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Real Effects of the Sovereign Debt Crisis in Europe: Evidence from Syndicated Loans

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We explore the causes of the credit crunch during the European sovereign debt crisis and its impact on the corporate policies of European firms. Our results show that value impairment in banks' exposures to sovereign debt and the risk-shifting behavior of weakly capitalized banks reduced the probability of firms being granted new syndicated loans by up to 53%. This lending contraction depressed investment, employment, and sales growth of firms affiliated with affected banks. Our estimates based on firm-level data suggest that the credit crunch explains between 44% and 66% of the overall negative real effects suffered by European firms. (*JEL* G20, E44)

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Starting in 2009, Greece, Ireland, Italy, Portugal, and Spain (the GIIPS countries) drifted into a severe crisis as anxiety about their high indebtedness made it increasingly difficult to refinance their outstanding debt. This deterioration in the countries' creditworthiness fed back into the financial sector due to banks' large sovereign exposures (see, e.g., Acharya, Drechsler, and Schnabl 2014; and Acharya and Steffen 2015) and, as a result, bank lending contracted substantially. However, there is still no conclusive evidence on the causes and real effects of this credit contraction, partly because the impact of this crisis on bank lending is more complex than previous banking crises.

There are three channels through which the sovereign debt crisis could have affected bank lending: one working through the value decrease of the banks' preexisting sovereign debt holdings during the crisis (balance-sheet-hit channel) and two crowding-out channels working through a shift in the banks' portfolios from corporate lending toward risky sovereign debt (the moral suasion channel and risk-shifting channel). The goal of this paper is to analyze the mechanisms through which the crisis affected lending and to investigate the attendant consequences for the real economy.

Our results show that, due to the crisis-induced impairment of their preexisting sovereign bond holdings, banks from GIIPS countries (GIIPS banks) lost on average 10.8% of their equity, and banks from non-GIIPS European countries (non-GIIPS banks) lost on average 6% of their equity. These losses forced the banks to deleverage, which may have reduced their loan supply (see Bocola 2016 for a model of this balance-sheet-hit mechanism). We find that, indeed, the likelihood of precrisis clients of strongly impaired banks not receiving a loan increased by 6.6 percentage points (pp), which corresponds to a probability increase of not receiving a loan of 47%. In addition, this balance sheet hit weakened the banks' financial health, thereby reinforcing the two potential crowding-out channels that are unique to the eurozone crisis.[1]

First, through the risk-shifting channel (see, e.g., Uhlig 2014; Acharya and Steffen 2015; Farhi and Tirole forthcoming; and Crosignani 2017), weakly capitalized banks with significant preexisting sovereign debt exposures to countries affected by the sovereign debt crisis (i.e., GIIPS countries) were incentivized to further increase these risky holdings. Second, GIIPS countries might have explicitly or implicitly pressured their domestic banks to increase domestic sovereign bond holdings in case of difficulties in refinancing sovereign debt (the moral suasion channel; see, e.g., Reinhart and Sbrancia 2015; Ongena, Popov, and Van Horen 2016; Chari, Dovis, and Kehoe 2016; and Becker and Ivashina 2018).

As these two crowding-out channels both predict a portfolio shift from corporate lending toward sovereign debt, we start our analysis by tracking the banks' change in their sovereign debt holdings in the crisis period (2010 to 2012). In a second step, we then analyze how, depending on the change in their

[1] Broner et al. (2014) present a theoretical model of the crowding-out mechanism.

sovereign debt holdings, these banks changed their loan supply and determine the resulting real effects for their borrowers. For our analysis, we obtain bank-firm relationships from Thomson Reuters LPC's DealScan, firm-specific information from Bureau van Dijk's Amadeus database, and bank-specific information from various sources, including detailed data about the banks' sovereign debt holdings from the European Banking Authority (EBA) and the banks' annual and quarterly reports.

First, we investigate the behavior of non-GIIPS banks, which allows us to identify the risk-shifting channel, as these banks were not affected by moral suasion of GIIPS governments (see, e.g., Drechsler et al. 2016). We find that the banks most prone to risk shifting (i.e., weak banks with significant preexisting GIIPS sovereign exposures) indeed engaged in risk shifting by further increasing their highest preexisting GIIPS sovereign exposure during the crisis period (on average by roughly 30%). This portfolio reallocation led to a crowding-out of corporate lending, which increased the probability for firms connected to these risk-shifting banks not being granted a new syndicated loan by 2.6 pp (an increase of 30%).

