthExp/GDP_i$ is the overall economy's expenditure in health-related goods and services as a fraction of GDP. $PopElderly_i$ is the fraction of the population aged 65 and older. $ShareObese_i$ is the share of adults that self-report as obese based on the body mass index. $PopDensity_i$ is the number of people living in a country divided by the country's area in square kilometers. The observations in Panel A are based on weekly averages. Our benchmark sample covers the period between January 1, 2020 and October 15, 2020. Further details on the variables and their sources are provided in Table A-1 of the Internet Appendix.

Panel A: Time Series Variables								
	N	Mean	Std	Min	P25	Median	P75	Max
CDS_{it}	894	0.006	0.006	0.001	0.002	0.003	0.006	0.040
$CovidCases_{it}$	894	7.517	8.551	0.000	0.001	3.742	13.361	35.502
$CovidCases_{it}^{1/million}$	667	10.076	8.499	0.001	2.273	8.585	16.609	35.502
$\Delta CovidCases_{it}^{1/million}$	657	0.961	2.755	-0.019	0.048	0.111	0.292	26.000
Panel B: Cross-Sectional Variables								
	N	Mean	Std	Min	P25	Median	P75	Max
$Debt/GDP_i$	23	6.495	3.320	2.045	4.460	6.385	7.222	14.457
$Expenditures/GDP_i$	23	12.219	2.450	8.757	10.493	12.305	13.555	19.833
$Interest/GDP_i$	23	0.243	0.129	0.078	0.126	0.219	0.306	0.574
$Unemployment_i$	23	3.895	0.536	2.942	3.458	3.983	4.258	4.858
$GDPGrowth_i$	23	5.093	1.261	2.760	4.440	4.700	5.440	8.220
$UnfundedPension_i$	23	28.957	17.760	-3.000	17.000	26.000	40.000	64.000
$Rating_i$	23	5.478	1.675	1.000	4.000	6.000	7.000	7.000
$DocDensity_i$	23	3.291	0.889	2.062	2.606	3.125	3.973	5.481
$HealthExp/GDP_i$	23	13.606	2.405	10.357	11.974	13.199	15.653	20.757
$PopElderly_i$	23	16.130	2.029	11.000	15.000	16.000	17.000	21.000
$ShareObese_i$	23	30.852	3.378	25.700	27.800	30.900	33.000	39.500
$PopulationDensity_i$	23	117.729	112.627	9.498	39.074	78.224	158.765	461.585

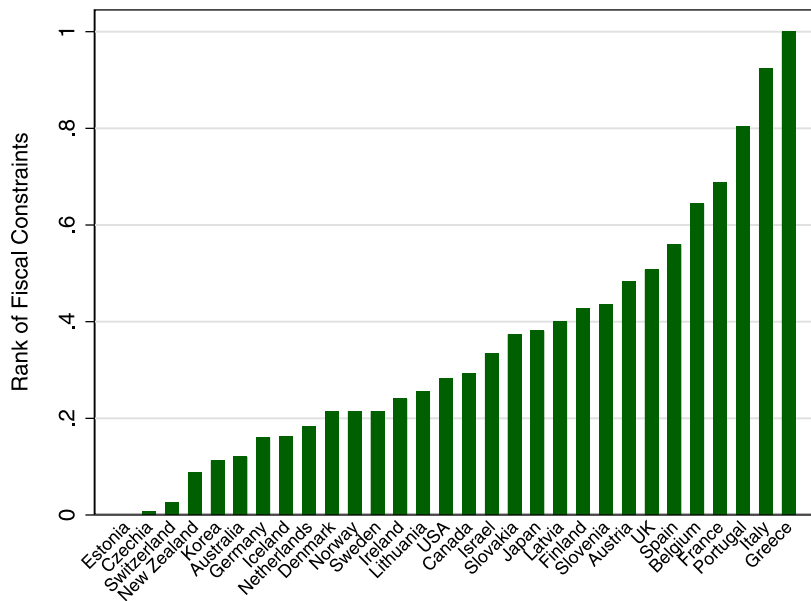


Fig. 3. Rankings of fiscal capacity. In this figure, we show the value of the variable $FiscallyConstrained_i$ for our sample of 30 countries. The variable is an average of the rank of six fiscal and economic indicators: debt, expenditures, interest payments scaled by GDP, GDP growth, unemployment rate, and credit rating. All variables are ranked so that, for each indicator, the most fiscally constrained country has a rank of one, and the least fiscally constrained country has a rank of zero. Since credit ratings are already inherently ranked, we scale them so that they are bounded by zero and one. The average rank is then scaled to take a value between zero and one. Data are obtained from the OECD, World Bank, and IMF, and refer to the country's standing in 2018.

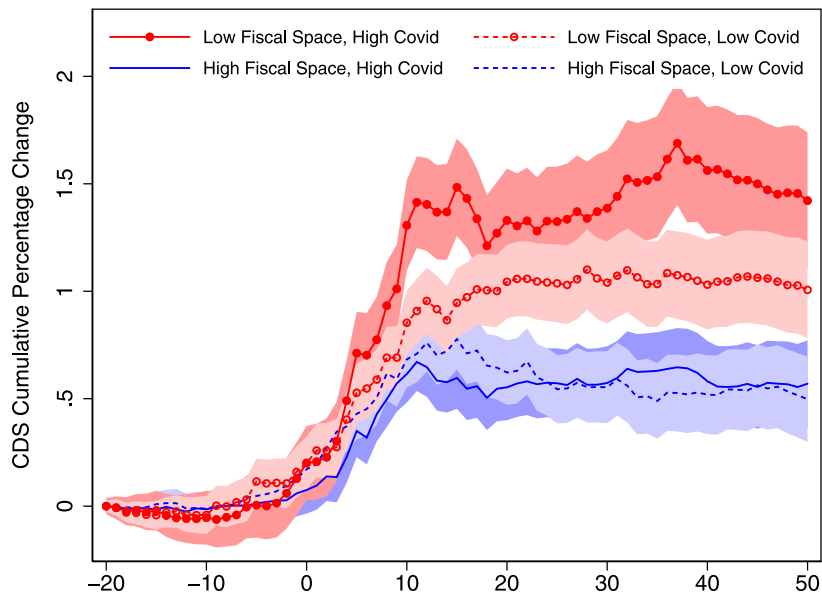


Fig. 4. CDS dynamics by COVID-19 infections and fiscal capacity. In this figure, we show the differences in evolution of sovereign CDS spread dynamics after double sorting countries into those that have above and below median fiscal space and those with above and below median COVID-19 infections. We implement an event study analysis, using as the event date the first day that the country-level incidence of COVID-19 surpasses one in a million cases. We determine fiscal capacity based on six indicators: government debt, expenditures, interest payments as a fraction of GDP, unemployment rate, GDP growth, and country credit ratings. We report for each group the average cumulative percentage change in CDS premiums from 20 days before to 50 days after the event day. We examine the increase in CDS spreads of countries with low and high fiscal space, conditioning on countries with high and low COVID-19 infection rates. Confidence bands indicate a two-standard-deviation range around the point estimate, and are calculated as $\sqrt{t} * \sigma_i$, where t is the number of days since day -20 and σ_i is the standard deviation of average returns for one of the four country groups i . Our sample spans the period between January 1, 2020 and May 18, 2020. Fiscal space indicators are based on their value at the end of 2018. Data on CDS spreads are obtained from Markit, while fiscal space indicators are obtained from the IMF, the OECD, and the World Bank.

between countries with high and low fiscal capacity and between countries with high and low COVID-19 penetration rates. Specifically, we consider countries to have low fiscal space if their fiscal capacity measure is below the sample median, and high otherwise. Similarly, we consider countries to have low (high) coronavirus penetration if they experience below (above) median COVID-19 infections per 1000 people in our sample.

We implement an event study analysis, using, as the event date, the first day that the country-level incidence of COVID-19 surpasses one in a million cases. We double-sort the 30 countries in our sample into four groups based on the median levels of fiscal capacity and the median levels of COVID-19 infections, above and below in each case, and in combination, e.g., high fiscal capacity and high infection rate. For each group, we compute the average cumulative CDS percentage change from 20 days before to 50 days after the event day.

Fig. 4 underscores that the impact of a high number of COVID-19 infections on sovereign risk indicators is significantly greater for countries with high fiscal capacity than for countries with low fiscal capacity. Specifically, for countries with a low incidence of COVID-19 (dashed lines), the average cumulative CDS percentage increase is about 50 and 100% for fiscally unconstrained and fiscally constrained countries, respectively. In contrast, for countries with a high incidence of COVID-19 (solid lines), the average

cumulative CDS percentage increase is about 50 and 150% for unconstrained and constrained countries, respectively.

