EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

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Sovereign to corporate risk spillovers

Revised June 2018

No 1878 / January 2016

Abstract

The first Greek bailout on April 11, 2010 triggered a significant reevaluation of sovereign credit risk across Europe. We exploit this event to examine the transmission of sovereign to corporate credit risk. A ten percent increase in sovereign credit risk raises corporate credit risk on average by 1.1 percent after the bailout. The evidence is suggestive of risk spillovers from sovereign to corporate credit risk through a financial and a fiscal channel, as the effects are more pronounced for firms that are bank or government dependent. We find no support for indirect risk transmission through a deterioration of macroeconomic fundamentals.

Keywords: bailout, contagion, credit risk, Greece, risk transmission

JEL Classification: F34; F36; G15; H81; G12

Non-technical Summary

Financial and sovereign distress are often intertwined and associated with real economic costs (see, e.g., Reinhart and Rogoff, 2008). The wave of sovereign distress in the Eurozone following the 2007-2009 financial crisis is an example. The academic literature to date focuses on the analysis of interlinkages between sovereigns and financial institutions (the so-called sovereign-bank loop, see Brunnermeier et al., 2016). The empirical evidence that sovereign credit risk also transmits into the non-financial corporate sector is more limited.

In this paper, we aim to quantify spillover effects from sovereign into corporate credit risk. Conceptually, sovereign distress may spill over into the corporate sector directly through expected increases in taxation, reductions in subsidies, the decreased value of implicit and explicit government guarantees, or through impairments in credit provision of banks affected by sovereign risk. A quantification of such risk transmission is empirically challenging as there exist intricate linkages between a government and the corporate sector that give rise to causal, reversed, or spurious interpretations. We address these challenges by exploiting the announcement of the first Greek support package on April 11, 2010, which led to a significant increase of sovereign risk of all European countries. This allows us to rely on variation in sovereign credit spreads, which is seemingly unrelated to corporate fundamentals. We use credit default swaps (CDS) to capture daily changes in credit risk and rely on a sample of 226 firms from fifteen European countries. Our main findings suggest that a ten percent increase in the level of sovereign credit risk is associated with a 1.1 percent increase in the level of corporate credit risk. This relation was insignificant prior to the event.

The Greek support package was a central event in the European sovereign debt crisis on several important dimensions. First, instead of having a calming effect on the market, it triggered a large increase in Greek CDS spreads. Second, the support package is the first explicit violation of the no-bailout clause of the Maastricht Treaty, making its implementation uncertain. Third, after requesting financial support, official statistics on the economic outlook had to be revised. This includes, among others, the upward revision of Greece's 2009 budget deficit and the downgrade of Greek bonds to junk status by Standard&Poor's (S&P). Overall,

the Greek support package required immediate transfer payments from other European Union (EU) member states and raised the likelihood that more transfers were to follow. Following the support package announcement, the level of sovereign credit spreads increased across Europe. We argue that the support package led to a rise in credit risk of all European governments, which in turn affected the credit risk of European corporations.

We argue that the sovereign risk channel is the primary channel through which European corporations are affected. However, to the extent that other macroeconomic linkages may plausibly exist, they are insignificant during our sample period. As Greece is a fairly small economy whose industry is dominated by tourism and shipping, a sovereign shock that originates in Greece and that has a negative impact on its local economy is less likely to affect the credit risk of Europe's largest corporations. We provide two falsification tests that aim to capture the exposure to Greece. First, we compute the consolidated foreign bank claims vis-`a-vis Greece for each country relative to its GDP. Countries relatively more exposed to Greece do not reflect greater risk transmission. Second, we test whether companies with subsidiaries in Greece are more strongly affected by an increase in sovereign credit risk, a conjecture that the data does not support. Lastly, we emphasize and show that our sample period coincides with a recovery of corporate fundamentals following the financial crisis. This mitigates concerns that the documented effects arise endogenously because of a downward trend in the aggregate economy rather than a shock to sovereign credit risk.

To shed further light on the channels through which sovereign risk gets transmitted to corporate credit risk, we test cross-sectional predictions associated with a fiscal and a financial channel. We explore the fiscal channel through linkages that a company may have with its respective domestic government. Our first test is based on public ownership. European governments hold significant equity stakes in companies of strategic importance. This is particularly common in industries, such as utilities, telecommunications, and transportation. We find that companies with a large public ownership are more strongly affected by a negative shock to sovereign risk. In a similar vein, we use the Pellegrino and Zingales (2014) industry classification of government dependence, which captures an industry's relative media coverage related to government activity. The results are very similar. Both tests highlight that companies are more affected if they have close business ties with

the government as we develop an identification strategy around the first Greek support package. This shock introduces exogenous variation to sovereign credit risk among European countries, which helps us mitigate concerns of confounding effects due to macroeconomic fundamentals. Thus, it allows us to isolate spillovers from sovereign to corporate credit risk. The identification also allows us to shed light on fiscal and financial channels through which the risk gets transferred.

1 Introduction

Financial and sovereign distress are often intertwined and associated with real economic costs (see, e.g., Reinhart and Rogoff, 2008). The wave of sovereign distress in the Eurozone following the 2007-2009 financial crisis is an example. The academic literature to date focuses on the analysis of interlinkages between sovereigns and financial institutions (the so-called sovereign-bank loop, see Brunnermeier et al., 2016). The empirical evidence that sovereign credit risk also transmits into the *non-financial* corporate sector is more limited (examples are Adelino and Ferreira, 2016 and Almeida et al., 2016). While it is tempting to believe that the evidence on the relationship between sovereigns and financial institutions carries forward to non-financial institutions, anecdotal evidence highlights that this relationship is not obvious. For example, a FitchRatings' special report on the Eurozone crisis claims:[1]

"So far, the only corporates outside Greece to have experienced sovereign-driven rating action have been utilities." They further state that *"the market broadly agrees with a level of credit separation between Eurozone sovereigns and corporates."*

In this paper, we aim to quantify spillover effects from sovereign into corporate credit risk. We define spillovers as excessive co-movement triggered by a shock to sovereign credit risk.[2] Conceptually, sovereign distress may spill over into the corporate sector directly through expected increases in taxation, reductions in subsidies, the decreased value of implicit and explicit government guarantees, or through impairments in credit provision of banks affected by sovereign risk. A quantification of such risk transmission is empirically challenging as there exist intricate linkages between a government and the corporate sector that give rise to causal, reversed, or spurious interpretations. We address these challenges by exploiting the announcement of the *first* Greek bailout on April 11, 2010, which led

to a significant increase of sovereign risk of *all* European countries. This allows us to rely on variation in sovereign credit spreads, which is seemingly unrelated to corporate fundamentals. We use credit default swaps (CDS) to capture daily changes in credit risk and rely on a sample of 226 firms from fifteen European countries. Our main findings suggest that a ten percent increase in the level of sovereign credit risk is associated with a 1.1 percent increase in the level of corporate credit risk. This relation was insignificant prior to the event.

The Greek bailout was a central event in the European sovereign debt crisis on several important dimensions. First, instead of having a calming effect on the market, it triggered a large increase in Greek CDS spreads. This is illustrated in Figure 1, with Greek CDS spreads increasing from an average of 337 basis points (bps) to an average of 697 bps after the bailout. Second, the bailout is the first explicit violation of the no-bailout clause of the Maastricht Treaty, making its implementation uncertain. Third, after requesting financial support, official statistics on the economic outlook had to be revised. This includes, among others, the upward revision of Greece's 2009 budget deficit and the downgrade of Greek bonds to junk status by Standard&Poor's (S&P). Overall, the Greek bailout required immediate transfer payments from other European Union (EU) member states and raised the likelihood that more transfers were to follow. Following the bailout announcement, the level of sovereign credit spreads increased across Europe. We argue that the bail-out led to a rise in credit risk of all European governments, which in turn affected the credit risk of European corporations.[3]

We argue that the sovereign risk channel is the primary channel through which European corporations are affected.[4] However, to the extent that other macroeconomic linkages may plausibly exist, they are insignificant during our sample period. As Greece is a fairly small economy whose industry is dominated by tourism and shipping, a sovereign shock that originates in Greece and that has a negative impact on its local economy is less likely to

affect the credit risk of Europe's largest corporations. We provide two falsification tests that aim to capture the exposure to Greece. First, we compute the consolidated foreign bank claims vis-à-vis Greece for each country relative to its GDP. Countries relatively more exposed to Greece do not reflect greater risk transmission. Second, we test whether companies with subsidiaries in Greece are more strongly affected by an increase in sovereign credit risk, a conjecture that the data does not support. Lastly, we emphasize and show that our sample period coincides with a recovery of corporate fundamentals following the financial crisis. This mitigates concerns that the documented effects arise endogenously because of a downward trend in the aggregate economy rather than a shock to sovereign credit risk.

The risk transmission from sovereign to corporate credit risk is unaffected by a broad set of controls. We control for time-invariant firm characteristics and time-varying common macroeconomic fundamentals. Our results are also not influenced by cross-sectional differences in the liquidity of CDS spreads, company-specific equity returns, country specific stock market returns, or by aggregate exposures to foreign sovereign credit risk. Looking at differences across countries, we find that risk spillovers are more pronounced for members of the Eurozone, among which particularly financially distressed countries, represented by Ireland, Italy, Portugal, and Spain (the (G)IIPS countries), are affected.[5]

To shed further light on the channels through which sovereign risk gets transmitted to corporate credit risk, we test cross-sectional predictions associated with a fiscal and a financial channel. We explore the fiscal channel through linkages that a company may have with its respective domestic government. Our first test is based on public ownership. European governments hold significant equity stakes in companies of strategic importance. This is particularly common in industries, such as utilities, telecommunications, and transportation. We find that companies with a large public ownership are more strongly affected by a negative shock to sovereign risk. In a similar vein, we use the Pellegrino and Zingales

(2014) industry classification of government dependence, which captures an industry's relative media coverage related to government activity. The results are very similar. Both tests highlight that companies are more affected if they have close business ties with the government.

Given the sovereign-bank nexus described in Gennaioli et al. (2014), sovereign risk may be also transmitted through the financial sector to non-financial companies. If the consolidated claims of a country's banking sector are undiversified and largely dependent on the government during periods of sovereign distress, as documented by Gennaioli et al. (2016), Altavilla et al. (2017), and Ongena et al. (2016) among others, the lending function of banks will prove less resilient. We find stronger risk spillovers to non-financial companies for countries in which the banking sector holds a relatively larger fraction of consolidated government debt. In addition, Acharya et al. (forthcoming) and Bottero et al. (2016) suggest that companies relying mainly on banks affected by the sovereign debt crisis face a risk of credit rationing. We find a similar result in our sample, namely that, irrespective of whether we measure bank dependence at the company-level or the country-level, companies using relatively more bank financing show a higher sensitivity to increased sovereign risk.

The empirical evidence on interlinkages between sovereign and corporate credit risk has primarily focused on emerging economies. The interest has shifted towards developed economies with the onset of the European debt crisis. Bai and Wei (2017) study the sovereign-corporate risk transmission and argue that the correlation between sovereign and corporate spreads is stronger in countries that have weaker property rights as well as for state-owned companies. Lee et al. (2016) show that companies can decouple themselves from sovereign risk, either through foreign investments in countries with better property and creditor rights, or by cross-listing in countries with more stringent disclosure requirements. In contemporaneous work, Bedendo and Colla (2016) document a positive correlation between sovereign and corporate credit risk. Our paper features an important distinction,

as we develop an identification strategy around the first Greek bailout. This shock introduces exogenous variation to sovereign credit risk among European countries, which helps us mitigate concerns of confounding effects due to macroeconomic fundamentals. Thus, it allows us to isolate spillovers from sovereign to corporate credit risk. The identification also allows us to shed light on fiscal and financial channels through which the risk gets transferred.

Dittmar and Yuan (2008) suggest that the *primary* issuance of sovereign bonds in *emerging* markets may enhance the efficiency of corporate bonds in the *secondary* market by lowering yields and bid-ask spreads. Similarly, Agca and Celasun (2012) and Dailami (2010) highlight adverse linkages between public external debt and corporate bond spreads in *emerging* economies.[6] We, on the other hand, study *developed* economies using a shock to sovereign credit risk based on the arguably more homogeneous and frequent information in daily CDS spreads.

Our work is also related to the literature that explores the linkages between sovereign credit risk and the financial sector. One example is Acharya et al. (2014), who illustrate how financial bailouts can transfer risk from the private to the public balance sheet, which then feeds back through the channels of bailout guarantees and public bond holdings. On the other hand, Gennaioli et al. (2014) show how sovereign defaults can lower the amount of private credit provision. This effect is stronger for countries with more developed financial institutions and for countries where banks are strongly invested in government bonds. Our empirical evidence for *non*-financial institutions thus complements their findings for the financial sector. While the above references examine, as we do, the risk transfer within countries, Kallestrup et al. (2016), for example, study cross-country financial linkages between bank and sovereign CDS spreads.[7]

Finally, this paper is related to the literature focusing on contagion and spillover effects.