Second, to investigate the relative importance of the risk-shifting and the moral suasion channel for GIIPS banks, we exploit three important differences between these channels: (i) Banks with risk-shifting incentives deliberately increase their risky sovereign debt exposure and thus do not seek to hedge the additional exposure. Conversely, banks affected by moral suasion were coerced into increasing their domestic sovereign debt exposure above their preferred level and thus should have hedged this unwanted exposure. (ii) While the risk-shifting explanation predicts that a bank's incentive to buy a particular risky asset increases with its preexisting exposure to this asset, the moral suasion explanation provides no such differential prediction. (iii) Governments with refinancing problems are likely to pressure mostly domestic, government-controlled banks.

Our results suggest that moral suasion was not an important driver for the banks' purchases of domestic sovereign debt since GIIPS banks most prone to moral suasion (i.e., weak banks that were government controlled) increased their holdings less than weak non-government-controlled banks. In line with this finding, we find no evidence that moral suasion affected the banks' loan supply. Neither weak government-controlled banks nor banks that purchased additional domestic sovereign debt while hedging this additional exposure significantly reduced their lending.

Regarding the impact of the risk-shifting channel on GIIPS banks, we show that banks with the strongest risk-shifting incentives increased their highest preexisting GIIPS sovereign exposures significantly more than other banks (gross increase of 48% vs. 32%), without hedging this additional exposure. This evidence is consistent with risk shifting but not with moral suasion. Moreover, we find that these banks significantly reduced their loan supply, thereby increasing the probability for borrowers of these banks of not receiving a new syndicated loan by 9.5 pp.

Finally, our results show that the lending contraction through the hit-on-balance-sheet and the risk-shifting channels dragged down the European real economy. By exploiting multiple bank-firm relationships to control for borrower specific factors (similar to Khwaja and Mian 2008), we show that firms with a high indirect exposure to the crisis through their banks (i.e., firms connected to banks with risky sovereign exposures) suffered significant real effects: These firms recorded 4.7 pp lower employment growth, which corresponds to 28% of the precrisis standard deviation (SD), 5.9 pp lower investments (29% of precrisis SD), and 5.6 pp lower sales growth (24% of precrisis SD) than ex ante comparable firms that were not linked to banks strongly affected by the crisis. Our estimates suggest that of the overall real effects that can be attributed to the crisis, the credit crunch explains 61% of the sales decrease, 62% of the investment contraction, and 66% of the employment decline for GIIPS countries and 44%, 46%, and 49% for European non-GIIPS countries, respectively. To gain some perspective on the magnitude, consider that overall, in the GIIPS countries, the unemployment rate increased by 37%, and investment contracted by around 190 billion euros during the crisis.

These results do not seem to be driven by how firms and banks formed business relationships, nor by precrisis differences between affected and nonaffected banks, or between loan syndicates with and without affected banks. Moreover, we conduct two additional tests to rule out alternative explanations related to loan demand or macroeconomic shocks.

First, we apply a strategy similar to that of Peek and Rosengren (1997) and focus our analysis on European firms that were not directly affected by the crisis, that is, non-GIIPS firms without business exposure to affected countries that had precrisis links with banks most affected by the crisis (i.e., GIIPS banks). For example, a German firm without business activities in GIIPS or non-EU countries that had a precrisis lending relationship with a Spanish bank. To rule out that a firm's dependency on GIIPS banks is positively correlated with its non-observed business exposure to GIIPS countries, we consider only non-GIIPS firms for which the GIIPS bank relationships are due to reasons unrelated to their geographical business exposure. More precisely, we focus on non-GIIPS firms that inherited their GIIPS bank link before the start of our sample period (before 2006) through a takeover. All real effects results continue to hold for this robustness test.

Second, we show that the negative impact of the loan supply reduction was more severe for firms that were unable to obtain financing from another source (i.e., unrated and/or unlisted firms), which confirms that the credit crunch caused negative real effects.

Broadly, our paper adds to the literature examining the impact of crises on lending and the resulting real effects at the firm level.[2] Few papers address this

[2] See Chodorow-Reich (2014) for a comprehensive overview over the "natural experiment" literature on shocks that induce variation in the cross-section of credit availability.

issue as such an analysis requires comprehensive data on bank-firm links and firm characteristics. Regarding the 2008–09 financial crisis, Chodorow-Reich (2014) uses DealScan data to show that U.S. firms with relationships with banks impaired by the crisis reduced employment more than firms linked to healthier lenders. Using data from Peru, Paravisini et al. (2014) show that credit shocks caused by the 2008–09 financial crisis affected exports by raising the variable production costs.

Bentolila et al. (forthcoming) document that during the 2008–09 financial crisis, Spanish firms that had relationships with banks that obtained government help eliminated more jobs than firms with links to healthy banks. Cingano, Manaresi, and Sette (2016) provide evidence that Italian firms that borrowed from banks with higher interbank exposure experienced a larger drop in investment and employment in the aftermath of the 2008–09 financial crisis.