Despite similar infection rates, markets thus perceive the sovereign credit risk of countries with low fiscal capacity to be more adversely affected by the pandemic. These differences are economically meaningful. Conditional on having a high incidence of COVID-19 infections, CDS spreads for countries with a limited fiscal space increase, on average, about three times as much over a window of 50 days than they do for fiscally unconstrained countries. Next, we proceed with a more formal analysis, which shows how fiscal space is a primary amplifier for the impact of the pandemic on sovereign credit risk.

5. Main results

In Section 5.1, we examine the unconditional relation between the intensity of the virus's penetration and the measures of sovereign credit risk. In Section 5.2, we study how fiscal capacity contributes to this relation. We provide evidence on fiscal capacity thresholds in Section 5.3 and similar evidence on the sensitivity of sovereign credit risk to U.S. states' COVID-19 infection rates in Section 5.4. We discuss robustness tests in Section 5.5, the effect of public health policies in Section 5.6, and channels in Section 5.7.

Table 3

COVID-19 infections and sovereign credit spreads.

In this table, we report the estimated coefficients from the panel regression analysis of the relation between the percentage changes in the number of COVID-19 cases for country i on day t , $\Delta\text{COVIDCases}_{it}$, and the corresponding percentage changes in sovereign CDS spreads, ΔCDS_{it} , for the 30 countries in our sample. We control for local determinants of credit risk, such as the return in the country's major stock index, Equity_{it} ; the foreign exchange rate return, FX_{it} ; and global determinants, which include the return on the S&P 500 index, UsRet_t ; the percentage changes in the VIX index, ΔVIX_t ; the TED spread, ΔTED_t ; investment grade (speculative grade) bond spreads, defined as the difference between BBB (BB) and AAA (BBB) corporate bond yield indices, $\Delta\text{BBB} - \text{AAA}_t$ ($\Delta\text{BB} - \text{BBB}_t$); and the dollar factor, USDollar_t . We report the adjusted R^2 , the number of observations, and whether regressions contain daily time or country fixed effects. Standard errors are two-way clustered at the country- and day-level, and *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}
$\Delta\text{COVIDCases}_{it}$	0.071*** (3.903)			0.035*** (3.505)	0.035*** (3.551)	0.017* (1.731)
Equity_{it}			-0.582*** (-4.182)	-0.550*** (-4.141)	-0.539*** (-4.138)	-0.366*** (-3.306)
FX_{it}			-0.387 (-0.732)	-0.347 (-0.685)	-0.354 (-0.696)	-0.066 (-0.131)
UsRet_t		-0.175 (-1.691)	-0.075 (-0.669)	-0.080 (-0.738)	-0.081 (-0.757)	
ΔVIX_t		-0.008 (-0.267)	-0.015 (-0.535)	-0.015 (-0.552)	-0.014 (-0.528)	
ΔTED_t		0.012 (0.748)	0.018 (1.182)	0.013 (0.803)	0.012 (0.779)	
$\Delta\text{BBB} - \text{AAA}_t$		0.205** (2.162)	0.176** (2.235)	0.118 (1.547)	0.118 (1.530)	
$\Delta\text{BB} - \text{BBB}_t$		0.075** (2.222)	0.032 (1.046)	0.036 (1.246)	0.037 (1.250)	
$\Delta\text{USDollar}_t$		0.958* (1.715)	0.919 (1.373)	0.976 (1.505)	0.992 (1.524)	
Adj. R^2	0.061	0.193	0.239	0.250	0.253	0.330
Obs	2970	2640	2559	2559	2559	2793
# Countries	30	30	30	30	30	30
Time FE	No	No	No	No	No	Yes
Country FE	No	No	No	No	Yes	Yes

5.1. Sensitivity of sovereign credit spreads to COVID-19 infections

Guided by our first hypothesis, we test whether daily fluctuations in sovereign CDS premiums are related to daily fluctuations in COVID-19 infections in order to establish the relation between a country's coronavirus spread and its credit risk.

We report these results in Table 3. In column (1), we show the univariate relation between percentage changes in CDS spreads and percentage changes in the number of COVID-19 infections. The coefficient estimate of the sensitivity of sovereign risk to the coronavirus transmission is positive and statistically significant, with a value of 0.071. This number is also economically meaningful, as it translates to a 2.1% increase in CDS premiums for a 30% increase in COVID-19 infections. For 238 out of 2970 country-day observations in our benchmark sample period, the daily increase in the number of COVID-19 cases is larger than 30%. The R^2 of this univariate regression, 6.1%, reflects a noteworthy correlation of 25% between changes in credit risk and changes in COVID-19 cases.

As shown in Fig. 1, the pandemic shock affects almost all countries within a few weeks of each other. A potential issue with our finding may be that the univariate relation between sovereign risk and COVID-19 infections may pick up correlations with other factors that share the same time trend. To allay this concern, we regress percentage changes in CDS spreads on global macroeconomic and fi-

ancial risk factors and present the results in column (2). Sovereign CDS spreads tend to be higher when returns on the S&P 500 stock index are low or corporate credit spreads are high. These spreads are also higher when the U.S. dollar strengthens. This evidence is consistent with global risk factors explaining part of the time variation in credit spreads, consistent with the findings of Pan and Singleton (2008) and Longstaff et al. (2011).

In column (3) of Table 3, we add the domestic stock market return and the exchange rate relative to the U.S. dollar as country-specific control variables. While the investment grade credit spread remains significant in explaining sovereign CDS dynamics, it is the domestic stock market return that is dominant in the specification. The estimated coefficient suggests that the economic magnitude is also large, as a 1% increase in domestic stock returns is matched, on average, with a 0.582% increase in CDS spreads. That a country's own financial market metrics are more important than U.S. risk factors in explaining sovereign credit risk dynamics is consistent with the evidence on the time-varying relevance of global and local risk factors (Augustin, 2018). Accordingly, even while affecting essentially every country around the globe, the impact of the pandemic on sovereign credit risk perceptions appears to be country specific.

The specification in column (4) shows that sovereign credit spreads respond positively to country-specific increases in COVID-19 infections, lending support to our first hypothesis. This effect is above and beyond the effect that

Table 4

COVID-19 infections, credit risk, and fiscal capacity.

In this table, we report the estimated coefficients from the panel regression analysis aimed at investigating the determinants of the relation between daily percentage changes in COVID-19 infections for country-*i* on day-*t*, $\Delta\text{COVIDCases}_{it}$, and sovereign CDS spreads, ΔCDS_{it} . We interact the variable of interest, $\Delta\text{COVIDCases}_{it}$, with indicators of the fiscal health of a country: gross central government debt, Debt/GDP_i ; government expenditures, $\text{Expenditures}/\text{GDP}_i$; and interest payments, $\text{Interest}/\text{GDP}_i$, all measured as a fraction of GDP. We complement the analysis considering economic indicators, such as the country's unemployment rate, Unemployment_i , and GDP growth, GDPGrowth_i . Finally, we consider the effect of cross-sectional differences in credit rating, Rating_i . Rather than using the values of the indicators, we use their rank in the sample of countries normalized to one, i.e., the country with the smallest expenditures relative to GDP will have $\text{Expenditures}/\text{GDP}_i = 0$, while the country with the largest expenditures will have $\text{Expenditures}/\text{GDP}_i = 1$. Since rating is already a rank variable, we simply normalize it, so that the country with the highest credit rating has $\text{Rating}_i = 1$. We also include country-specific time-varying explanatory variables, such as the return in the country's stock market index, Equity_{it} , and foreign exchange rate return, FX_{it} . Further details on the variables and their sources are provided in Table A-1 of the Internet Appendix. All specifications include country- and day-fixed effects, and standard errors are two-way clustered at the country- and day-level. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}
$\Delta\text{COVIDCases}_{it}$	-0.033 (-1.376)	-0.002 (-0.078)	-0.024 (-1.151)	-0.028 (-1.178)	0.069*** (2.848)	0.089** (2.322)
$\Delta\text{COVIDCases}_{it} \times \text{Debt}/\text{GDP}_i$	0.098** (2.233)					
$\Delta\text{COVIDCases}_{it} \times \text{Expenditures}/\text{GDP}_i$		0.044 (1.007)				
$\Delta\text{COVIDCases}_{it} \times \text{Interest}/\text{GDP}_i$			0.080* (1.889)			
$\Delta\text{COVIDCases}_{it} \times \text{Unemployment}_i$				0.084** (2.283)		
$\Delta\text{COVIDCases}_{it} \times \text{GDPGrowth}_i$					-0.106** (-2.097)	
$\Delta\text{COVIDCases}_{it} \times \text{Rating}_i$						-0.090* (-1.973)
Equity_{it}	-0.356*** (-3.356)	-0.362*** (-3.295)	-0.362*** (-3.368)	-0.360*** (-3.296)	-0.359*** (-3.327)	-0.362*** (-3.383)
FX_{it}	-0.014 (-0.027)	-0.046 (-0.091)	-0.040 (-0.080)	0.009 (0.017)	-0.047 (-0.094)	-0.030 (-0.060)
Adj. R ²	0.338	0.331	0.336	0.336	0.339	0.334
Obs	2793	2793	2793	2793	2793	2793
# Countries	30	30	30	30	30	30
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes

the pandemic may have on a country's stock market. The elasticity of CDS spreads to COVID-19 infections is 0.035 and statistically significant at the 1% level. The elasticity parameter of 0.035 means that, after controlling for macro- and country-specific risk factors, a one-day 30% increase in the incidence of COVID-19 infections translates into a 1.1% increase in CDS spreads. The magnitude of this coefficient hardly changes when we include country fixed effects in column (5), indicating that this relation is primarily driven by within-country variations. Including daily time fixed effects, as we do in column (6), to absorb the positive trend in sovereign spreads and macro variables during the pandemic, reduces the magnitude of the estimated elasticity, but it remains marginally statistically significant.⁴ However, as we show in the next section, these specifications mask the important cross-country differences in fiscal capacity for explaining the dependence between a country's credit risk and economic shocks.

5.2. The role of fiscal capacity

Our main question is whether a country's fiscal capacity influences its resilience to a global crisis caused by an ex-

ternal shock, such as the coronavirus pandemic, as stated in our second hypothesis. In Table 4, we, therefore, examine whether measures of fiscal capacity influence a country's sovereign risk sensitivity to COVID-19 infection rates.

We first consider three indicators of fiscal capacity that relate directly to a country's financing constraints: gross central government debt, government expenditures, and interest payments. All three are measured as a fraction of GDP. We complement our analysis by considering two indicators of the country's economic cycle (the unemployment rate and the GDP growth rate) and, finally, its sovereign credit rating. These indicators are intimately related to the fiscal space of the country. All else equal, a higher unemployment rate decreases income tax receipts and increases unemployment benefits. Lower GDP growth decreases consumption and tax revenue. A low fiscal rating decreases investors' demand for the country's debt, hampering the country's ability to issue new debt at a low cost. Hence, all of these dimensions relate to the tightness of the country's fiscal space.

We transform each indicator into a rank variable of fiscal capacity. Ranks are calculated such that the country with the lowest value for a given indicator has a rank of zero, and the country with the highest value a rank of one. We present all of our results using the rank variables, as they reduce the sensitivity of our results to outliers,

⁴ The inclusion of time fixed effects absorbs the variation in macro-variables, thus we exclude them from the regression in column (6).

Table 5

COVID-19 infections, credit risk, and fiscal capacity.

In this table, we report the estimated coefficients from the panel regression analysis aimed at ruling out the supposition that the stronger relation between daily percentage changes in COVID-19 cases for country-*i* on day-*t*, $\Delta COVIDCases_{it}$, and sovereign CDS spreads, ΔCDS_{it} , for countries with low fiscal space is determined by confounding factors. We interact the variable of interest, $\Delta COVIDCases_{it}$, with a continuous rank variable that measures a country's fiscal constraints, $FiscallyConstrained_i$, and with continuous rank variables that capture a country's exposure to a high penetration of COVID-19. Specifically, we create the following rank variables: the strain on a country's health system, $StrainedHealthSystem_i$, which is decreasing in the number of doctors per 1000 inhabitants and the fraction of GDP spent on healthcare; the degree of risk that the coronavirus poses to the population, which is higher in the fractions of the elderly and obese, $PopulationAtRisk_i$; and the density of a country's population, $PopulationDensity_i$. The specification in column (1) includes the global variables employed in Table 4. All specifications include country-specific time-varying explanatory variables, such as the return in each country's stock market index, $Equity_{it}$, and the foreign exchange rate return, FX_{it} . The specifications in columns (2)–(5) include country- and day-fixed effects. Standard errors are two-way clustered at the country- and day-level for the specifications in columns (1)–(5), and at the day-level for column (6)–(7). For the analysis in this table, the sample consists of 30 countries, with the exceptions of column (6), where it is restricted to Eurozone countries, and column (7) where it is restricted to countries outside the Eurozone. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}
$\Delta COVIDCases_{it}$	-0.019 (-1.030)	-0.035* (-1.714)	-0.007 (-0.255)	-0.028 (-0.787)	-0.047** (-2.260)	-0.030 (-1.111)	-0.035 (-1.491)
$\Delta COVIDCases_{it} \times FiscallyConstrained_i$	0.156*** (3.347)	0.154*** (3.168)	0.158*** (2.977)	0.159*** (3.033)	0.153*** (3.101)	0.145*** (2.899)	0.110* (1.807)
$\Delta COVIDCases_{it} \times StrainedHealthSystem_i$			-0.056 (-0.935)				
$\Delta COVIDCases_{it} \times PopulationAtRisk_i$				-0.018 (-0.273)			
$\Delta COVIDCases_{it} \times PopulationDensity_i$					0.021 (0.687)		
$FiscallyConstrained_i$	-0.002 (-0.417)						
$Equity_{it}$	-0.529*** (-4.180)	-0.351*** (-3.349)	-0.312*** (-2.851)	-0.351*** (-3.352)	-0.352*** (-3.370)	-0.637*** (-5.760)	-0.009 (-0.087)
FX_{it}	-0.250 (-0.496)	0.035 (0.069)	0.166 (0.336)	0.033 (0.066)	0.033 (0.065)		0.408 (1.621)
Adj. R ²	0.269	0.345	0.309	0.344	0.345	0.456	0.238
Obs	2559	2793	2608	2793	2793	1507	1286
# Countries	30	30	30	30	30	16	14
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Global Controls	Yes	No	No	No	No	No	No

such as Japan, which has a debt-to-GDP ratio of greater than 200. Our results are, however, robust to including the raw fiscal capacity variables. We discuss robustness tests in Section 5.5.

The results reported in columns (1)–(6) of Table 4 consistently show that sovereign credit risk is more sensitive to the intensity of the coronavirus penetration rate when a country is in worse fiscal shape, thereby supporting our second hypothesis. The coefficients of all of the relevant sovereign credit risk variables are statistically significant, except for the expenditure variable. All of the interaction terms also have the expected sign. Greater debt, expenditures, interest payments as a fraction of GDP, and higher unemployment all lead to larger coefficient estimates, while better credit ratings and higher GDP growth reduce the magnitude of the sovereign CDS–COVID-19 infection relation.

The magnitudes of the interaction coefficients are also economically meaningful. Based on the coefficient for $\Delta CovidCases_{it}$ and on its interaction term with debt-to-GDP in column (1), 0.098, a one-day 30% increase in COVID-19 infections translates into a 0.5% increase in CDS spreads for a country at the 50th percentile of the debt-to-GDP distribution. However, for a country at the 75th percentile of the rank distribution, the effect is significantly

larger: a daily 30% increase in infection rates results in a daily increase of 1.2% in CDS premiums.⁵

In Table 5, we construct one aggregate metric of fiscal constraints. Specifically, we sign all measures of fiscal capacity such that higher values indicate lower fiscal capacity. We then aggregate them into one rank indicator, $FiscallyConstrained_i$, which captures a country's fiscal constraints across multiple dimensions. The results reported in columns (1)–(5) all indicate that, unconditionally, there is no meaningful relation between the intensity of the infection rates and sovereign credit risk after controlling for time-varying risk factors at the country level, unobserved time-invariant country characteristics, or common unobserved cross-country effects. Moreover, unconditionally, there is no significant relation between sovereign risk and fiscal constraints, as demonstrated by the insignificant estimated coefficient for the fiscally constrained rank variable reported in column (1).

⁵ In Section 5.3, we relax the restriction that the sensitivity of CDS spreads to the spread of the pandemic must increase linearly in the fiscal capacity measures. We find that, for each measure, there is a statistically significant difference in the elasticity between fiscally constrained and unconstrained countries.