Brutti and Sauré (2015), for instance, show how real and financial shocks to Greece spread to neighboring European economies.[8] In contrast, we study how a re-assessment of sovereign credit risk due to a shock originating in Greece influences corporate credit risk within each country. Adelino and Ferreira (2016) show that sovereign rating downgrades impair banks' willingness to lend and increase their loan spreads, while Almeida et al. (2016) suggest that sovereign rating downgrades reduce firm investment and financial leverage.

The rest of the paper proceeds as follows. Section 2 motivates different channels of sovereign to corporate risk spillovers. Section 3 reviews a timeline of the Greek bailout, discusses why the event led to a significant rise of other sovereigns' credit spreads, and discusses identification challenges. We explain our empirical methodology in Section 4. This is followed by an overview of the data in Section 5. A discussion of our main results and the analysis of risk transmission channels can be found in Section 6. Section 7 presents relevant robustness. We conclude in Section 8.

2 Channels of Sovereign to Corporate Risk Spillovers

Sovereign and corporate risk are economically linked in intricate ways. On the one hand, increased sovereign risk may simply signal bad macroeconomic fundamentals, which may enhance corporate risk. On the other hand, sovereign risk may itself have an inherent impact on corporate risk, as we argue in this paper. Economic motivations for such a direct risk spillover are twofold: first, increased sovereign risk forces a government to take fiscal actions that hurt the economy. Second, sovereign risk adversely affects the health of the domestic financial sector, which in return is forced to reduce corporate lending. Based on these mechanisms, this section discusses several plausible channels in more detail.

Starting on the revenue side of fiscal policies, an increase in sovereign risk may force governments to raise current and/or future tax rates. An increase in corporate tax rates

hampers private incentives to invest, thereby reducing future growth and corporate profitability Acharya et al. (2014). This directly affects the credit risk of a firm. In extreme cases, such an increase in sovereign risk could lead to expropriation, whereby governments seize corporate assets within their jurisdictions. This becomes economically meaningful ex-ante, because the expropriation threat alone can trigger foreign capital flight. The emerging market crises of the 1990s, and particularly Mexico's balance of payment crisis, illustrate how quickly a government liquidity crisis can transform into a general economic crisis.

Increased sovereign risk may also lead to a downsizing of government expenditures. Such budget cuts affect in particular firms providing goods and services that depend a lot on public investment for building and maintenance of infrastructure or on public consumption. Yet, it reduces not only the credit quality of companies directly interacting with the government, but it can spread through their entire supply-chain network causing multiplying effects. In extreme cases, a government facing sovereign risk may even decide to reduce its spending on retirement and social benefits, possibly reducing household consumption as well.

Subsidies for industries considered to be of national importance are widespread around the world. Increased sovereign distress can force a government to discontinue its financial backing of domestic corporations. In particular, bailout guarantees for corporations or entire industries are less valuable and less credible if the sovereign is in distress. Despite the fact that the provision of social insurance to the corporate sector may be costly, there exists anecdotal evidence of government bailouts, e.g. the bailout of the car manufacturer Opel by the German government in May 2009, and the emergency loans extended to GM by the Obama administration in 2009.

Spillovers from sovereign to corporate risk may also be channeled through the financial sector. The sovereign-bank nexus has attracted a lot of attention in recent years. Gen-

naioli et al. (2014) build a model in which sovereign distress erodes the balance sheets of domestic banks. Affected banks are forced to strengthen their capital ratios, chiefly by cutting their lending activity. The resulting deterioration in credit access directly affects the borrowing terms of companies, eventually leading to a decline of domestic economic activity. An implication of this channel is that bank dependent companies should be affected relatively more Acharya et al. (forthcoming). For similar reasons, we expect this effect to be particularly relevant in Europe, where companies rely more on bank funding than in the U.S.

3 A Shock to Sovereign Credit Risk

Benzoni et al. (2015) show how an adverse shock to *one* country is followed by updates of investors' beliefs about the *uncertain* default probabilities of *all* sovereigns. Consistent with their theoretical framework, we use the Greek bailout announcement on April 11, 2010 as a shock to Greek sovereign risk that led to a reevaluation of the credit risk of other European sovereigns. This allows us to study the within country risk transmissions from sovereign to corporate credit risk. We first review the milestones of the Greek bailout, as summarized in Figure 2, and subsequently discuss *why* the event allows us to identify spillover effects from sovereign onto corporate credit risk.

3.1 The Greek Bailout

Sovereign default risk within the EU was low, if not inexistent, prior to the 2007 turmoil in the financial markets. The average sovereign CDS spread in the region was approximately 14 bps from January 2007 to September 2008.[9] Following the financial crisis, with bailouts and fiscal stimulus programs occurring around the globe, financial markets began to re-evaluate the riskiness of sovereign debt.[10] In particular within the EU, there was a lot of

uncertainty about excessive deficits and the effectiveness of the measures taken to address structural deficit problems. The EU Special Economic Policy Summit, which convened on February 11, 2010, re-emphasized the responsibility of all euro area members to ensure stability within the Eurozone. Effective measures and programs were discussed for all member states. The initiatives put forward by the Greek government to cut its deficit by 4 percent from the 2009 figure of 12.7 percent were fully supported.

On February 15, 2010, the Economic and Financial Affairs Council (ECOFIN) of the EU approved the proposals put forward by the Greek government to correct its budget deficit.[11] It was agreed that Greece should achieve a deficit in accordance with the Maastricht Treaty (below three percent) by 2012. Furthermore, the implementation would be monitored through a joint effort with the European Central Bank (ECB) and the International Monetary Fund (IMF). A few days later, at the spring European Council meeting of March 25 to 26, 2010, finance ministers were confident that the efforts taken by the Greek government would be sufficient to achieve the 2010 targets. Moreover, the council emphasized that, with such decisive measures, Greece should be able to regain the trust of the financial markets on its own. There was no request from the Greek government for any financial support. On the contrary, its actions and messages suggested that the budgetary targets would be met, and that all the budgetary issues could be resolved. Greece successfully raised €5 billion on the market on March 29, 2010. Nevertheless, it was asked to develop a timeline for the implementation of all the measures by May 15, 2010, and then to report its progress on a quarterly basis.

This notion of control was successfully held up by the Greek government until the weekend preceding April 11, 2010, when Greece requested financial support from the EU. The finance ministers convened immediately and agreed upon a support package of up to €30 billion of bilateral loans over the next three years, with additional financing by the IMF. In return, the Greek authorities would develop a decisive consolidation program, closely

monitored by the so-called troika (European Commission, IMF, and the ECB).

Shortly thereafter, on May 2, 2010, the support package was finalized. It contained a three-year support and restructuring program: €80 billion in bilateral loans from the EU plus an additional €30 billion in stand-by loans from the IMF. Greece received immediate support amounting to €45 billion. The support package, having a total volume of €110 billion, was more than three times the size of the initial agreement of €30 billion reached on April 11, 2010. On May 8, 2010, the Summit of the Heads of States and Governments of the Euro area finalized and officially passed the support package for Greece through legislation. As a result of this turmoil around the rescue of Greece, and in order to prevent future emergency rescue packages, an ECOFIN meeting on May 9, 2010 developed comprehensive stability measures such as the European Financial Stabilization Mechanism (EFSM), with the potential to grant support packages of up to €750 billion.

3.2 Unanticipated Consequences of the Bailout

Our argument that the bailout had unanticipated effects builds on several important observations. First, we would generally expect a bailout to decrease the financial risk of the supported entity, as shown, for example, by Acharya et al. (2014). Therefore, Greek sovereign CDS spreads may have been expected to decrease following the announcement of the bailout on April 11, 2010. The opposite is the case, however. Figure 1 depicts the Greek sovereign CDS and its bid-ask spread from February 15, 2010 to June 25, 2010. After April 11, Greek sovereign borrowing costs exhibit a steep increase. Greek CDS spreads double to about 800 bps and the corresponding bid-ask spreads more than triple to about 30 bps. Such an increase of Greek sovereign risk may be reconciled by the dilution of existing creditors through more senior claimants such as the ESFM or the IMF.[12] Nevertheless, the strong increase in spreads highlights the significance of the economic disruption caused

by the bailout.

Second, the Greek bailout is a significant event in the history of the EU. It represents a violation of the no-bailout clause agreed upon in the 1992 ratification of the Maastricht Treaty. Article 103 of the treaty stipulates explicitly that *"neither the Community nor any Member State is liable for or can assume the commitments of any other Member State."*[13] It was, therefore, not clear *if* and *how* this bailout could be structured. To underscore the sudden and enhanced focus on the distressed situation, we show that our event date coincides with a shift in public awareness of European sovereign credit risk. Figure 3 plots the daily Google search intensity of the key words *Euro Crisis*, *Greek Bailout*, and *Greek Debt*. The search intensity exhibits an immediate increase after April 11, suggesting a rise in media coverage and public awareness.

Finally, in April 2010, there was a lot of uncertainty about the actual economic situation of Greece. With the request for financial support and high media coverage, official statistics were continually being updated. Most incoming information was arguably worse than expected. On April 22, 2010, EU officials lifted the estimate of Greece's 2009 deficit from 12.7 percent to 13.6 percent, arguing that it could top 14 percent. Later in the year, the actual budget deficit for 2009 was adjusted to be 15.6 percent, and this was followed by 10.8 percent in 2010. There was also a heated debate about the actual size of the support package. The initial number, as of April 11, was understood to be about €30 billion over the next three years. On Monday, April 19, Bundesbank president Axel Weber publicly announced that Greece may require financial assistance of as much as €80 billion to escape its debt crisis and avoid default The finalized first support package amounted to €110 billion over the next three years. However, a second bailout package of €130 billion became necessary as early as October 2011. As a result of disappointing Greek financial statistics, S&P downgraded Greece by three notches to BB+, the first level considered to be of junk status, on April 27, 2010.

3.3 Identifying Spillovers from Sovereign to Corporate Risk

We have discussed thus far that the bailout period is characterized by a significant deterioration in the quality of Greek sovereign risk. The identification strategy of our paper relies on two additional assumptions. At first, the bailout led to an increase in credit risk of other European sovereigns. As an economic motivation for the existence of this effect, we refer not only to sizeable, direct transfer payments to Greece, but also to more indirect effects like altered incentives that undermine fiscal responsibility in all EU countries. A major concern was that a bailout would open up a Pandora's box, resulting in risk transfers between members of the EU for a long period of time.[14]

Figure 4 highlights that the bailout triggered, indeed, a risk adjustment for European countries. In this figure, we compare the evolution of the US CDS spread with the average sovereign CDS spread in Europe (excluding Greece). We standardize both CDS spreads by their corresponding levels on February 15, 2010, the beginning of our sample period. While both measures exhibit a strong common trend prior to our event date, they start to diverge immediately after April 11, 2010, with European entities becoming riskier.[15] This suggests that our event uncovers an increase of sovereign risk in Europe rather than a common global trend.

We also assume that the Greek bailout impacted the corporate sector primarily through the sovereign risk channel Corsetti et al. (2013, 2014). In fact, we show that other plausible channels that may affect corporate credit risk, such as direct exposure or exposure through banks, are insignificant. In contrast to European governments, European companies are not directly liable for the financing of the bailout package. Furthermore, as one of the smaller countries in Europe, deteriorating economic conditions in Greece do not have material direct effects on large European companies operating world-wide. Finally, with all legal barriers and economic uncertainty about the bailout deal in mind, investors' attention

clearly focused on sovereign risk throughout this period. Thus, the effects of the Greek bailout that are not channeled through the sovereign sector are likely negligible, an assertion that we explicitly test for in the empirical analysis.

In our identification setup, one might be concerned that the Greek bailout coincides with another unobserved event. For instance, a deterioration in the credit quality of the European corporate sector may have triggered a negative update of corporate fundamentals. Consequently, this may plausibly lead to a deterioration of sovereign risk, rather than the other way round. However, the descriptive evidence in Figure 5, which shows a quarterly plot of sales and EBITDA scaled by total assets is contra-indicative of this reverse causality. The figure indicates that sales and profits dropped drastically in 2008 during the height of the financial crisis, but that during our event period in April 2010, both measures were recovering and on a steady and rebounding trend. Therefore, we do not have any specific reason to believe that, in 2010, fundamentals of European corporations could cause the change in sovereign credit risk. Though the above lines of reasoning are intuitive given the explicit and implicit guarantees provided by European sovereigns to Greece, we revert to such concerns throughout the empirical analysis. We provide more detailed discussions and present several (falsifying) tests to support our findings.

4 Empirical Methodology

To quantify spillover effects from sovereign to corporate credit risk, we use the Greek government bailout on April 11, 2010, as it triggered a reevaluation of sovereign default risk throughout the EU. The variable E_t denotes a dummy variable in our model specification that takes the value one after the event and zero otherwise. We measure changes in corporate credit risk by the log change in the corporate CDS spread, which is denoted as $\Delta cds^c_{i,j,t}$ for firm i in country j at time t. On the other hand, $\Delta cds^s_{j,t}$ refers to the log change in the

sovereign CDS spread for country j at time t. Similar to Acharya et al. (2014), we specify our baseline regression as a simple difference regression:

$$\begin{aligned} \Delta cds^{c}_{i,j,t} &= \alpha_0 + \alpha_1 \times E_t \times \Delta cds^{s}_{j,t} + \alpha_2 \times \Delta cds^{s}_{j,t} \\ &+ \gamma^{\top} X_{(i),j,t} + \delta_i + \gamma_t + \varepsilon_{i,j,t}. \end{aligned} \tag{1}$$

The coefficient of interest is α_1, which measures the excess co-movement between sovereign and corporate spillover effects, which is expected to be positive. The coefficients δ_i and γ_t represent firm and time fixed effects, respectively.[16] Finally, $\gamma^{\top} X_{(i),j,t}$ contains several control variables that absorb the influence of country- and company-specific time-varying risk factors that may influence the dependent variables. We double-cluster all standard errors at the day and company level to account for both time-series and cross-sectional correlation in the error terms, following the suggestion of Petersen (2009).[17]

Note that we eliminate the influence of any common macroeconomic or financial factor on corporate credit risk by including (day) time fixed effects in all regression models. Moreover, we include firm fixed effects to some specifications in order to purge out the influence of any unobserved (time-invariant) firm specific characteristics. In addition, Greek corporations are excluded from all regressions in order to ensure that the results are not driven by distressed Greek corporations. To summarize, we focus on the within-country risk transmission from sovereign to corporate credit risk, using the Greek bailout as an event that triggered the reevaluation of other (non-Greek) sovereigns' credit risk.

We extend Equation 1 to test for cross-sectional differences. This requires the introduction of an additional term $C_{(i),j}$ that captures the cross-sectional dimension. Depending on the tested hypothesis, $C_{(i),j}$ may vary at the country or company-level. The specific model

specification used is the following difference-in-difference regression model:

$$\begin{aligned}\Delta cds^{c}_{i,j,t} &= \alpha_0 + \alpha_1 \times E_t \times \Delta cds^{s}_{j,t} \times C_{(i),j} + \alpha_2 \times E_t \times \Delta cds^{s}_{j,t} \\ &+ \alpha_3 \times E_t \times C_{(i),j} + \alpha_4 \times \Delta cds^{s}_{j,t} \times C_{(i),j} \\ &+ \alpha_5 \times \Delta cds^{s}_{j,t} + \gamma^{\top} X_{(i),j,t} + \delta_i + \gamma_t + \varepsilon_{i,j,t}. \end{aligned} \tag{2}$$

The coefficient of interest in these regressions is α_1, which captures the differential excess co-movement associated with the Greek bailout.

5 Data

We use CDS data to measure both sovereign and corporate credit risk. This has several advantages over using bond yield-spreads. First, CDS allow for a meaningful and consistent comparison of corporate borrowing costs across companies and countries as they are highly standardized products with pre-determined and identical contractual agreements. In contrast, bond data are highly heterogeneous with respect to the legal jurisdiction of the issuing country (for public bonds), covenants, coupon structures, maturities and issue amounts. The attractiveness of CDS data is further underscored by the availability of high-frequency constant-maturity spreads. Declining maturities are a key characteristic implicit in bond spreads, making it challenging to find readily available and highly comparable data.

Second, from a theoretical perspective, a CDS spread is equivalent to the spread of a floating rate note above a risk-free threshold (Duffie 1999). This assertion relies on the assumption of frictionless markets. However, recent research provides evidence of a persistent negative "CDS-bond basis" during the financial crisis, suggesting that CDS spreads were persistently *lower* than bond spreads (Bai and Collin-Dufresne 2013). From this perspec-

tive, we are likely to *underestimate* any effect on corporate credit risk, compared to tests using yield-spreads.

Third, the fall of Lehman Brothers emphasized that CDS spreads may be biased estimates of sovereign and corporate credit risk because of counterparty risk. Arora et al. (2012), however, show that, even though counterparty risk is priced in credit derivatives, the order of magnitude is economically insignificant. The credit risk of a counterparty would need to increase by more than six percentage points in order to decrease CDS spreads by one basis point. Moreover, the effect of counterparty risk on CDS spreads is negative, suggesting that we may *underestimate* the changes associated with a rise in sovereign credit risk.

Finally, anecdotal evidence suggests that CDS spreads, despite their unfunded nature, may be less liquid than originally assumed, and there is recent academic evidence provided by Tang and Yan (2007) and Bongaerts et al. (2011) of liquidity and liquidity risk in credit derivatives.[18] Illiquidity is, however, likely to be greater for bond spreads than for CDS spreads. To mitigate any concerns, we verify that our results are robust against liquidity effects by controlling for each company's CDS bid-ask spreads.

Our final sample consists of 21,470 observations for 226 corporate reference companies in 15 countries. Our sample period spans from February 15, 2010, eight weeks before the event date on April 11, 2010 to June 25, 2010, eight weeks after the bailout package was officially approved on May 2, 2010.[19] Focusing on the immediate weeks around the event limits the risk of identifying a relationship that is due to other confounding effects that happened during the turbulent European sovereign debt crisis. We source Credit Market Analysis (CMA) data through Datastream. We start with the available universe of sovereign 5-year mid-market, bid and ask quotes for Europe, as the 5-year horizon represents the most liquid maturity in both the sovereign and corporate CDS markets. We choose

the full-restructuring credit event clause, which is the standard contract documentation for Western European sovereign reference entities. The currency denomination available for members of the Eurozone, the United Kingdom, and Norway is USD, while the reference contracts for Switzerland, Sweden and Denmark are EUR denominated.[20] Within each country, we identify all EUR-denominated *non-financial* corporate reference entities which trade under the modified modified restructuring (MMR) contract clause for the senior unsecured capital structure.[21] Thus, we use the most standardized contract specification in the European CDS market and end up with a sample of 226 companies.

To complement our database, we collect country-specific and firm-specific variables. More specifically, we collect country-specific stock market returns based on the Morgan Stanley Composite Total Return indices and we take the EUR/USD foreign exchange rate from the Federal Reserve Bank of St. Louis website. We source foreign currency long-term sovereign credit ratings from Fitch Ratings, we get sovereign bond yield data from Bloomberg, and we obtain data on countries' financial structure from the Financial Structure Database published by the World Bank.

In addition, we collect the CMA CDS bid-ask spreads from Thomson Reuters Datastream to control for liquidity effects. We use Datastream to source other firm-specific control variables such as each company's stock returns, which we use to control for endogenously deteriorating values of firm fundamentals. Furthermore, we manually match our database with Bureau van Dijk's Amadeus database for non-financial companies. We use balance sheet information, in particular companies' dependence on bank loans, and information on public ownership, which we manually verify for consistency. All information is based on the fiscal year 2009, which is the latest available information immediately preceding our event date. Finally, we obtain the Standard & Poor's long-term issuer credit ratings for all companies from the ECB Centralised Securities Database.

Descriptive summary statistics for the pre- and post-event windows are reported in Table 1. There is substantial heterogeneity in the sample, both across time and across countries. The average corporate CDS spread increased from 161 bps in the pre-event period to 181 bps in the aftermath period that included the Greek IMF bailout. The lowest average spread, at 81 bps in the pre-event period, is found for Belgium, going up to a maximum of 390 bps for Norway. Portugal recorded the highest *increase* in average corporate spread, going from 122 to 206 bps, followed by Spain, where the average corporate CDS increased by 71 bps from 161 to 232, i.e., an increase of 44%. The lowest average sovereign spreads in the pre-event window are observed for the Nordic countries, with values of 17, 26, and 37 bps for Norway, Finland, and Sweden, respectively, while in the post-event window the average spreads for the same countries are 22, 29, and 39 bps. Greek spreads experience the greatest rise, going from an average of 337 to 697 bps, i.e., an increase of 107%. Table 2 provides further cross-sectional statistics at the country level on sub-groups of our sample. The table illustrates that, during our time period, companies in the Eurozone are, on average, riskier than companies outside the monetary union. The average difference in spreads is 17 bps before Greece's shock, and increases to 26 bps thereafter. Similarly, the average firm in the (G)IIPS countries, excluding Greece, is riskier than the average firm in the remaining Euro-member states, but after the bailout announcement, the average spread increases from 158 to 221 bps. In the non-(G)IIPS comparison group, the spread of the average firm rises by nine percent from 171 to 186 bps.

6 Discussion of Main Results

We begin in Section 6.1 with a detailed analysis of our unconditional spillover estimates of sovereign to corporate credit risk. In Section 6.2, we discuss the channels through which sovereign risk may transmit into corporate credit risk.

6.1 Sovereign to Corporate Credit Risk Spillovers

Our main hypothesis suggests a risk transfer from sovereigns to the corporate sector. Estimation results for the simple difference specification, outlined in equation 1, are reported in Panel A of Table 3. Columns 1 and 2 include only observations from the pre-bailout period. Prior to April 11, there is no statistically significant relationship between corporate and sovereign entities. The regression coefficient on the domestic sovereign CDS has the expected positive sign, but is statistically insignificant. This model captures approximately 32 to 34 percent of the variation in corporate CDS spread changes.

In contrast, the relationship between corporate and sovereign CDS becomes positive and statistically significant in the period after the bailout, as demonstrated in columns 3 and 4. A one percent increase in the sovereign CDS is associated, on average, with a 0.11 percent increase in credit risk for domestic corporations after the bailout, which is economically significant (and similar in magnitude to the risk transfer documented for financial firms by Acharya et al, 2014), as the following simple calculation shows: the mean sovereign CDS spread increases from the pre-bailout period to the post-bailout period by 67 percent. Following the previously mentioned estimate, this leads to an increase in the average corporate spread in Europe of 12.9 bps ($161 bps \times 67\% \times 0.11$).[22] Putting it differently, a one standard deviation increase in sovereign CDS (0.071) corresponds to an increase in corporate CDS of 0.14 standard deviations ($(0.11 \times 0.071)/0.058 = 0.14$, see Table 1). Also, the explanatory power of the benchmark model increases to 60 percent in the post-event period. All model specifications include daily time fixed effects, thereby controlling for the influence of any common macroeconomic or financial factors. In addition, the result is robust against controlling for any unobservable and time-invariant firm-specific characteristics. Including company fixed effects does not significantly influence the magnitude of the regression's coefficient of interest. In the following robustness section, we will further

show that controlling for time-varying firm or country-specific variables does not alter our results.

Finally, columns 5 and 6 highlight the spillover effects of sovereign risk following the bailout. In a regression for the full sample period, we interact the sovereign credit risk proxy with an indicator variable marking the period after April 11, as indicated in equation 1. The difference estimator suggests that a ten percent increase in domestic sovereign credit risk raises corporate credit risk approximately by an additional one percent after the bailout.[23]

Through most of our analysis, we use CDS spreads as a measure of both sovereign and corporate credit risk. We have verified our results using log changes in sovereign bond yield spreads. As expected, we find a greater magnitude of the risk transmission if we base our test on sovereign bond data, as is reported in Panel B of Table 3. The estimated coefficient is now 0.16, which is statistically significant and which has a larger economic significance than the result we obtain based on CDS spreads. Finally, we show that our results are robust when we collapse the corporate credit risk information to a single representative firm in each country. Table A-1 in the external appendix examines the increase in co-movement between the average corporate CDS spread in each country and its corresponding sovereign CDS spread. The estimated coefficient is 0.11, thus similar in magnitude, and also highly statistically significant.

6.2 Discussion of Risk Transmission Channels

This section intends to highlight the channels through which sovereign risk may affect corporate credit risk. In line with the discussion in Section 2, we examine three different types of cross-sectional predictions. First, in Section 6.2.1, we test whether the Greek shock is transmitted through a company's direct exposure to Greece, rather than through sovereign risk. Second, in Section 6.2.2, we investigate the fiscal channel of sovereign risk

transmission, by testing whether companies with direct business ties to their domestic government are associated with a greater increase in corporate credit risk. Last, the risk transmission from sovereign to corporate credit risk could also be channeled through the financial sector. Cross-sectional predictions suggesting that bank dependence may enhance risk spillovers are tested in Section 6.2.3.[24]

6.2.1 Direct Exposure to Greece

Our results are suggestive of a significant risk transmission from the sovereign to the corporate sector. However, one concern could be that this risk transfer from Greece would not only affect European sovereigns, but (simultaneously) the corporate sector directly, or through banks due to exposure to Greek sovereign debt. Hence, one may be concerned that increased corporate risk spills over to sovereign risk, instead of the other way round. We provide two tests that address this concern.