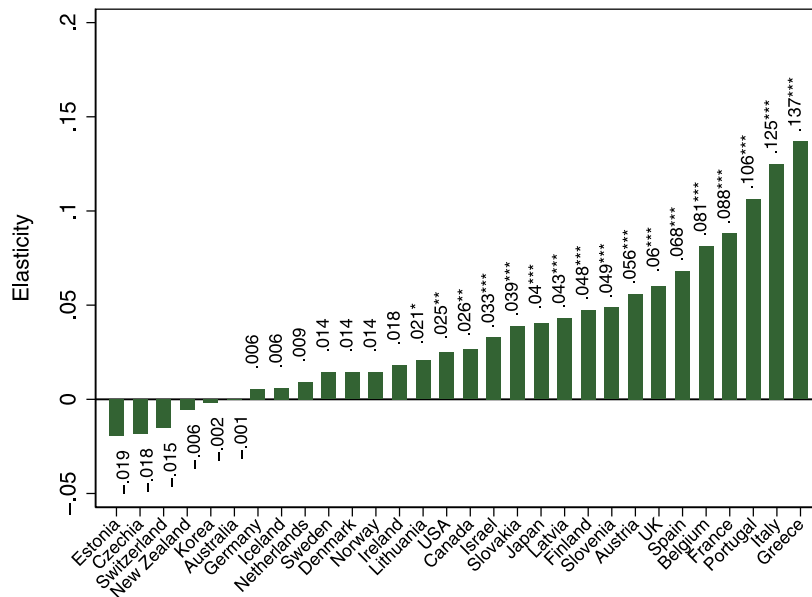


Fig. 5. Elasticity of sovereign credit risk to COVID-19 infections. This figure shows the sensitivity of percentage changes in sovereign CDS spreads to percentage changes in the number of COVID-19 cases for each country in our sample of 30 developed economies. The sensitivity parameters are calculated based on the regression analysis reported in column (1) of Table 5, and are a function of a country's fiscal capacity. Together with the incidences of COVID-19 infections and their interaction with the country's fiscal capacity, the regression includes local and global risk factors, such as the return of the country's major stock market index, foreign exchange rate return, the return of the S&P 500, and the corresponding volatility index. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively. Statistical significance is calculated based on the estimate of a Wald-test from a variance-covariance matrix that is two-way clustered at the country- and day-level. Data on CDS spreads are obtained from Markit. COVID-19 data are from the European Centre for Disease Prevention and Control. Fiscal space indicators are obtained from the IMF, the OECD, and the World Bank.

Nonetheless, regardless of the specification, we find a robust relation between the intensity of infection rates and sovereign credit risk for more fiscally constrained countries. The estimated coefficient is always significant at the 1% significance level. A magnitude of 0.156, based on the finding in column (1), means that a 30% increase in COVID-19 infections increases a country's CDS spreads by 1% if the country is ranked at the 25th percentile of the distribution for fiscal constraints, and by 3% if it is ranked at the 75th percentile of that same distribution. Moving from column (1) to column (2), we observe that the coefficient remains unaffected even after including country and time fixed effects.

The sensitivity of sovereign default risk to the spread of COVID-19 infections increases non-linearly as a function of fiscal capacity. To illustrate this heterogeneity across countries, we plot in Fig. 5 the country-specific estimates, based on the regression specification reported in column (1) of Table 5 and each country's rank value. It is noteworthy that the elasticity estimates for Portugal and France are between ten and 15 times larger than those for Germany and the Netherlands, despite the similarity in COVID-19 infection rates across these countries. Fig. A-1 in the Internet Appendix provides similar evidence of country heterogeneity in the sensitivity of sovereign default risk to each of the six fiscal capacity indicators.

In columns (3)–(5) of Table 5, we attempt to rule out the possibility that our results are driven by confounding factors that capture a country's ex-ante exposure to a

health crisis. For example, if a government has better infrastructure and a more developed healthcare system, it may be better equipped to weather the pandemic. Similarly, if a country's population is younger and fitter, it may be able to recover more quickly from the pandemic, thus limiting the economic consequences of the virus outbreak. We create additional rank variables that capture the strain on a country's healthcare system (*StrainedHealthSystem*), which is decreasing both in the number of doctors per 1000 inhabitants and in the fraction of GDP spent on healthcare; the fraction of the population more vulnerable to COVID-19, which is increasing in the fractions of the elderly and the obese (*PopulationAtRisk*); and the density of a country's population (*PopulationDensity_i*).

The results in columns (3)–(5) of Table 5 indicate that none of these variables alters how financial markets price sovereign creditworthiness as the COVID-19 infections unfold. All of the estimates of the coefficients are statistically insignificant. The coefficient of the variable capturing a country's fiscal constraints is statistically significant and similar in size across all specifications.

5.3. Fiscal thresholds

Our findings from Fig. 5 suggest the existence of a fiscal threshold that determines a country's resilience to external shocks. Specifically, out of our sample of 30 developed economies, the elasticity of sovereign credit risk to the coronavirus spread is significantly different from zero

Table 6

Fiscal capacity threshold in the relation between COVID-19 infections and credit risk.

In this table, we report the values of the fiscal constraint measures that split our sample into subsamples of increasing sensitivity of credit risk to the spread of COVID-19 infections. In Panel A (B) we focus on specifications where the sample is split into two (three) subsamples. In column “Simple Threshold,” for each fiscal capacity variable, we report the value that separates countries into two subsamples, such that, for one of them, the relation between the coronavirus spread and credit risk is significant at the 1% level. We base this split on the specifications in columns (1)–(6) in Table 4, and the corresponding country-specific sensitivities shown in Fig. A-1 of the Internet Appendix. “Country Distribution” indicates how many countries fall above and below the threshold for each measure. For example, based on the specification reported in column (1) of Table 4, for the 15 countries with $Debt/GDP_i$ higher than 59.3%, $\partial \Delta CDS_{it} / \partial \Delta CovidCases_{it}$ is statistically different from zero at the 1% level. In columns (4)–(9) of Panel A, we report the results of estimating $\Delta CDS_{it} = \alpha + \beta_L(q_i \leq \gamma) \Delta CovidCases_{it} + \beta_H(q_i > \gamma) \Delta CovidCases_{it} + \delta^T X_{it} + \varepsilon_{it}$, where q_i is one of the fiscal capacity measures and γ is an endogenously determined threshold that maximizes the explanatory power of the regression. X_{it} contains country- and time-varying controls as per column (1) of Table 5. We report the estimated endogenous threshold γ , parameters β^L and β^H , and number of countries above and below the threshold, for each fiscal variable under the corresponding columns. Panel B reports similar quantities for the two-threshold specification, $\Delta CDS_{it} = \alpha + \beta_L(q_i \leq \gamma_1) \Delta CovidCases_{it} + \beta_M(\gamma_2 \geq q_i > \gamma_1) \Delta CovidCases_{it} + \beta_H(q_i > \gamma_2) \Delta CovidCases_{it} + \delta^T X_{it} + \varepsilon_{it}$. Further details on the variables and their sources are provided in Table A-1 of the Internet Appendix. Standard errors are heteroskedasticity-robust, and the superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: One Threshold								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variable	Simple Threshold	Country Distribution	Endogenous Threshold	Country Distribution	β^L	β^H	Difference β^H and β^L	Ratio β^H and β^L
$Debt/GDP_i$	59.3%	15/15	60.8%***	16/14	0.007	0.060***	0.053**	8.57
$Expenditures/GDP_i$	31.1%	13/17	39.57%***	24/6	0.025**	0.115***	0.090***	4.60
$Interest/GDP_i$	1.4%	15/15	2.64%***	27/3	0.029***	0.146***	0.117***	5.03
$Unemployment_i$	4.8%	15/15	6.43%***	23/7	0.018	0.084***	0.066***	4.67
$GDPGrowth_i$	2.4%	16/14	2.67%***	17/13	0.057***	-0.010	-0.067***	-0.18
$Rating_i$	18.3	16/14	14.48***	4/26	0.101***	0.021*	-0.080***	0.21
$FiscallyConstrained_i$	0.334	13/17	0.435***	22/8	0.012	0.081***	0.069***	6.75
$FiscallyConstrained_i^S$	-0.082	17/13	0.428***	25/5	0.019*	0.101***	0.082***	5.32

Panel B: Two Endogenous Thresholds								
Variable	Lower Threshold	Higher Threshold	Country Distribution	β^L	β^M	β^H	Difference β^M and β^L	Difference β^H and β^M
$Debt/GDP_i$	60.80%***	104.27%***	16/10/4	0.009	0.051***	0.120***	0.042*	0.069**
$Expenditures/GDP_i$	17.32%***	39.57%***	3/21/6	-0.034**	0.031***	0.113***	0.065***	0.082***
$Interest/GDP_i$	0.31%***	2.64%***	3/24/3	-0.028	0.034***	0.145***	0.062**	0.111***
$Unemployment_i$	2.80%***	6.43%***	3/20/7	-0.024	0.021*	0.084***	0.045**	0.063***
$GDPGrowth_i$	2.67%***	4.63%***	17/11/2	0.057***	-0.022	-0.049*	-0.079***	0.071**
$Rating_i$	14.48***	17.47***	4/10/16	0.100***	-0.008	0.032**	-0.108***	0.040
$FiscallyConstrained_i$	0.026***	0.435***	3/19/8	-0.048**	0.019*	0.087***	0.067***	0.068***
$FiscallyConstrained_i^S$	0.428***	1.07***	25/3/2	0.020*	0.087***	0.169***	0.067***	0.082***

at the 1% (5%, 10%) significance level for the 14 (16, 17) most fiscally constrained countries.⁶