First, if Greek sovereign risk would be transmitted through the banking sector, economies with banks being more exposed to Greece should be affected relatively more. To test this, we compute the exposure of each country to Greece based on consolidated foreign claims vis-à-vis Greece on an ultimate risk basis by nationality of reporting banks weighted by GDP. This data is publicly available from the Bank for International Settlements (BIS). The falsification test is based on a difference-in-difference regression for which we interact a Greek exposure variable with both the percentage changes in sovereign CDS spreads and the shock indicator variable. We show results for two specifications: for the first one, *Greek Exposure* is defined to be one for countries with an exposure to Greece relative to its GDP above that of the median country in the sample, and zero otherwise. For the second test, *Greek Exposure* is defined to be one for the three countries that are the most exposed to Greece (France, Ireland, and Portugal), and zero for the three countries that are the least

exposed (Italy, Spain, and Sweden). The results, which we report in Table 4 show that all coefficients on the triple interaction term are insignificant, small in magnitude and do not show any increased dependence. This suggests that bank's exposure to Greece does not explain the increased risk in European economies.

Second, if risk would spill over to the corporate sector directly, corporations relatively more exposed to Greece should be affected more. To test this, we construct a dummy variable that takes the value one if a corporation has one or more subsidiaries in Greece and zero otherwise. Again our test is based on the same econometric model for which we interact the corporate exposure dummy with both the percentage changes in sovereign CDS spreads and the shock indicator variable. Results are reported in Table 4. We find that all regression coefficients on the triple interaction term are insignificant and small in magnitude, suggesting that direct exposure of corporations to Greece did not significantly impact the increased risk in European firms.

6.2.2 The Fiscal Channel

One channel how increased sovereign risk may be transmitted to non-financial companies could be direct business ties a company has with the government. We explicitly investigate two direct connections: First, governments are often major shareholders in companies that are deemed to be of strategic relevance. If a sovereign government experiences a negative shock, then we would expect this shock to be reflected more in the credit risk of companies that are characterized through large public ownership. Second, in some sectors governments are among the most important customers, or at least very influential in the purchasing or regulatory process. This is especially true for infrastructure investments in telecommunications and utilities, or the coverage of products and services through public insurance plans, which all hinge on government support. Therefore, we expect that companies in sectors of

high state-dependence are relatively more affected through a negative shock to sovereign risk.

We capture public ownership through an indicator that takes on the value one if the government of a company's headquarter holds an equity stake that is larger than 5% of the company's market capitalization, and zero otherwise. We find in our sample 34 (201) companies with public ownership exceeding (below) 5%. The results are presented in Table 5. The results in columns 1 and 2 support our conjecture with a statistically significant difference at the 5% level between companies with high and low public ownership. The magnitude of the coefficient suggests that a one percent increase in sovereign credit risk increases the corporate credit risk of companies with a high public ownership by 0.07 percent more after the bailout than that of companies with a low public ownership. The statistically significant spillover effect associated with the public ownership indicator indicates that the public ownership channel contains information above that captured by time-invariant firm characteristics.

To identify industries that are relatively more dependent on states, we use a proxy for "government dependence" constructed by Pellegrino and Zingales (2014). Based on Factiva's News Search Database, they define a sector's "government dependence" as the proportion of articles about an industry sector that contain the topics government policy/regulation/aid. Our non-financial firms are categorized in ten sectors. Out of these, we identify the five sectors with higher government dependence based on the measure of Pellegrino and Zingales (2014). These sectors are Government, Utilities, Telecommunication, Oil & Gas, and Health. We create an indicator variable that gets the value one if the firm is in one of those five state-dependent sectors, and zero otherwise. We interact this dummy with our original variable to investigate if firms in government-dependent industries are affected more. Columns 3 and 4 in Table 5 report the results for our model with the interaction of state dependence. We find that a one percent increase in sovereign

credit risk increases the corporate credit risk of companies in state-dependent industries by 0.1 percent more after the bailout relative to companies that are not state-dependent. The finding is statistically significant at the 1% level.

6.2.3 The Financial Channel

The findings in Section 6.2.1 suggest that European banks' direct exposure to Greek claims does not transmit spillovers. However, following the mechanism in Gennaioli et al. (2014), there should be strong links between bank lending and their exposure to distressed sovereign bonds within a country. Altavilla et al. (2017), Gennaioli et al. (2016), and Ongena et al. (2016) all report evidence that a country's banking sector increased holdings of local public debt during the European sovereign debt crisis, which amplified the negative effects of the crisis, and ultimately led to a crowding-out of corporate lending (Becker and Ivashina, 2018). Therefore, increased sovereign risk should more strongly affect those companies that rely more on bank financing.

Our first test exploits the fact that banks hold significant amounts of domestic sovereign debt. Using the same BIS data source as in Section 6.2.1, we construct a measure that captures the exposure of a country's banking sector with respect to the domestic government. For each country, we compute the banking sector's fraction of consolidated claims against the domestic official sector over total claims on an ultimate risk basis. Table A-3 in the external appendix shows an average (median) exposure of 18.5% (15.5%) with a standard deviation of 5.6%.[25] We expect stronger risk spillovers in countries where the banking sector is more sensitive to sovereign risk. Regression results can be found in columns 5 and 6 of Table 5. A one percent increase in sovereign credit risk leads to additional 0.029 percent in corporate credit risk after the bailout if a banking sector's exposure to the domestic government is one standard deviation higher. This effect is statistically significant at the

5% level.

In a next step, we explicitly test for the bank-lending channel by examining whether firms that are more bank dependent are also relatively more affected by the increase in sovereign credit risk. This test builds on an established literature showing that a deteriorating health in the financial sector is followed by a reduction in bank credit supply. Ivashina and Scharfstein (2010) document a greater reduction in bank lending during the recent financial crisis for those companies that suffered larger financial losses. Santos (2011) and Bord and Santos (2014) show that loan spreads increased more for less healthy banks. Similarly, Campello et al. (2010) show that firm's corporate policies are more adversely affected if they are more bank dependent. While this evidence relates to the United States, similar evidence is available in the context of the European sovereign debt crisis. Using syndicated loan data, Popov and Horen (2016) document a greater contraction in bank credit supply for non-GIIPS countries that were more heavily exposed to GIIPS government bonds, while Acharya et al. (forthcoming) show that firms exposed to affected banks had lower employment growth, capital expenditures and sales growth.[26]

We construct a continuous measure of bank dependence as the ratio of total bank loans to total liabilities for each firm. The average (median) ratio of total bank loans to total liabilities is 11.5% (5.4%), and ranges between 0% and 100%, as we show in Table A-3 in the external appendix. The results in column 7 of Table 5 suggest that a one percent increase in domestic sovereign credit risk increases corporate credit risk by additional 0.009 percent after the bailout if a company's bank dependence is one standard deviation higher. The coefficient is statistically significant at the 5% level. In column 8, we further include firm fixed effects. Neither the statistical significance nor the economic magnitude change.

As an alternative measure of bank dependence, we classify countries based on the importance of their banking system. In other words, we compare countries based on their culture

of bank financing. Following Levine (2002), we use the ratio of the aggregate value of all bank deposits extended by banks to the private sector in each country to the corresponding stock market capitalization.[27] A ratio above one indicates that the financial system is bank based. Table A-3 in the external appendix suggests that the average measure of bank-based financial systems is 1.783, with a median of 1.550. The results in columns 9 and 10 of Table 5 confirm that the sovereign risk spillovers are indeed stronger the greater the size of the banking sector relative to the country's stock market capitalization. The coefficient of 0.050 is of similar magnitude to the estimate obtained from a classification of bank dependence at the firm level, and it remains statistically significant at the 5% level.

7 Robustness and Further Results

In Section 7.1, we demonstrate that a deterioration of macroeconomic fundamentals is unlikely to explain the sovereign risk transmission. Differences for Eurozone countries and distressed countries are discussed in Section 7.2.

7.1 Additional Controls and Macroeconomic Fundamentals

In this section, we attempt to provide evidence that our effects are not determined by deteriorating firm or country fundamentals. Returning to our benchmark specification, we add further control variables to the model, individually and jointly, with the results shown in Table 6. Among these are company-specific bid-ask spreads for CDS contracts, country-specific equity index returns, a foreign exposure measure with respect to other European countries, as well as company-specific stock returns.[28]

Given the extraordinary nature of the sample period of interest, one could argue that the documented spillover effects to corporate credit risk may arise because of an increased

illiquidity of CDS contracts. We proxy for liquidity as the percentage change in a company's bid-ask spread.[29] There exists a positive relationship between corporate CDS spreads and their corresponding bid-ask spreads after April 11. Accounting for illiquidity, however, has no impact on the estimate of sovereign CDS, neither for the pre-bailout period in column 1, nor for the post-bailout period in column 5.

Second, we control for the domestic equity index return in order to tease out any residual relationship between the financial sector and sovereign credit risk. This also controls for the possibility that the relationship between sovereign and corporate credit risk may counterfactually arise because of deteriorating macroeconomic fundamentals. As can be seen in columns 2 and 6, our regression coefficient of interest changes only marginally in magnitude and remains statistically significant. A one percent higher sovereign CDS raises corporate credit risk by 0.09 percent after the bailout. The effect of the domestic stock market return is significant and has the expected negative sign throughout the whole sample period.

Third, as we explicitly focus on within-country spillover effects from domestic sovereign to corporate credit risk, we control for the cross-country spillover effects that may arise through companies' exposure to other sovereigns. More specifically, we construct a foreign-country exposure measure for each corporation as the GDP-weighted average of all other countries' CDS spreads in the sample, excluding that of the domestic country itself. This helps to mitigate the concern that our findings are impacted by regional spillover effects. Again, controlling for cross-country exposure does not have any impact on the estimate of interest, as shown in columns 3 and 7.

Next, we control in Table 6 for each company's stock return to rule out that our result is driven by endogenously deteriorating corporate fundamentals. A classical Merton model predicts that equity returns should be sufficient to locally capture the company's debt returns (Acharya et al. (2014)). Thus, if the difference estimator remains unaffected by

the inclusion of the stock return as a control variable, then this should provide strong support for the empirical evidence of sovereign to corporate risk spillover in response to the unanticipated rise of sovereign credit risk. Due to space limitations, we only report this model specification jointly with all other control variables. The results are reported in columns 4, 8 and 9. Stock returns are insufficient to fully capture the return variation in corporate CDS spreads. The difference estimator remains highly statistically significant with a value of 0.09 and a regression R^2 of 62%. Another possibility is to control for company-specific characteristics that vary at a lower frequency than stock returns, such as firm size, corporate ratings, and leverage. Given our identification strategy that uses a short window around the event, information on company characteristics that usually varies only at a quarterly frequency is already accounted for by the firm fixed effects, which effectively control for time-invariant firm characteristics. Finally, in unreported results, we test our results using only investment-grade companies. The coefficients are of similar magnitude, and significant at the 5% significance level.

We focus in our analysis on a short period around the announcement of the Greek bailout to avoid picking up other news that entered the market during the turbulent European sovereign debt crisis, such as the reactivation of the Securities Markets Programme (SMP) later in the year, the long-term refinancing operations (LTROs), and the outright monetary transactions (OMT). While we have defined a pre-event and a post-event period, one may argue that the true post-bailout period is after May 2, 2010, the date when the final support package to Greece was officially approved. Thus, we verify our results using a different sample cut, for which we define the bailout period as the three weeks in between the bailout announcement on April 11 and the official approval of the bailout on May 2. This period is marked with substantial uncertainty about the actual size and implementation of the Greek bailout. In addition, we define the post-bailout period as the eight weeks after the official approval of the bailout from May 2 to June 25, 2010. The results, which are

reported in Table A-2 of the external appendix, show that there is a gradual increase in the co-movement between sovereign and corporate credit risk. In Panel A, in which we examine the bailout period (from April 11 to May 2), the difference estimator increases to a value of 0.05, although the effect is insignificant. In Panel B, on the other hand, in which we compare two balanced sample periods using a cleaner definition of the pre- and post-bailout periods, the difference estimator has a greater magnitude, i.e. 0.12, and it is statistically significant at the one percent level.

7.2 Differential Effects for Eurozone Members and Distressed Countries

Our objective is to capture spillover effects from a shock to sovereign credit risk. We have provided empirical evidence that the Greek bailout is associated with increased credit risk of *all* European countries. This explanation is supported by the theoretical mechanism described in Benzoni et al. (2015). In this section, we provide evidence of heterogeneity in the intensity of the risk spillovers.

The formal violation of the no-bailout clause and the financial lifeline offered to Greece entailed immediate costs and increased the probability of future bailouts of other distressed sovereigns. While the incurred bailout costs were initially carried by all EU member states, it is plausible that countries also sharing the common currency were hit harder. First, countries that adopted the Euro cannot use monetary policy instruments to increase their competitiveness through inflation and currency depreciation. Second, a failure to solve the sovereign debt crisis could potentially result in a break-up of the Eurozone, with unpredictable costs. This scenario would bear more adverse consequences for Eurozone countries even ex-ante.[30]

To test for differential effects, we include an additional cross-sectional dimension in our empirical model, as outlined in equation 2. We begin with an indicator variable marking

whether the company is headquartered within the Eurozone area. Columns 1 and 2 in Table 7 provide empirical support to the stated hypothesis. Companies in the Eurozone are comparatively more sensitive to changes in the domestic CDS spread after April 11. The difference is statistically significant at the one percent level. A one percent increase in sovereign risk increases borrowing costs by 0.06 percent more for companies in Eurozone countries than companies in non-Eurozone countries after April 11.

Continuing with an even finer separation of the Eurozone, we divide the sample into crisis and non-crisis countries. We define as crisis countries the (G)IIPS states, excluding Greece as it is the epicenter of the shock we are looking at. Thus, we can test whether the previous cross-sectional results for the Eurozone can largely be attributed to Italy, Ireland, Portugal and Spain, or to the other countries in the Eurozone. The results are reported in columns 3 to 6 of Table 7. In line with a contagion/"wake-up call" interpretation of sovereign risk spillovers Giordano et al. (2013), we find that the result is stronger in the crisis countries, which we compare to non-crisis countries *outside* the Eurozone, in which a one percent increase in sovereign risk is associated with an increase in corporate credit risk of 0.10 percent. This estimate is statistically significant at the one percent level. The magnitude of the effect can be compared to an increase of 0.02 percent for the non-crisis countries in the Eurozone. This increase, however, is not significant. In particular the results for the Eurozone countries underscore that a monetary union membership reduces a country's flexibility for monetary policy adjustments, which may make its corporate sector more vulnerable to sovereign risk shocks.

8 Conclusion

We provide empirical evidence that is suggestive of spillovers from sovereign to corporate credit risk. Thus, sovereign risk may have adverse real effects that could materialize through

an increase in corporate borrowing costs. To quantify the risk transmission from sovereign to corporate credit risk, we use the first Greek bailout on April 11, 2010, as a negative exogenous shock to the credit risk of *all* governments within the EU. This event drastically increased economic uncertainty and raised the likelihood of future default contingencies.

The quantitative effects are economically meaningful. We find that a ten percent increase in sovereign credit risk is associated, on average, with a 1.1 percent increase in corporate credit risk after the bailout. Cross-sectionally, this effect is stronger for countries within the common currency union, for companies with close ties to the domestic government, and for companies that rely more on bank financing. We interpret these results as evidence for the existence of a fiscal and a financial channel that may enhance spillovers from sovereign to corporate credit risk.

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Notes

[1]FitchRatings, Corporates and the Eurozone Crisis: An Updated Q&A on Events So Far (June 14, 2012).

[2]The existing contagion literature distinguishes between different methods to measure spillovers (see Dungey et al. (2005) for a survey, or recently Bekaert et al. (2014)). We follow Dungey et al. (2005) by estimating spillovers as changes in beta coefficients. This approach does not suffer from the volatility bias emphasized in the seminal paper of Forbes and Rigobon (2002).

[3]The interpretation of a shock to one country adversely affecting other countries is consistent with the theoretical framework in Benzoni et al. (2015). In their model, contagion across countries occurs when investors update their beliefs about the *uncertain* default probabilities of all sovereigns following an adverse shock to one of them. This generates a co-movement in sovereign spreads that is greater than that justified by macroeconomic fundamentals alone.

[4]See for example Bocola (2016), Corsetti et al. (2013), and Corsetti et al. (2014) for theoretical explanations on how the sovereign risk channel is consistent with an increase in corporate borrowing costs.

[5]GIIPS is an acronym for Greece, Italy, Ireland, Portugal, and Spain. By wrapping the letter "G" in brackets, we are emphasizing that we exclude Greek corporations entirely from our analysis.

[6]More specifically, Dailami (2010) focuses on the relationship between public and corporate bond spreads, while Agca and Celasun (2012) show that, ceteris paribus, corporate yield spreads are higher when the level of external public debt is higher.

[7]We refer to Augustin et al. (2014) for an exhaustive survey of this literature.

[8]Breckenfelder and Schwaab (2017) provide also evidence of cross-country spillover effects.

[9]See Panel B of Table 1 in Acharya et al. (2014).

[10]In 2011, even the safety of US treasury bonds was debated when the public debt ceiling had to be lifted, and S&P downgraded the United States from AAA to AA+ on August 5, 2011.

[11]ECOFIN is comprised of all the finance ministers of the EU member states.

[12]See Steinkamp and Westermann (2014) for a discussion on how the EFSM claims led to a dilution of existing creditors.

[13]The no-bailout clause was carried forward to Article 125 of the Lisbon Treaty, which was ratified in 2007.

[14]Other mechanisms that could explain an increase in sovereign spreads are a dilution of seniority rights from existing creditors Steinkamp and Westermann (2014), or a wake-up-call contagion that lead to a reevaluation of economic fundamentals in the Eurozone Giordano et al. (2013).

[15]The results are qualitatively similar if we plot the average CDS spread in Europe against alternative benchmark groups from different geographical regions. These results are available upon request.

[16]Note that the term E_t drops out of the specification because of collinearity with time fixed effects.

[17]Clustering at the firm level may lead to downward biased standard errors as the variation of the key

dependent variable is at the country level (Moulton (1990)). Clustering at the country level is similarly problematic as we have only fifteen countries in our sample, which is less than the critical level of 42 clusters recommended by Angrist and Pischke (2009). For completeness, we verify that our results are robust against clustering at the country level, which produces for most tests *smaller* standard errors than those obtained with clustering at the firm dimension.

[18]Longstaff et al. (2005), for example, assume that CDS spreads are perfectly liquid in order to estimate the liquidity component implicit in bond spreads.

[19]The total sample includes 19 weeks of data, including the three weeks between the bailout announcement and its approval, a period marked by uncertainty and a gradual reevaluation of sovereign risk.

[20]While it would be preferable to have all CDS quotes denominated in USD, we ensure that our results are not affected by including interactions between the EUR/USD exchange rate return and a dummy variable for countries with USD denominated CDS spreads.

[21]There is only limited pricing availability in the CMA database, provided through Thomson Reuters Datastream, for European corporate reference contracts with the full-restructuring clause, which is standard for Western European sovereign CDS. One concern is that our results could be driven by the restructuring premium implicit in CDS contract clauses, as suggested by Berndt et al. (2007). This effect is muted by the MMR clause, which limits the maturity of deliverable debt obligations to a maximum of 60 months. In other words, the Cheapest-to-Deliver (CTD) option is less of a concern in contracts issued under the MMR clause compared to the full-restructuring clause. Thus, as long as we use a corporate contract clause for which the CTD is *less* of a problem than for the sovereign contract clause, we will *underestimate* the increase in corporate credit risk.

[22]The effect is more pronounced if we consider corporations in other distressed countries separately. In Portugal, for example, the mean sovereign CDS increases by 105 percent. According to our model, this leads to an increase in corporate credit risk of 14.1 bps.

[23]In unreported results, we find that the standard errors *decrease* if we cluster at the country dimension, and so statistical significance increases. Furthermore, we also test a specification that includes a one-period lag in the change of sovereign credit spreads. Our results remain qualitatively unchanged.

[24]The external appendix contains two additional tests that are not directly linked to a channel: first, following the evidence in Bai and Wei (2017), Table A-4 confirms that our results are stronger for countries with weaker property rights. Second, Table A-5 documents the existence of a sovereign ceiling Almeida et al. (2016), which provides additional support for causality going from sovereign to corporate credit risk.

[25]Denmark, the Netherlands, Norway, and Portugal do not report claims for the official sector and are for that reason not included in this test.

[26]Becker and Ivashina (2014) argue that firms could substitute bond financing for bank loans as an alternative source of funding. Such an explanation is less relevant in our case as we look at the relationship between sovereign and corporate credit risk around the window *immediately* surrounding the Greek bailout.

[27]We use data on countries' financial structure for the year 2010, downloaded from the Financial Structure Database published by the World Bank. Robustness tests using data for 2005, or using the average across multiple years, does not change the results.

[28]In unreported estimations, we also include the variance of country-specific equity index returns to additionally account for country-specific volatility. All results remain unchanged.

[29]We have verified that there was no general drop in CDS trading liquidity around our event date using

the publicly available data on gross and net notional amounts of CDS outstanding from the Depository Trust and Clearing Corporation. Data is available for all countries in our sample, except for Norway and Switzerland.

[30]Even a low expectation of redenomination risk may lead to more significant effects in Eurozone countries Kriwoluzky et al. (2015), providing yet another argument why sovereign and corporate spreads may co-move. However, the analysis of Krishnamurthy et al. (2018) suggests that this effect appears to be negligible for our sample period. During that time, we also find no variation in quanto spreads, a proxy for redenomination risk Buraschi et al. (2014); DeSantis (2015).

Figure 1: Sovereign CDS of Greece

Figure 1 depicts the Greek bid-ask spread (in basis points) on the right axis against the Greek CDS spread (in basis points) on the left axis. The solid vertical line in the graph marks our event date, April 11, 2010. The dashed vertical line refers to May 2, 2010, the day that the Greek bailout package was finalized. The sample period spans from February 15, 2010 to June 25, 2010. Source: CMA Datavision.

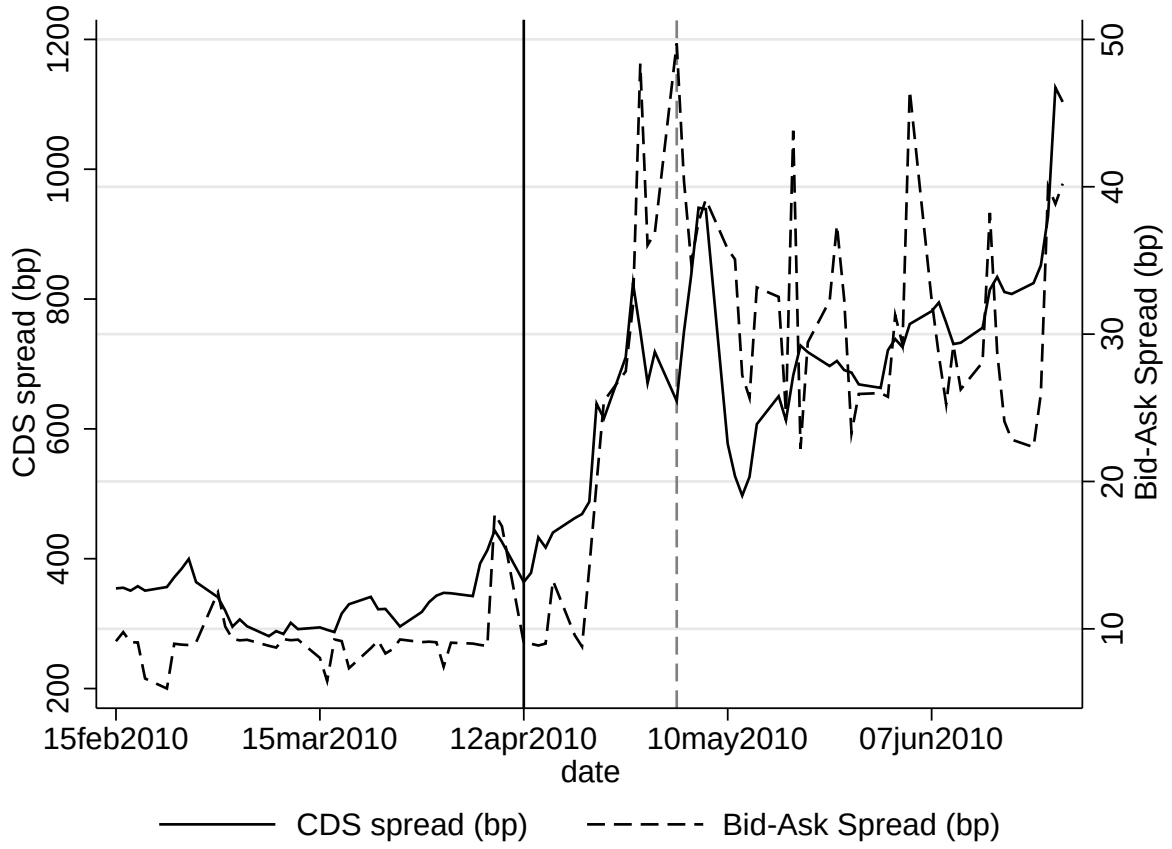

Figure 2: Timeline of Events

In this figure, we summarize the milestones of the Greek bailout over the period from February 11, 2010 to May 9, 2010.