To better understand the economic determinants of that threshold, we review similar cutoff levels for the individual components of the aggregate fiscal capacity measure, using the regression specifications reported in Table 4. In Panel A of Table 6 (column (2)), we report, for each metric, the value of the first country for which the sensitivity is significant at the 1% level. Noteworthy, our results suggest that a country’s resilience to external shocks is significantly impaired at debt-to-GDP ratios above 59.3%. This threshold value is remarkably close to the 60% debt-to-GDP ratios predicated in the Eurozone convergence targets, also known as the Maastricht criteria. The existence of a fiscal threshold affecting sovereign borrowing costs is in line with the literature on fiscal limits (Poterba, 1996; Debrun et al., 2008), the relation between fiscal rules and financ-

ing costs (e.g., Eichengreen and Bayoumi, 1994; Poterba and Rueben, 1999; Heinemann et al., 2014; Iara and Wolff, 2014; Hatchondo et al., 2016), and the role of fiscal default (Chernov et al., 2020b).

For most measures, the threshold is roughly equal to the median of the metric’s sample distribution, as highlighted by the (approximately) equal sample splits reported in column (3). For example, the sensitivity of sovereign risk to the pandemic’s spread is significant if unemployment is larger than 4.8% or when expenditures surpass 31.1% of GDP.

To formally establish the existence of fiscal thresholds, we test for the existence of endogenous thresholds following Hansen (2000). Thus, for each fiscal capacity metric q_i , and for our aggregate measure for fiscal constraints, we examine whether there exists a threshold γ above which the sensitivity of sovereign default risk to external shocks is significantly strengthened. Specifically, we estimate endogenous-threshold regressions of the following form:

$$\Delta CDS_{it} = \alpha_0 + \beta_L(q_i \leq \gamma) \Delta CovidCases_{it} + \beta_H(q_i > \gamma) \Delta CovidCases_{it} + \delta^T X_{i,t} + \varepsilon_{it}, \quad (3)$$

⁶ The statistical significance of the elasticities of sovereign risk to COVID-infections conditional on the rank of fiscal capacity is based on a Wald test of the partial derivative $\partial \Delta CDS_{it} / \partial \Delta COVIDCases_{it} = -0.019 + 0.156 \cdot FiscallyConstrained_i$, evaluated at each country’s value of fiscal constraints.

where β_L and β_H define the sensitivities of countries that are below or above the threshold, respectively. This specification, while similar to that in Eq. (2), relaxes the assumption that the sensitivity of CDS premiums to the spread of the pandemic is linear in the fiscal capacity measures. The statistical significance for the regression parameters and their differences is based on two-way standard errors clustered at the day and country level, while the significance of the threshold is based on a bootstrapped procedure following Hansen (2000). We report the results in columns (4)–(9) in Panel A of Table 6.

The endogenous threshold technique confirms the intuition from the simple thresholds obtained through our rank regressions. For each metric, there is a statistically significant threshold, around which there is a significant shift in the exposure to external shocks. The threshold values obtained from these endogenous threshold estimations are similar to the simple thresholds (column (4)), although they are less centered around the sample medians (column (5)).

The ordering of the coefficient estimates reported in columns (6) and (7) confirms that the most fiscally constrained countries also show a stronger sensitivity of credit risk to the spread of COVID-19. A test of the difference between β_L and β_H , reported in column (8), suggests that the difference between high and low sensitivities is consistently significant at the 1% or 5% level. In column (9), we report the ratios of both beta estimates, which can be as high as 8.57 in the case of debt-GDP. This evidence is strongly supportive of our second hypothesis, which suggests that fiscal capacity is a primary amplifier of a country's exposure to external shocks.

We extend the endogenous threshold technique to test for the possibility of two endogenous thresholds. These results are reported in Panel B of Table 6. Focusing on debt-to-GDP ratios, we find significant thresholds at 60.8 and 104.27%, based on the results in columns (2) and (3), respectively. As before, we find that the sovereign risk exposure to COVID-19 infection rates jumps by a factor of six around the first endogenous threshold of 60.8% (columns (5) and (6)); this difference is statistically significant (column (8)). We also find support for a statistically significant second endogenous threshold at a debt-to-GDP ratio of 104.3%. Our results pinpoint an important discontinuity in the relation between sovereign default risk and economic growth with respect to a country's fiscal capacity, consistent with the debate around the nonlinear relation between debt and economic growth (Reinhart and Rogoff, 2010; Checherita-Westphal and Rother, 2011; Herndon et al., 2013; Eberhardt and Presbitero, 2015).

5.4. Evidence for monetary unions

Our results at the country level indicate that, for countries with lower fiscal capacity, sovereign credit risk increases more in response to an increase in COVID-19 infection rates. Because countries in our sample are differentially exposed to fiscal and monetary policy, there is a concern that our results may be tainted by a country's sensitivity to monetary policy shocks. We therefore examine the role of fiscal capacity in subsamples in which the

role of monetary policy is neutralized, as it is common to all member countries or states of a monetary union. These tests, which are the premise of our third hypothesis, help solidify our finding of a fiscal channel in amplifying sovereign default risk exposures to external shocks.

Out of the 30 developed economies in our sample, 16 countries from the Eurozone (i.e., Eurozone members minus Cyprus, Luxembourg, and Malta) have discretion only over their fiscal policy, since their common monetary policy is solely dictated by the ECB. The other 14 countries have independent fiscal and monetary policies. Thus, to validate the conclusion that the relation between sovereign credit risk's sensitivity to COVID-19 infections is truly due to the fiscal capacity channel, we replicate our analysis first for the sample of 16 Eurozone countries and then for the sample of 23 U.S. states. For both samples, monetary policy is common and held fixed at the monetary union level.⁷ Because of the coarser nature of CDS time series data for U.S. states, we conduct the corresponding analysis at the weekly, rather than the daily, frequency.

In columns (6) and (7) of Table 5, we find that the results shown in column (2) of Table 5 hold for both the subsample of Eurozone countries and for countries outside the Eurozone. Thus, we obtain qualitatively similar results as we do for the original sample, supporting the role of the fiscal capacity channel in amplifying the impact of COVID-19 infections on sovereign default risk.

In columns (1) and (2) of Table 7, in line with the country results, we find that there is an unconditional relation between the sovereign credit risk of U.S. states and the number of COVID-19 infections. Moreover, the insignificant coefficient for the CDS price of the U.S. government, reported in column (1), suggests that states' credit risk evolves independently from that of the federal government (although both depend on the global controls, which are included, but not shown, in column (1)). The common variation is absorbed by the time fixed effects that we add to the regression specifications reported in columns (2)–(10). Because the pandemic spread to the U.S. much later than to Europe, we perform the analysis for the U.S. states using the full sample period up to October 2020.⁸

The unconditional relation in columns (1) and (2), however, hides a stronger, conditional relation. In columns (3)–(9) of Table 7, we examine the role of rank variables for fiscal capacity measured at the state level. As in our analysis for countries, we document that U.S. states with low fiscal capacity are penalized more by financial markets. This

⁷ The main ECB policy rates apply equally to all Eurozone members. Quantitative easing (QE) is conducted proportionally to a country's contribution to the ECB's capital, which depends on a country's domestic product and population. With the most recent Pandemic Emergency Purchase Programme announced in late March 2020, the ECB has marginally greater flexibility in terms of the timing of the purchases of member countries' bonds, which must nevertheless reflect each country's capital contributions over the life of the program.

⁸ The month of April marked a more severe impact of the pandemic on the East Coast, an impact that was felt by the rest of the country by June. For the Southern and Western states, the first wave abated as late as September. We illustrate the cross-state heterogeneity in the timing and incidence of the coronavirus spread by replicating Fig. 1 for the U.S. in Fig. A-2 of the Internet Appendix, grouping all states into the four regions identified by the Census Bureau (Northeast, Midwest, South, and West).

Table 7

COVID-19 infections, credit risk, and fiscal capacity for U.S. states.