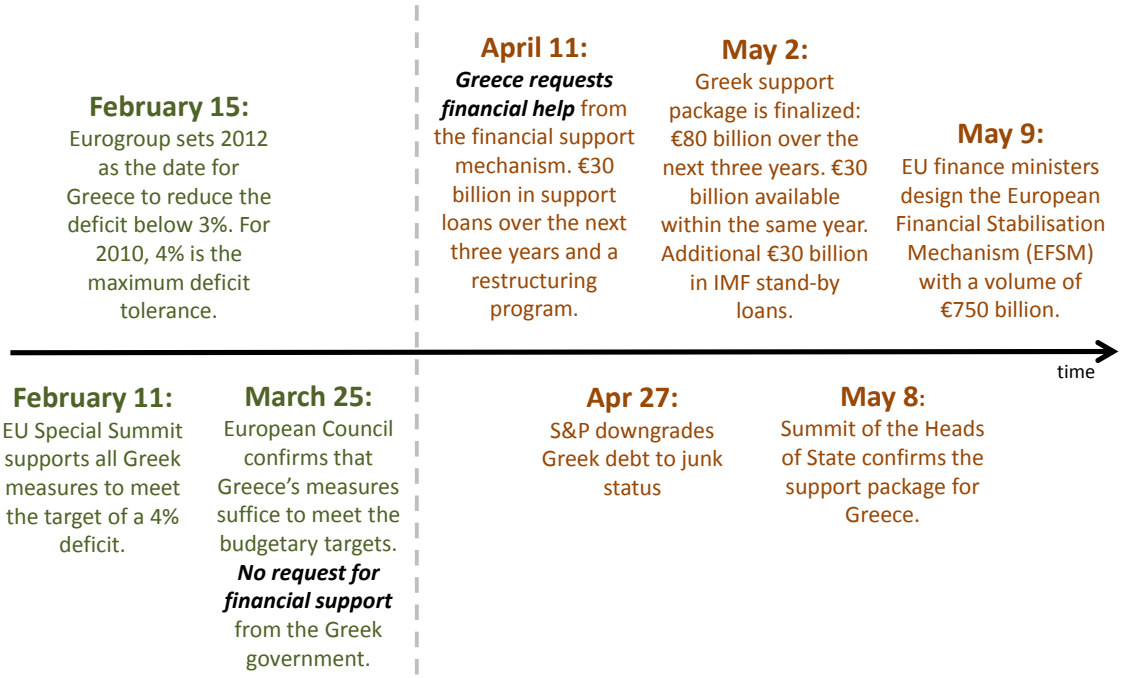

Figure 3: Google Trend Search

This graph depicts the search intensity on the internet-based search platform Google for the keywords "Greek bailout," "Greek debt," and "Euro crisis," over the time period from January 2007 to January 2011. Google does not disclose the absolute number of hits for searches, but rather a relative search intensity over time. Source: Google.

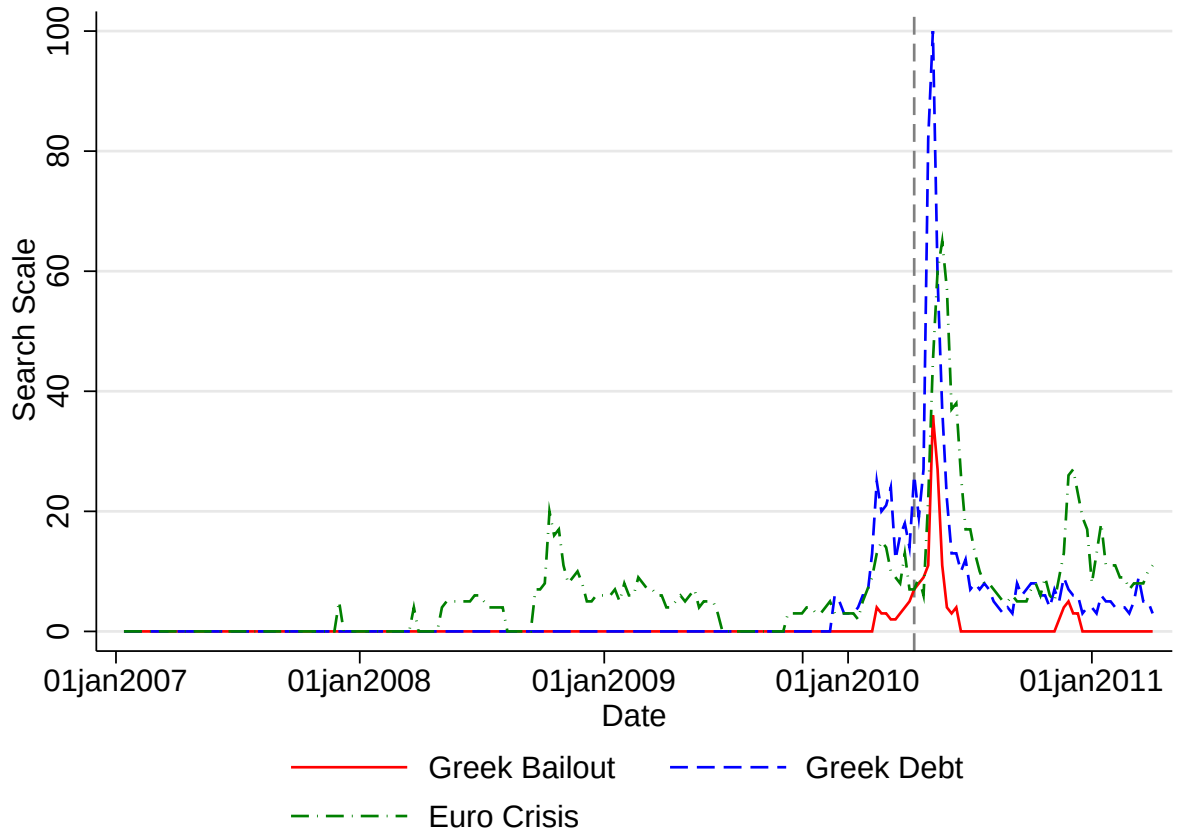

Figure 4: Sovereign CDS

In Figure 4, we plot the evolution of an average European sovereign CDS spread against that of the US CDS spread. The European index includes all countries in our sample, except Greece. We standardize each CDS spread by its corresponding level on February 15, 2010, and we plot the evolution as an index level, expressed as a percentage relative to the respective starting value. The solid vertical line in the graph marks our event date, April 11, 2010. The dashed vertical line refers to May 2, 2010, the day that the Greek bailout package was finalized. The sample period spans from February 15, 2010 to June 25, 2010. Source: CMA Datavision.

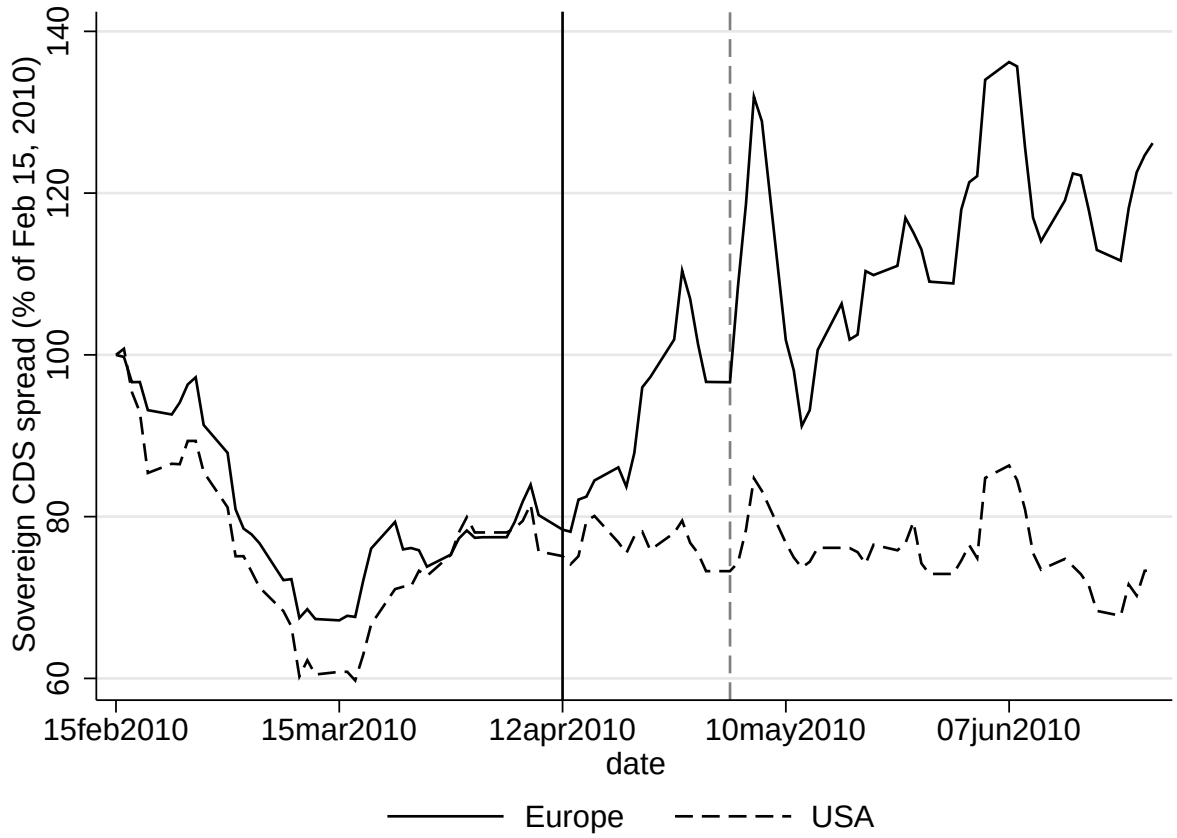

Figure 5: Time-series of European Corporate Fundamentals

Figure 5 depicts two performance measures of the European corporate sector, highlighting the aggregate health of corporate fundamentals. We construct a balanced panel of companies with quarterly observations for the years 2005 through 2012. The dashed line represents the mean of total sales, while the solid line reports the mean of EBITDA. Both measures are standardized by lagged total assets. The vertical line in the graph marks our event date, April 11, 2010. Source: COMPUSTAT Global.

Table 1: Country Summary Statistics for CDS Spreads

	Pre-Bailout					Post-Bailout					
	mean	sd	min	max	obs	mean	sd	min	max	obs	**N**
Panel A: Corporate CDS Spreads											
Austria	118	35	73	165	80	139	37	85	215	110	2
Belgium	81	24	53	115	80	92	26	53	135	110	2
Denmark	109	37	61	198	160	147	75	60	342	220	4
Finland	272	249	46	925	240	248	206	45	755	330	6
France	135	120	42	700	1520	160	141	43	820	2090	38
Germany	194	216	40	1253	1480	211	211	41	1065	2035	38
Ireland	271	17	250	320	40	270	15	249	316	55	1
Italy	153	118	49	437	360	207	149	48	644	495	9
Netherlands	179	272	35	1482	720	185	260	36	1322	990	19
Norway	390	476	48	1324	120	443	544	47	1475	165	3
Portugal	122	14	90	157	120	206	45	122	307	165	3
Spain	161	129	38	612	440	232	172	39	837	605	11
Sweden	146	192	45	932	560	150	186	49	916	770	14
Switzerland	84	51	17	213	440	109	98	19	595	605	11
UnitedKingdom	155	198	17	1670	2680	168	176	19	1233	3685	67
Total	161	195	17	1670	9040	181	193	19	1475	12430	226
Delta	-0.003	0.029	-0.883	0.414		0.006	0.058	-0.603	0.651		
Panel B: Sovereign CDS Spreads											
Austria	62	11	49	85	40	76	13	56	110	55	1
Belgium	58	8	46	72	40	100	25	56	144	55	1
Denmark	35	4	29	42	40	42	4	32	51	55	1
Finland	26	4	21	34	40	29	4	23	36	55	1
France	48	8	36	62	40	73	13	48	100	55	1
Germany	34	6	26	45	40	43	6	29	60	55	1
Greece	337	41	281	443	40	697	162	364	1126	55	1
Ireland	137	15	115	166	40	220	43	142	285	55	1
Italy	111	14	90	136	40	171	37	123	245	55	1
Netherlands	36	4	30	44	40	45	6	33	56	55	1
Norway	17	1	15	19	40	22	3	17	29	55	1
Portugal	144	23	112	193	40	295	66	152	461	55	1
Spain	115	15	92	142	40	207	43	125	275	55	1
Sweden	37	5	32	47	40	39	3	33	45	55	1
Switzerland	41	5	34	55	40	51	5	43	62	55	1
UnitedKingdom	79	7	68	93	40	81	6	71	100	55	1
Total	82	78	15	443	640	137	171	17	1126	880	16
Delta	-0.005	0.044	-0.157	0.185		0.008	0.071	-0.543	0.329		

Notes: This table provides basic summary statistics (in basis points) of daily CDS spreads for corporate and sovereign reference entities in Panels A and B, respectively, broken down by country over two different time periods. We report the mean (*mean*), the standard deviation (*sd*), the minimum (*min*), the maximum (*max*) and the number of observations (*obs*). Also, log changes for all observations are listed for both panels in the rows titled *Delta*. The last column, with the header *N*, reports the number of companies in Panel A, and the number of countries for each line in Panel B. The pre-bailout period stretches from the start of the sample on February 15, 2010 to the Greek bailout on April 11, 2010. The post-bailout period refers to the time after the event, up to the end of the sample period on June 25, 2010. Source: CMA Datavision.

Table 2: Summary Statistics for Corporate CDS Spreads in the Country Cross-Sections

	Pre-Bailout					Post-Bailout				
	mean	sd	min	max	obs	mean	sd	min	max	obs
Euro country	168	187	35	1482	5080	192	189	36	1322	6858
$non - Euro\ country$	151	203	17	1670	3960	166	197	19	1475	5346
$(G)IIPS$	158	117	38	612	960	221	150	39	837	1320
$non - (G)IIPS$	171	200	35	1482	4120	186	196	36	1322	5665

Notes: This table provides basic summary statistics (in basis points) of daily CDS spreads for corporate reference entities, categorized according to the cross-sectional tests at the country level we conduct in this paper. We report the mean (*mean*), the standard deviation (*sd*), the minimum (*min*), the maximum (*max*) and the number of observations (*obs*). The statistics are reported separately for the periods before and after the event, on April 11, 2010. The first two rows report summary statistics for countries inside and outside the Eurozone. The third and fourth rows separate the statistics for the (G)IIPS and non-(G)IIPS countries inside the Eurozone. (G)IIPS stands for Greece, Italy, Ireland, Portugal, and Spain. The parentheses around G are there to emphasize that Greece is omitted from the group. The sample period spans from February 15, 2010 to June 25, 2010. The pre-bailout period stretches from the start of the sample on February 15, 2010 to the Greek bailout on April 11, 2010. The post-bailout period refers to the time after the event up to the end of the sample period on June 25, 2010. Source: CMA Datavision, The Heritage Foundation, Bureau Van Dijk Amadeus, World Bank, Fitch Ratings, Standard & Poor's, ECB Centralised Securities Database.

Table 3: Sovereign and Corporate Credit Risk

VARIABLES	(1) Pre-Bailout	(2) Pre-Bailout	(3) Post-Bailout	(4) Post-Bailout	(5) Difference	(6) Difference
Panel A: Sovereign CDS Spreads						
Post*Sov CDS					0.094***	0.098***
					(0.036)	(0.038)
Sovereign CDS (%)	0.016	0.014	0.111***	0.109***	0.016	0.012
	(0.014)	(0.014)	(0.037)	(0.039)	(0.014)	(0.014)
Observations	9,040	9,040	12,430	12,430	21,470	21,470
R-squared	0.3246	0.3431	0.5988	0.6066	0.5592	0.5647
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES
Panel B: Sovereign Yield Spreads						
Post*Sov yield					0.161***	0.155**
					(0.059)	(0.061)
Sov yield (%)	0.008	0.013	0.168***	0.163**	0.008	0.008
	(0.012)	(0.012)	(0.062)	(0.065)	(0.012)	(0.012)
Observations	9,040	9,040	12,430	12,430	21,470	21,470
R-squared	0.3244	0.3430	0.5994	0.6070	0.5597	0.5651
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Panel A in this table reports the results from regressing the log changes in the corporate CDS spreads of company i in country j, $\Delta log\left(CDS^{c}_{i,j,t}\right)$, on log changes in the sovereign CDS spread of the same country $\Delta log\left(CDS^{s}_{j,t}\right)$. Panel B in this table reports the results from regressing the log changes in the corporate CDS spreads of company i in country j, $\Delta log\left(CDS^{c}_{i,j,t}\right)$, on log changes in 5-year sovereign yields of the same country $\Delta log\left(BY^{s}_{j,t}\right)$. The first two columns include only observations before the event date (April 11, 2010), whereas columns 3 and 4 only include observations after the event date. The last two columns include all the observations and report the difference estimator. *Post* is a dummy variable that takes the value one after the event, and zero otherwise. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision.

Table 4: Greek Exposure

Cross-section (C_i):	Greek exposure		Greek exposure		Greek subsidiaries	
Variation in C_i:	Country-level		top/bottom 3		Firm-level	
	(1)	(2)	(3)	(4)	(5)	(6)
C_i*Post*Sov CDS	-0.033	-0.034	-0.071	-0.076	0.003	0.001
	(0.028)	(0.028)	(0.048)	(0.049)	(0.033)	(0.033)
C_i * Sov CDS	0.035*	0.037**	0.028	0.033	0.013	0.014
	(0.018)	(0.018)	(0.034)	(0.034)	(0.019)	(0.020)
C_i * Post -0.001	-0.001	0.000	0.000	0.000	0.000	
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Post*Sov CDS	0.119***	0.121***	0.139***	0.150***	0.097**	0.101**
	(0.042)	(0.042)	(0.049)	(0.048)	(0.039)	(0.041)
Sovereign CDS (%)	-0.003	-0.007	0.069	0.056	0.011	0.006
	(0.021)	(0.021)	(0.044)	(0.042)	(0.018)	(0.018)
Cross-section (C_i)	-0.000		-0.001		-0.000	
	(0.001)		(0.001)		(0.001)	
Observations	20,235	20,235	7,220	7,220	18,620	18,620
R-squared	0.5542	0.5597	0.6002	0.6033	0.5620	0.5678
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports results from difference-in-difference regressions based on cross-sectional variation in the exposure to Greece. Dependent variables are log changes in corporate CDS spreads. C_i refers to cross-sectional dimensions: *Greek Exposure* is a dummy variable indicating the relative exposure of a country to Greece based on consolidated foreign claims vis-à-vis Greece on an ultimate risk basis by nationality of reporting banks. For columns 1 and 2, *Greek Exposure* is defined to be one for countries with an exposure to Greece above that of the median country in the sample, and zero otherwise. For columns 3 and 4, *Greek Exposure* is defined to be one for the three countries that are the most exposed to Greece (France, Ireland, and Portugal), and zero for the three countries that are the least exposed (Italy, Spain, and Sweden). Columns 5 and 6 use a dummy that tags companies with at least one subsidiary in Greece. Other variables follow the definition of Table 3. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision, Bank for International Settlements, Bureau van Dijk.

Table 5: State and Bank Dependence

	Panel A: Fiscal Channel				Panel B: Financial Channel					
Cross-section (C_i):	Public Ownership		State Dependence		Sovereign Exposure		Bank Dependence		Bank-based	
Variation in C_i:	Firm-level		Industry-level		Country-level		Firm-level		Country-level	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
C_i*Post*Sov CDS	0.063*	0.064*	0.106***	0.106***	0.512**	0.515**	0.064**	0.063**	0.050**	0.051**
	(0.035)	(0.035)	(0.030)	(0.031)	(0.225)	(0.225)	(0.027)	(0.027)	(0.025)	(0.025)
C_i * Sov CDS	0.002	0.001	-0.000	-0.001	0.391**	0.388**	0.001	0.001	0.014	0.013
	(0.027)	(0.027)	(0.021)	(0.021)	(0.176)	(0.176)	(0.019)	(0.019)	(0.023)	(0.022)
C_i * Post	-0.001	-0.001	-0.001	-0.001	0.009	0.009	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.008)	(0.008)	(0.001)	(0.001)	(0.001)	(0.001)
Post*Sov CDS	0.083**	0.086**	0.052	0.054*	-0.032	-0.030	0.059*	0.062*	0.048*	0.050*
	(0.035)	(0.037)	(0.032)	(0.033)	(0.048)	(0.049)	(0.034)	(0.035)	(0.028)	(0.029)
Sovereign CDS (%)	0.016	0.012	0.016	0.012	-0.065*	-0.068*	0.019	0.016	0.005	0.002
	(0.015)	(0.015)	(0.014)	(0.015)	(0.036)	(0.037)	(0.014)	(0.014)	(0.019)	(0.020)
Cross-section (C_i)	0.001		0.002***		0.002		0.000		0.001**	
	(0.001)		(0.001)		(0.005)		(0.000)		(0.001)	
Observations	21,470	21,470	21,470	21,470	18,810	18,810	20,425	20,425	21,470	21,470
R-squared	0.5598	0.5653	0.5621	0.5672	0.5630	0.5688	0.5746	0.5791	0.5596	0.5651
-	-	-	-	-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes:This table reports results from difference-in-difference regressions based on cross-sectional proxies of state or bank dependence. Dependent variables are log changes in corporate CDS spreads. C_i refers to varying cross-sectional dimensions: columns 1 and 2 use *Public Ownership*, which is a dummy whether a local government's ownership in a company exceeds 5%; columns 3 and 4 use an industry classification of *State Dependence* proposed by Pellegrino and Zingales (2014) (government, utilities, telecommunications, oil & gas, and health); columns 5 and 6 use a local banking sector's *Sovereign Exposure* computed as claims against the domestic public sector divided by total claims on an ultimate risk basis; columns 7 and 8 use a company's *Bank Dependence* defined as the ratio of bank loans over total liabilities; and columns 9 and 10 use a country classification into *Bank-based* economies, suggested by Levine (2002), which we split at the median of bank deposits over stock market capitalization. Other variables follow the definition of Table 3. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision, Bureau van Dijk, BIS, World Bank.

Table 6: Controlling for Liquidity, Foreign Country Exposures, and Equity Index and Stock Returns

VARIABLES	(1) Pre-Bailout	(2) Pre-Bailout	(3) Pre-Bailout	(4) Pre-Bailout	(5) Post-Bailout	(6) Post-Bailout	(7) Post-Bailout	(8) Post-Bailout	(9) Difference
Post*Sov CDS									0.089**
									(0.035)
Sovereign CDS (%)	0.014	0.013	0.017	0.014	0.108***	0.091***	0.137**	0.118**	0.026
	(0.014)	(0.014)	(0.023)	(0.024)	(0.039)	(0.029)	(0.062)	(0.052)	(0.028)
Bid-Ask Spread (%)	-0.001			0.002	0.032***			0.030***	0.021***
	(0.005)			(0.003)	(0.005)			(0.005)	(0.004)
Daily Equity Index (%)		-0.089		-0.042		-0.406***		-0.434***	-0.366***
		(0.083)		(0.077)		(0.135)		(0.147)	(0.132)
Foreign Exposure (%)			0.033	-0.038			0.229	0.153	0.098
			(0.186)	(0.158)			(0.274)	(0.233)	(0.193)
Stock Return (%)				-0.044**				-0.072	-0.064**
				(0.022)				(0.051)	(0.032)
Observations	9,040	9,040	9,040	7,160	12,430	12,430	12,430	9,845	17,005
R-squared	0.3431	0.3432	0.3431	0.4231	0.6162	0.6089	0.6067	0.6581	0.6235
-	-	-	-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
-	-	-	-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results from regressing the log changes in the corporate CDS spreads of company i in country j, $\Delta log\left(CDS^{c}_{i,j,t}\right)$, on log changes in the sovereign CDS spread of the same country j, $\Delta log\left(CDS^{s}_{j,t}\right)$. *Post* is a dummy variable that takes the value one after the event (April 11, 2010) and zero otherwise. We control for liquidity effects using changes in the CDS bid-ask spreads (Bid-Ask Spread), for the relationship with the domestic stock market using the daily equity index returns (Daily Equity Index), and for foreign (European) country exposure using the GDP-weighted changes of sovereign CDS spreads of all other European countries $\neq j$. Stock Return (%) captures the stock return of publicly traded companies. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double-clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision, MSCI.