In this table, we report the estimated coefficients from the panel regression analysis aimed at investigating the relation between weekly percentage changes in COVID-19 cases for state-*i* on day-*t*, $\Delta\text{COVIDCases}_{it}$, and its CDS spread, ΔCDS_{it} . Our analysis includes the 23 U.S. States for which Markit provides CDS spread series. We interact the variable of interest, $\Delta\text{COVIDCases}_{it}$, with rank variables of the fiscal health of each state: gross state government debt, Debt/GDP_i ; state expenditures, $\text{Expenditures}/\text{GDP}_i$; and interest payments, $\text{Interest}/\text{GDP}_i$, all measured as a fraction of GDP. Unemployment_i and GDPGrowth_i capture the current economic conditions for a given state. UnfundedPension_i is the fraction of the state's pension plan not funded by the plan's current assets. We also consider credit ratings, Rating_i . Rather than using the values of the indicators, we use their rank in the sample of 23 states, normalizing it to one, i.e., the state with the smallest expenditures relative to GDP will have $\text{Expenditures}/\text{GDP}_i = 0$, while the state with the largest expenditures will have $\text{Expenditures}/\text{GDP}_i = 1$. We normalize the credit rating so that the state with the highest credit rating has $\text{Rating}_i = 1$. Non - AAA_i is an indicator variable that is equal to one if state-*i* has a credit rating less than AAA, and zero otherwise. We include the CDS spread of the federal U.S. government as an explanatory variable in specifications without time fixed effects. The specifications in columns (2) to (10) also include state fixed effects. Standard errors are heteroskedasticity-robust, and the superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}
$\Delta\text{COVIDCases}_{it}$	0.012*** (3.724)	0.008* (1.792)	0.000 (0.034)	0.005 (0.950)	-0.004 (-0.636)	-0.007 (-1.008)	0.007 (1.313)	-0.005 (-1.131)	0.032*** (6.192)	-0.003 (-0.680)
$\Delta\text{CDS}_{it}^{US}$	-0.036 (-0.882)									
$\Delta\text{COVIDCases}_{it} \times \text{Debt}/\text{GDP}_i$			0.010 (1.492)							
$\Delta\text{COVIDCases}_{it} \times \text{Expenditures}/\text{GDP}_i$				0.004 (0.543)						
$\Delta\text{COVIDCases}_{it} \times \text{Interest}/\text{GDP}_i$					0.019** (2.332)					
$\Delta\text{COVIDCases}_{it} \times \text{Unemployment}_i$						0.021** (2.561)				
$\Delta\text{COVIDCases}_{it} \times \text{GDPGrowth}_i$							0.003 (0.291)			
$\Delta\text{COVIDCases}_{it} \times \text{UnfundedPension}_i$								0.021*** (4.263)		
$\Delta\text{COVIDCases}_{it} \times \text{Rating}_i$									-0.005*** (-5.396)	
$\Delta\text{COVIDCases}_{it} \times \text{Non - AAA}_i$										0.012*** (2.732)
Adj. R ²	0.205	0.267	0.270	0.266	0.277	0.280	0.266	0.292	0.315	0.277
Obs	883	883	883	883	883	883	883	883	883	883
# States	23	23	23	23	23	23	23	23	23	23
Time FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Global Controls	Yes	No	No	No	No	No	No	No	No	No

effect is statistically significant for the various metrics of fiscal constraints, measured at the state level: the magnitude of interest expense relative to GDP, unemployment, and state credit rating. The coefficients of the fraction of expenditures relative to GDP, debt to GDP, and GDP growth rate are insignificant.

Compared to the analysis at the country level reported in Table 4, we complement our analysis for U.S. states with an additional measure of fiscal constraints. We examine UnfundedPension_i , a measure that captures the magnitude of a state's unfunded public pension obligations. For each U.S. state, we calculate the fraction of the state's insufficiently funded public pension obligations based on the plan's current asset holdings (PCT, 2019). Specifically, we measure the level of underfunding as one minus the ratio of a pension plan's assets divided by its accrued pension liabilities. A value of zero would thus correspond to a plan that is fully funded, while a positive value would indicate that the plan is underfunded. In our sample, UnfundedPension_i ranges from -3% for Wisconsin to 64% for New Jersey. As the aggregate state and local pension funding gaps amount to \$1.28 trillion, or 6% of federal GDP (PCT, 2019), they represent a significant liability for

U.S. states. The results in column (8) of Table 5 show that insufficient funding of public pension plans increases the vulnerability of U.S. states' default risk to external shocks.

In column (10), we further examine the differential impact of COVID-19 infection rates on a state's default risk for AAA versus non-AAA rated states. In our sample, eight out of 23 states are rated AAA: Delaware, Florida, Georgia, Maryland, North Carolina, Texas, Utah, and Virginia. The positive and statistically significant coefficient estimate indicates that only states with a credit rating lower than AAA are affected by the intensity of COVID-19 infections.

CDS data are available for only 23 of the 50 states. Correspondingly, our fiscal capacity variables are ranked for this sample of 23 states. To ensure that our results are not driven by our restricted ranking of 23 states, we revisit the rank regressions, whereby we assign ranks based on all 50 states. This may lead to greater differences in the ranks between the individual states, positioning them higher or lower in the aggregate sample. Using this alternative methodology, we obtain similar results; hence, we do not report them.

Similar to our cross-country analysis, we construct one aggregate measure of fiscal constraints based on a state's

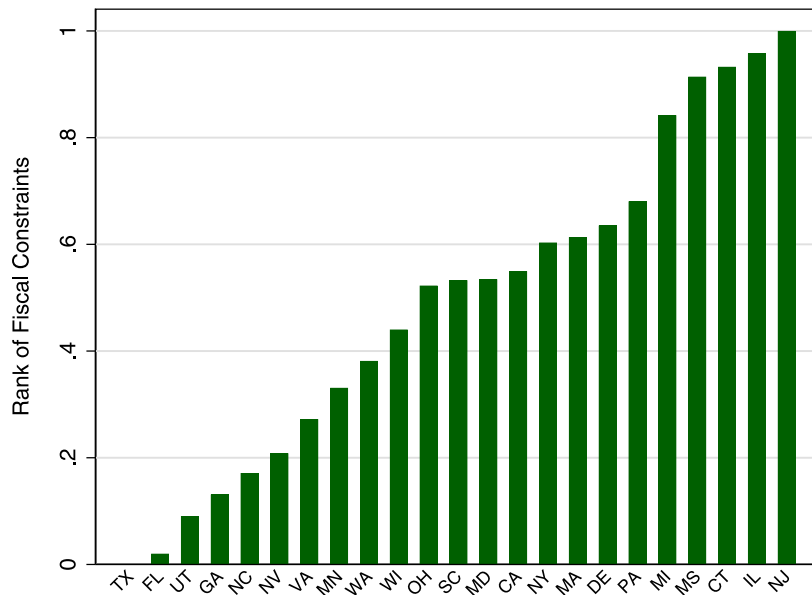


Fig. 6. Rankings of fiscal capacity for U.S. states. In this figure, we present the value of the variable $FiscallyConstrained_i$ for our sample of 23 U.S. states. The variable is an average of the rank of four indicators of fiscal capacity: expenditures, interest payments, debt scaled by GDP, and credit rating. All variables are ranked so that, for each indicator, the most fiscally constrained state has a rank of one, and the least fiscally constrained state has a rank of zero. Since credit ratings are already inherently ranked, we scale them so that they are bound by zero and one. The average rank is then scaled to take a value between zero and one.

aggregate debt, expenditures, and interest expenses as a fraction of GDP, unemployment, GDP growth, public pension funds' funding gap, and credit rating. We report the ranking of the states in Fig. 6. This figure shows that the states with the most constrained fiscal capacity are Connecticut, Illinois, and New Jersey. Texas, Florida, and Utah are the least fiscally constrained. Table A-3 in the Internet Appendix reports the value of the $FiscallyConstrained_i$ metric, together with the values of the seven indicators used to compute it, at a state-by-state level.

The results in columns (1)–(4) of Table 8 confirm our country-level findings in Table 5. Unconditionally, there is an insignificant or negative relation between the incidence of COVID-19 infections and a state's default risk measure. In contrast, for fiscally constrained states, a greater number of infections is significantly associated with an increase in CDS spreads. Furthermore, the significance of the interaction between the fiscal space variable and the incidence of COVID-19 infections is undiminished when we control for the quality of a state's healthcare system, as measured by the number of doctors per 1000 inhabitants; the fraction of GDP spent on healthcare; the fraction of the population who are elderly or obese; and the population density.