Table 7: Euro versus non-Euro and Crisis versus Non-Crisis Countries

VARIABLES	(1) Euro	(2) Euro	(3) (G)IIPS	(4) (G)IIPS	(5) Non-(G)IIPS	(6) Non-(G)IIPS
Euro*Post*Sov CDS	0.060**	0.060**				
	(0.025)	(0.025)				
(G)IIPS*Post*Sov CDS			0.104***	0.103***		
			(0.039)	(0.039)		
Non-(G)IIPS*Post*Sov CDS					0.023	0.023
					(0.019)	(0.019)
Euro * Sov CDS	0.052***	0.051***				
	(0.019)	(0.019)				
(G)IIPS * Sov CDS			0.096**	0.096**		
			(0.041)	(0.042)		
Non-(G)IIPS * Sov CDS					0.042**	0.042**
					(0.018)	(0.018)
Euro * Post	-0.000	-0.000				
	(0.001)	(0.001)				
(G)IIPS * Post			-0.000	-0.000		
			(0.002)	(0.002)		
Non-(G)IIPS * Post					-0.000	-0.000
					(0.001)	(0.001)
Post*Sov CDS	0.039	0.042	-0.023	-0.022	0.024	0.026
	(0.030)	(0.030)	(0.022)	(0.022)	(0.029)	(0.029)
Sovereign CDS (%)	-0.026	-0.030	0.010	0.009	-0.035	-0.036
	(0.019)	(0.020)	(0.014)	(0.013)	(0.022)	(0.022)
Euro-country	0.000					
	(0.001)					
(G)IIPS			0.002**			
			(0.001)			
Non-(G)IIPS					-0.000	
					(0.001)	
Observations	21,470	21,470	11,685	11,685	19,190	19,190
R-squared	0.5618	0.5673	0.5440	0.5493	0.5636	0.5691
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results from difference-in-difference regressions. The dependent variables are log changes in corporate CDS spreads and *Sov CDS* defines the change in the sovereign CDS spread of the same country. *Post* is a dummy variable that takes the value one after the event date (April 11, 2010), and zero otherwise. *Euro Country* is a dummy variable that takes the value one if a country is a member of the Eurozone, and zero otherwise. *(G)IIPS* is a dummy variable that takes the value one for crisis countries, i.e., the (G)IIPS countries (Italy, Ireland, Portugal, Spain), and zero for non-crisis countries outside the Eurozone. *Non-(G)IIPS* is a dummy variable that takes the value one for non-crisis countries in the Eurozone, and zero for non-crisis countries outside the Eurozone. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double-clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision.

External Appendix

Sovereign to Corporate Risk Spillovers

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Abstract

The first Greek bailout on April 11, 2010 triggered a significant reevaluation of sovereign credit risk across Europe. We exploit this event to examine the transmission of sovereign to corporate credit risk. A ten percent increase in sovereign credit risk raises corporate credit risk on average by 1.1 percent after the bailout. The evidence is suggestive of risk spillovers from sovereign to corporate credit risk through a financial and a fiscal channel, as the effects are more pronounced for firms that are bank or government dependent. We find weaker support for indirect risk transmission through a deterioration of macroeconomic fundamentals.

Table A-1: Sovereign and Corporate Credit Risk - Country Averages

VARIABLES	(1) Pre-Bailout	(2) Pre-Bailout	(3) Post-Bailout	(4) Post-Bailout	(5) Difference	(6) Difference
Post*Sov CDS					0.114***	0.116***
					(0.031)	(0.034)
Sovereign CDS (%)	0.017	0.015	0.131***	0.131***	0.017	0.015
	(0.031)	(0.031)	(0.048)	(0.048)	(0.031)	(0.031)
Observations	600	600	825	825	1,425	1,425
R-squared	0.7002	0.7094	0.8848	0.8873	0.8657	0.8681
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Country FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Country	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results from regressing the log changes in the average corporate CDS spread of company i in country j, $\Delta log\left(CDS^{c}_{i,j,t}\right)$, on log changes in the sovereign CDS spread of the same country $\Delta log\left(CDS^{s}_{j,t}\right)$. The first two columns include only observations before the event date (April 11, 2010), whereas columns 3 and 4 only include observations after the event date. The last two columns include all the observations and report the difference estimator. *Post* is a dummy variable that takes the value one after the event, and zero otherwise. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Country) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and country fixed effects (Firm FE). Source: CMA Datavision.

Table A-2: Pre-bailout, Bailout and Post-Bailout Periods

	(1) Pre-Bailout	(2) Pre-Bailout	(3) Post-Bailout	(4) Post-Bailout	(5) Difference	(6) Difference
Panel A: 3 weeks after bailout						
Post*Sov CDS					0.051	0.051
					(0.035)	(0.033)
Sovereign CDS (%)	0.016	0.014	0.068*	0.054**	0.016	0.012
	(0.014)	(0.014)	(0.036)	(0.026)	(0.014)	(0.014)
Observations	9,040	9,040	3,390	3,390	12,430	12,430
R-squared	0.3246	0.3431	0.3921	0.4430	0.3486	0.3640
Panel B: 4-11 weeks after bailout						
Post*Sov CDS					0.116***	0.120***
					(0.033)	(0.035)
Sovereign CDS (%)	0.016	0.014	0.132***	0.130***	0.016	0.011
	(0.014)	(0.014)	(0.035)	(0.038)	(0.014)	(0.015)
Observations	9,040	9,040	9,040	9,040	18,080	18,080
R-squared	0.3246	0.3431	0.5800	0.5909	0.5446	0.5512
-	-	-	-	-	-	-
Time FE	YES	YES	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES	NO	YES
-	-	-	-	-	-	-
Cluster Time	YES	YES	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results from regressing the log changes in the corporate CDS spreads of company i in country j, $\Delta log\left(CDS^{c}_{i,j,t}\right)$, on log changes in the sovereign CDS spread of the same country $\Delta log\left(CDS^{s}_{j,t}\right)$. The first two columns include only observations before the event date (April 11, 2010), i.e. the pre-bailout period, whereas columns 3 and 4 only include observations after the event date. In Panel A, we define the bailout period by the three weeks in between the bailout announcement on April 11 and the official approval of the bailout on May 2. This period is marked with substantial policy uncertainty about the actual size of the support to Greece. In Panel B, we define the post-bailout period by the eight weeks after the official approval of the bailout on May 2. In The last two columns include all the observations and report the difference estimator for each specification, respectively. *Post* is a dummy variable that takes the value one after the event, and zero otherwise. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision.

Table A-3: Summary Statistics for Cross-sectional Sorting Variables

	(1)	(2)	(3)	(4)	(5)
Variables	*Mean*	*Std*	*Min*	*Median*	*Max*
Bank Loan/ Total Liability	0.115	0.204	0.000	0.054	1.000
Banks sovereign exposure	0.185	0.056	0.084	0.155	0.312
Bank size/ stock market	1.783	0.938	0.674	1.550	3.804
Corp_sov_diff	110.468	164.552	0.035	65.324	955.010
Corp_sov_diff_rating	7.587	3.310	1.000	7.000	16.000

Notes: This table reports summary statistics for several cross-sectional sorting variables. *Bank loan/ Total liability* is the ratio of total bank loans to total liabilities as of 2009. The data on bank loans and total liabilities is sourced from Bureau van Dijk's Amadeus database. *Bank size/ stock market* is the ratio of the aggregate value of all bank deposits extended by banks to the private sector in each country to the corresponding stock market capitalization. The data on countries' financial structure for the year 2010 is downloaded from the Financial Structure Database published by the World Bank. *Corp_sov_diff* is the distribution of the average difference between corporate and sovereign CDS spreads before the event date, after removing those companies whose average CDS spread before the bailout is lower than that of its sovereign. *Corp_sov_diff_rating* reports the distribution of the difference in credit ratings between sovereigns and corporate firms. We use the Standard & Poor's long-term issuer credit ratings for corporate companies from the ECB Centralised Securities Database. For sovereigns, we use the foreign currency long-term credit rating from Fitch Ratings.

Table A-4: Property Rights

VARIABLES	(1) Non-Financial	(2) Non-Financial
PropertyRights*Shock*Sov CDS	-0.335***	-0.329***
	(0.126)	(0.127)
Property Rights * Sov CDS	-0.252**	-0.255**
	(0.126)	(0.127)
Property Rights * Shock	-0.002	-0.002
	(0.005)	(0.005)
Shock*Sov CDS	0.323***	0.319***
	(0.110)	(0.110)
Sovereign CDS (%)	0.225**	0.226**
	(0.111)	(0.112)
PropertyRights	-0.007*	
	(0.004)	
Observations	21,470	21,470
R-squared	0.5648	0.5699
-	-	-
Time FE	YES	YES
Firm FE	NO	YES
-	-	-
Cluster Time	YES	YES
Cluster Firm	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports the results from a difference-in-difference regression where we test whether the credit risk of companies in countries with worse property rights is more adversely affected than the credit risk of companies in countries with better property rights. *Post* is a dummy variable that takes the value one after the event date (April 11, 2010), and zero otherwise. A country's property rights score is indicated through the variable *PropertyRights*, which is sourced from the Heritage Foundation. The property rights score is rescaled to be between zero and one. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision and the Heritage Foundation.

Table A-5: Sovereign Ceiling

	(1) Spread-based	(2) Spread-based	(3) Rating-based	(4) Rating-based
CorpSovDiff*Post*Sov CDS	0.072**	0.071**		
	(0.032)	(0.033)		
CorpSovDiffRating*Post*Sov CDS			0.107***	0.108***
			(0.033)	(0.033)
CorpSovDiff*Sov CDS	-0.037	-0.036		
	(0.023)	(0.023)		
CorpSovDiffRating*Sov CDS			-0.023	-0.022
			(0.045)	(0.046)
CorpSovDiff*Post	-0.001	-0.001		
	(0.001)	(0.001)		
CorpSovDiffRating*Post			0.003	0.003
			(0.003)	(0.003)
Sov CDS * Post	0.012	0.014	0.053*	0.054*
	(0.028)	(0.028)	(0.029)	(0.030)
Sov CDS	0.009	0.006	0.031*	0.029
	(0.018)	(0.020)	(0.018)	(0.018)
CorpSovDiff	0.001			
	(0.001)			
CorpSovDiffRating			0.001	
			(0.001)	
Observations	16,150	16,150	14,060	14,060
R-squared	0.5953	0.5995	0.5880	0.5924
-	-	-	-	-
Time FE	YES	YES	YES	YES
Firm FE	NO	YES	NO	YES
-	-	-	-	-
Cluster Time	YES	YES	YES	YES
Cluster Firm	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table reports results from a difference-in-difference regression based on cross-sectional variation in the difference between corporate and sovereign CDS. *Post* is a dummy variable that takes the value one after the event date (April 11, 2010), and zero otherwise. We classify firms based on the average difference between corporate and sovereign CDS spreads before the event date, after removing those companies whose average CDS spread before the bailout is lower than that of its sovereign. *CorpSovDiff* is a dummy variable that takes on the value one if the corporate CDS is equal or close (from above) to that of its sovereign and zero otherwise. More precisely, the cut-off level is the 25th percentile of the distribution. As an alternative, we classify firms based on their rating relative to that of their corresponding sovereign. We use the Standard & Poor's long-term issuer credit ratings for corporate companies from the ECB Centralised Securities Database. For sovereigns, we use the foreign currency long-term credit rating from Fitch Ratings. *CorpSovDiffRating* is a dummy variable that takes on the value one if a company has a credit rating equal to or one category below that of its corresponding sovereign. The sample period goes from February 15, 2010 to June 25, 2010. Standard errors are double clustered by firm (Cluster Firm) and time (Cluster Time). Each column indicates whether the regression contains time (Time FE) and firm fixed effects (Firm FE). Source: CMA Datavision, Fitch Ratings, ECB Centralised Securities Database.

Acknowledgements

Formerly circulated under the title "Sovereign Credit Risk and Corporate Borrowing Costs." We thank seminar participants at the NYU conference on New Research and Outlook for Credit Markets 2016, the Stockholm School of Economics, the BI-Norwegian Business School, the 2014 International Risk Management Conference, the Luxembourg Central Bank, the Conference on the European Sovereign Debt Crisis in Monaco, and the IFABS Oxford Corporate Finance Conference for great suggestions. We also thank the editor Pok-sang Lam, Fang Cai (discussant), Margherita Bottero, Henrik Cronqvist (discussant), Miguel Ferreira, Paolo Guarda, Marie Hoerova, Alexandre Jeanneret, Albert Menkveld (discussant), Kalin Nikolov, Jean-Pierre Schoder, Per Strömberg, and two anonymous referees for very valuable comments. The views expressed in this paper are those of the authors and do not necessarily reflect those of the European Central Bank or the Eurosystem.

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PDF ISBN 978-92-899-1691-2 ISSN 1725-2806 doi:10.2866/968883, QB-AR-15-118-EN-N