5.5. Robustness and discussion

In this section, we implement a number of robustness tests. Central to our identification is that COVID-19 infection rates are reasonable approximations for exogenous shocks to future growth expectations. The cross-country timing and incidence of COVID-19 infections during the

first wave of the pandemic is likely to be as close to an exogenous shock to economic growth as we can hope for. It is also available for all 30 OECD countries in our sample and is uniformly measured, making it directly comparable across all countries.

Nonetheless, our first robustness tests examine other plausible approximations of economic growth shocks in Table A-4 in the Internet Appendix, including country stock returns; Google data on the time users spend at retail stores, at home, or at work; countrywide location data from Apple on driving and walking; and COVID-19 news and sentiment indices created by a commercial vendor, Ravenpack. The results using alternative candidates for economic growth shocks are largely in line with our conclusions based on COVID-19 infection rates. As an alternative measure of economic growth shocks, we also examine the number of deaths caused by the coronavirus. In Fig. A-3 of the Internet Appendix, we show that death and infection rates are highly correlated. Their cross-correlations peak at a lag of ten days, suggesting that infection rates are a leading indicator. We opt to use the lead indicator as our main measure of economic shocks.

Second, we examine alternative formulations of our measure of fiscal constraints. Our benchmark specification considers rank variables that are less sensitive to outliers. In Internet Appendix Table A-5, we show that our results are robust to including the raw fiscal capacity variables. Indeed, we show that Ireland, which has a GDP growth estimate of 8%, significantly impacts the elasticity for GDP growth (columns (5) and (6)). In column (7) of Table A-5 of the Internet Appendix, we replicate our analysis using

Table 8

COVID-19 infections, credit risk, and fiscal capacity for U.S. states.

In this table, we report the estimated coefficients from the panel regression analysis, which aims to demonstrate that confounding factors are not driving the stronger relation between daily percentage changes in COVID-19 cases for state-*i* on day-*t*, $\Delta\text{COVIDCases}_{it}$, and sovereign CDS spreads, ΔCDS_{it} , for states with low fiscal space. We interact the variable of interest, $\Delta\text{COVIDCases}_{it}$, with a continuous rank variable that measures a state's fiscal constraints, $\text{FiscallyConstrained}_i$, and with rank variables that capture a state's exposure to a high penetration of the virus. Specifically, we create rank variables for: the strain of a state's health system, $\text{StrainedHealthSystem}_i$, which is decreasing in the number of doctors per 1000 inhabitants and in the fraction of GDP spent on healthcare; the degree of risk that the coronavirus poses to the population, which is increasing in the fractions of the elderly and obese, $\text{PopulationAtRisk}_i$; and the density of a state's population, $\text{PopulationDensity}_i$. All specifications include state- and day-fixed effects. Standard errors are heteroskedasticity-robust, and the superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}	ΔCDS_{it}
$\Delta\text{COVIDCases}_{it}$	-0.010* (-1.858)	-0.015 (-1.158)	0.001 (0.174)	-0.014** (-2.415)
$\Delta\text{COVIDCases}_{it} \times \text{FiscallyConstrained}_i$	0.024*** (3.895)	0.026*** (3.328)	0.023*** (4.102)	0.019*** (3.318)
$\Delta\text{COVIDCases}_{it} \times \text{StrainedHealthSystem}_i$		0.007 (0.421)		
$\Delta\text{COVIDCases}_{it} \times \text{PopulationAtRisk}_i$			-0.022* (-1.846)	
$\Delta\text{COVIDCases}_{it} \times \text{PopulationDensity}_i$				0.012** (2.115)
Adj. R ²	0.290	0.290	0.299	0.295
Obs	883	883	883	883
# States	23	23	23	23
Time FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes

an alternative measure, $\text{FiscallyConstrained}_i^S$. This aggregate metric of fiscal constraints is based on the average raw values of the six indicators after they have been rescaled to a cross-sectional distribution with mean zero and a standard deviation of one. The results are similar.

Given the lag in reporting of macroeconomic indicators, we construct our measure of fiscal constraints using the 2018 values for its components. Implicit in our estimation is the assumption that the country ranking, as determined for the end of 2018, does not differ substantially from the ranking at the end of the following year. To support this assumption, we calculate $\text{FiscallyConstrained}_{it}$ for each year in the period 2010–2018 for all 30 countries in our sample. We divide the countries into quintiles and report the year-by-year transition matrix for the probability of a country switching across quintile ranks. We report the transition matrix in Table A-6. The values of the matrix's diagonal support the notion that countries are unlikely to change their relative ranks in any major way. A country in the most (least) fiscally constrained quintile has a 81% (82%) probability of staying in the same quintile the following year.

Third, we repeat our analysis using different sample periods. Our results are robust to extending the sample period until October 15, 2020, thereby including both the first and the second waves of the pandemic. Similarly, our findings remain unchanged if we repeat our analysis using the starting date of February 1, 2020 (i.e., the day after the WHO director-general's declaration that the 2019-nCoV outbreak constituted a public health emergency of international concern), or March 1, 2020 (just before the WHO officially declared the coronavirus outbreak a pandemic). These subsample results, which we report in Table A-7 in the Internet Appendix, corroborate our conclusions.

Fourth, we verify that our results are not driven by any single country. To that end, we replicate the specification in column (2) of Table 5 for 30 subsamples, dropping each country one at a time. We report the resulting parameters for the interaction term between the COVID-19 infection rates and our measure of fiscal constraints in Internet Appendix Fig. A-4. The figure shows that no single country drives the results.

Fifth, we examine alternative regression specifications. As we aim to estimate the elasticity between sovereign credit risk and COVID-19 incidence, our benchmark specifications rely on percentage changes for the dependent variable. We show, in column (1) of Table A-8 in the Internet Appendix, that our results are identical if we use log changes in spreads. In columns (2) to (4), we confirm that our results are robust to using the first differences of CDS premiums as the dependent variable, even after standardizing them (demeaned and standardized using a country's sample mean and standard deviation). Thus, the choice of dependent variable is immaterial to our conclusions. In columns (5)–(7) of Table A-8 in the Internet Appendix, we further corroborate our results using the level of CDS premiums (simple or standardized) and their log-levels.

We also examine different specifications for the independent variable. In columns (1)–(5) of Table A-9 of the Internet Appendix, we show that our conclusions remain unchanged when we instead use cumulative COVID-19 infections scaled by population (column (1)), the level of new COVID-19 infections (column (2)), the natural logarithm of either cumulative or new coronavirus cases (columns (3) and (4)), or the standardized level of total infections (column (5)).

Sixth, according to arbitrage pricing restrictions, CDS spreads and yield spreads should be closely related to each

other. Thus, we examine whether five-year CDS premiums are similar to the spread of five-year yields over maturity-matched overnight indexed swap rates. In Fig. A-5 in the Internet Appendix, we provide a scatter plot of the observations from the 22 countries for which we could obtain matching yield spread data. The estimated linear OLS relation has an intercept of close to zero (-0.00174) and a slope coefficient of 1.01, suggesting that CDS premiums and yield spreads are indeed similar.

Seventh, we estimate the sensitivity of growth rates in CDS premiums to growth rates in COVID-19 infections individually, on a country-by-country basis. In Panel (a) of Fig. A-6 in the Internet Appendix, we plot each country's time-series correlation between growth rates in CDS premiums and growth rates in COVID-19 infections against each country's measure of fiscal capacity. This figure underscores a statistically significant and positive cross-sectional relation between the correlation and fiscal capacity. In Panel (b) of Fig. A-6, we provide similar results using estimated elasticities between the growth rates in CDS premiums and COVID-19 infection rates.

Finally, we note that the overall increase in CDS premiums we observe may be decomposed into the expected default and risk premium components. We conjecture that we mainly capture a risk premium effect, as shocks with similar intensity translate into differential CDS premium responses across countries. We leave such decomposition for future research.

5.6. Public health policy response

We next examine the role of public health policies in response to the coronavirus spread in driving our results. In particular, we collect data on policy implementations from the Oxford COVID-19 Government Response Tracker (OxCGRT) (Hale et al., 2020) and create variables to capture the enactment of policies to foster social distance. We consider school closures ($SchoolClosure_{it}$); workplace closures ($WorkClosure_{it}$); restrictions on public gatherings, including event cancellations; limitations on gatherings of more than 100 people; closures of public transport ($GatheringLimits_{it}$); and curfews that prohibit trips outside of one's residence except for daily essentials ($MovementRestrictions_{it}$). Specifically, these indicator variables are equal to one if one of the lockdown measures is enacted, and zero otherwise.

In columns (1)–(4) of Table A-10 in the Internet Appendix, we first revisit our benchmark result after dropping country-day observations following the first day a lockdown measure is enacted. These unbalanced panel regressions show that both the statistical and economic significance of the main coefficient of interest is similar in periods with and without restrictions.

In column (5) of Table A-10, we drop observations following the first day that any nation-wide social distancing policy is enacted. Since most countries enacted some sort of country-wide social distancing measure, this specification is tantamount to dropping all observations after March 10, 2020, except for those from Sweden and the U.S., which

did not impose lockdown measures during the first wave of the pandemic.⁹ The results are similar.

In column (6) of Table A-10, we show that none of the policy measures are independently related to sovereign credit spreads. In column (7), we include a more conservative specification with country-month fixed effects, effectively absorbing any latent policy variation at the country level. The parameter of interest remains virtually unchanged. In column (8), we include geographical region by day fixed effects to absorb potential regional trends in the pandemic's trajectory. In column (9) of Table A-10, we absorb country-level differences in policy compliance and enforcement by including country-policy fixed effects. There is again little change in the magnitude of the main coefficient of interest.

Finally, in columns (1)–(4) of Table A-11 in the Internet Appendix, we include triple interaction effects between COVID-19 infections, fiscal capacity, and lockdown policy measures to permit fiscally constrained countries with and without lockdown measures to have a differential elasticity of sovereign credit spreads to COVID-19 infections. None of the triple interaction coefficients are statistically significant, suggesting that lockdown measures do not contribute to cross-sectional variation in sovereign credit risk's sensitivity to COVID-19 infection rates for fiscally constrained countries.

We rule out the alternative explanation that countries with larger borrowing costs (i.e., lower fiscal capacity) could be less inclined to implement lockdown measures and therefore face a heightened spread of COVID-19. That conjecture is related to Arellano et al. (2020), who suggest that countries trade off marginal benefits (saved human lives) and costs (reduced consumption and resulting debt crisis) to decide on public lockdowns. Specifically, we test whether countries with lower fiscal capacity are slower to implement social distancing measures. We use the data on countrywide lockdowns to test whether our measures of fiscal capacity and pre-pandemic levels of CDS premiums are correlated with the implementation speed of compulsory workplace and school closures. We report these results in Table A-12 of the Internet Appendix.

We fail to find a positive relation between measures of fiscal constraints and the speed with which governments shut down their economy (defined as the number of days since the coronavirus spread to one person per one million citizens). If anything, we find evidence that developed market countries with less fiscal capacity are more likely to implement lockdowns. That result, however, is driven by the prompt reactions of Italy and Portugal; the former swiftly closed both workplaces and schools before the spread reached the one-per-million level. Our results are likely to differ from those theorized by Arellano et al. (2020), because that paper focuses on developing economies, while our sample consists only of developed countries. Developed countries are believed to

⁹ Our results are unchanged if we drop Sweden and the U.S. from the sample. This is consistent with the results reported in Fig. A-4 in the Internet Appendix, which shows that no single country is driving the magnitude of our findings.

suffer a greater disutility upon the loss of a human life (Viscusi and Masterman, 2017), have safer debt, and enjoy better access to international markets, all factors that incentivize countries to implement lockdowns.

5.7. Alternative channels

Our prior analysis of the subsample of Eurozone countries and U.S. states rules out the monetary policy channel as a key driver of our results. Moreover, in our analysis of public health policies, we find that differential public health responses are also unlikely to play a significant role.

We explore four additional channels that could drive our results. First, we evaluate the financial sector channel, as the bank-to-sovereign risk transfer has been well-established in the literature as an important determinant of sovereign credit risk (e.g., Acharya et al., 2014; Gennaioli et al., 2014). In particular, we capture the ex ante likelihood of a “doom loop” by considering (i) the aggregate level of bank capitalization in each country, measured by the level of Tier 1 regulatory capital to total assets ($BankCap_{i,t}$); (ii) the fraction of domestic government bonds held by domestic investors ($BondHeldDom_{i,t}$); and (iii) the contribution of financial services to the aggregate GDP ($Fin./GDP_{i,t}$).¹⁰

Second, guided by the national accounts identity, we consider the effect of the pandemic on drivers of economic growth. We investigate whether sovereign risk is more strongly affected for countries that depend more on tourism ($Tour./GDP_{i,t}$), as the tourism sector is likely to be disproportionately affected by the pandemic. As a third channel, we measure a country's savings as a fraction of GDP ($Dom.Savings_{i,t}$) and examine whether a differential propensity to save could explain greater reductions in spending or investments in response to economic shocks. As a fourth channel, we examine whether countries that are more susceptible to volatile import and export flows, as measured by the volatility of their terms of trade, face differential exposure to COVID-19 infections. In fact, Hilscher and Nosbusch (2010) suggest that the volatility of the terms of trade ($Vol.Trade_{i,t}$) is a key driver of sovereign bond yields in emerging economies.

As shown in Panel A of Table A-13 of the Internet Appendix, fiscally constrained and unconstrained countries do not differ significantly in the characteristics that would support alternative channels for explaining our results. One exception is that countries with low fiscal space have lower amounts of domestic savings. There is weak statistical evidence that countries with low fiscal space have less prominent financial services, but the economic difference is small.

In Panels B and C of Table A-13, we show that none of the alternative channels are supported by the data, neither

when considered separately (Panel B) nor jointly (Panel C) with our measure of fiscal constraints. The volatility of terms of trade is an exception, but our coefficient of interest does not change in either magnitude or statistical significance.

Overall, these findings mitigate concerns that a country's fiscal capacity may be reflecting other country or state characteristics that could be responsible for channeling the economic impact of COVID-19 infection rates to sovereign default risk.

6. Conclusion

The COVID-19 pandemic represents one of the greatest challenges for the global economy since World War II. The vast spread of the virus and the ensuing public lockdowns represent an unexpected collapse in economic activity, leading to unprecedented increased deficit spending to stimulate the economy. Governments around the world have responded with fiscal and monetary stimuli on an extraordinary scale, and tax revenues are expected to plummet. As a result, public debt levels are forecast to increase significantly, even though many countries entered the pandemic with historically high leverage. These phenomena undoubtedly put severe strain on public balance sheets. Using prices of sovereign default insurance contracts, we provide a comprehensive overview of how financial markets perceive the effect of the coronavirus contagion on the default risk of sovereign governments and U.S. states.

We find strong evidence that sovereign credit spreads increase in response to COVID-19 infection rates for fiscally constrained countries. Fiscally sound countries appear to be more resilient to external growth shocks associated with the pandemic, as their sovereign risk sensitivity to COVID-19 infections is insignificant. To validate our findings that fiscal, not monetary, capacity is the main channel in amplifying sovereign credit risk, we document similar results for the Eurozone and at the U.S. state level, where all countries and states are bound by the same monetary policy, as determined by their respective unions. We also verify that our results are not driven by a sovereign's ex ante exposure to the coronavirus's spread. We do this by accounting for the number of doctors and hospital beds in the population, the population density, and the fraction of the population that is considered elderly or obese. We find that none of these factors is instrumental in explaining the exposure of sovereign risk to the rate of infections. Relatedly, we show that our results are not explained by cross-country differences in the timing and intensity of public health policy responses to the crisis, such as closures of schools and work places and restrictions on public gatherings and people's movement.

Our results have important policy considerations in light of current debates about the deleterious effects of fiscal capacity and the spread of the virus. Consistent with the evidence in Jordà et al. (2016) and Romer and Romer (2018), our finding that fiscal capacity amplifies the exposure of sovereign credit risk to systemic shocks underscores the need to unlever public balance sheets and increase fiscal capacity in economically favorable times. This is the macro-economic analog of macro-prudential regula-

¹⁰ Broner et al. (2010) suggest that a well-functioning secondary bond market serves as a disciplining device in order to prevent countries from defaulting on their debt. Relatedly, Gennaioli et al. (2014) suggest that countries are more likely to bail out their banks if financial institutions are more developed, resulting in a greater risk transfer. As we focus on 30 OECD (i.e., developed) economies, there is little cross-country difference in the degree of secondary bond market liquidity and the development of financial institutions.

tions of financial ratios, where capital buffers are accumulated during periods of growth and used in times of need. Our results emphasize that sovereigns with a larger fiscal space are more resilient to unexpected growth shocks.

Second, our results emphasize that the sovereign credit spreads of countries and U.S. states rise significantly more in response to an external shock when countries' and states' fiscal capacity is low. While different levels of fiscal capacity warrant different levels of credit risk, we find that financial markets penalize sovereigns disproportionately simply because they happen to start from an unfavorable fiscal position. Thus, our findings suggest that fiscal solidarity in times of extreme crisis may be warranted to avoid differential and disproportional spikes in default risk, in spite of identical shocks to economic growth.

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