Regarding the impact of the European debt crisis, Popov and Van Horen (2015) and De Marco (forthcoming), who both also use DealScan data, find that non-GIIPS European banks with large GIIPS sovereign exposures tightened their lending conditions more than nonexposed banks. Bofondi, Carpinelli, and Sette (forthcoming) confirm this finding using Italian credit register data. These studies, however, determine neither which channels actually caused the lending contraction, nor their consequences for the real economy. Using Italian survey data, Balduzzi, Brancati, and Schiantarelli (forthcoming) also find negative real effects of the eurozone crisis, that is, firms connected to banks with high credit default swaps (CDS) spreads invested and hired less and reduced borrowing. However, this study also does not investigate which channels caused the lending contraction and the resulting real effects.

1. Data

We use a novel data set that contains bank-firm relationships in Europe, along with detailed firm- and bank-specific information. Our sample period spans the years 2006 to 2012. Information about bank-firm relationships are from Thomson Reuters LPC's DealScan, which provides comprehensive coverage of the syndicated loan market. In Europe, bank financing is the key funding source for firms, as banks provide more than 70% of debt for European firms and only very few bonds are issued in Europe (see, e.g., Standard & Poor's 2010; and Dombret and Kenadjian 2015).

Moreover, syndicated loans are an important financing source for European nonfinancial corporations, as on average between 2006 and 2009 roughly 20% of all extended loans to these firms were syndicated loans.[3] We collect information on syndicated loans to nonfinancial firms from all GIIPS countries.

[3] Figure A1 shows the fraction of syndicated loans/total loans in a given country, measured as the average fraction for the precrisis period. This fraction tends to be slightly lower in GIIPS than non-GIIPS countries. Moreover, Table A18 presents descriptive statistics for the syndicated loans issued to firms in our sample countries. Note that the prefix A always indicates that the respective figure/table is in the Online Appendix.

In addition, to evaluate the impact of the bank lending supply shock on non-GIIPS European firms and better disentangle the concurrent macro and bank lending supply shocks, we include in our sample firms incorporated in Germany, France, and the United Kingdom (non-GIIPS countries). These are the countries with the largest number of syndicated loans among the European countries that were not significantly affected by the sovereign debt crisis. Overall, these eight countries cover 75%–80% of European syndicated loans in our sample period.[4] Consistent with the literature (see, e.g., Sufi 2007), we aggregate all loans to a bank's parent company.

We augment the data on bank-firm relationships with firm-level data obtained from Bureau van Dijk's Amadeus database. This database contains balance sheets and income statements for public and private companies in Europe. Furthermore, we match our sample to the Capital IQ database to obtain detailed data on the whole debt structure for a subsample of our firms, including detailed information on total outstanding and undrawn credit lines.

Moreover, we obtain bank-level information from various sources. We retrieve data about the sovereign debt holdings of European banks from the EBA's EU-wide stress tests and capital exercises (see, e.g., Acharya, Drechsler, and Schnabl 2014; and Popov and Van Horen 2015) and augment this data with hand-collected information of the banks' annual/quarterly reports. Furthermore, we obtain information about the banks' health from SNL Financial (leverage) and Bloomberg (ratings). Finally, we compile government bank ownership data from Bankscope, and extract the fraction of directors affiliated with the respective government from the BoardEx database. The definitions of all variables are given in Table 1.

2. Channels and Evolution of Sovereign Debt Holdings

Due to the balance sheet hit caused by the value loss of their preexisting sovereign debt holdings during the crisis, GIIPS banks lost on average 10.8% and non-GIIPS banks on average 6% of their equity.[5] These substantial losses induced the banks to deleverage, which may have led to a reduction in their loan supply (the balance sheet hit channel; see Bocola 2016 for the underlying theory). Moreover, this balance sheet hit weakened the banks' financial health, which reinforced two additional channels that are unique to the sovereign debt crisis: the moral suasion and the risk-shifting channels. Both of these channels involve a portfolio shift toward sovereign debt, which can lead to a crowding-out of bank lending due to the banks' funding constraints induced by market forces, regulatory requirements, and other financial frictions.[6]

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[4] Table A17 presents a breakdown of the number of firms by country.

[5] These losses were caused via three channels: (i) banks sell government bonds realizing a loss; (ii) bonds are in the trading book and therefore marked to market; and (iii) bonds are pledged to the European Central Bank (ECB), which makes margin calls in case the value of the collateral falls.

[6] See Broner et al. (2014) for a model of this crowding-out mechanism.

Table 1
Variable definitions

Variable	Definition
Bank level: Affected bank measures based on sovereign debt holdings data	
Net Change Risk-Shifting Asset$_t$	Increase in net holdings of the GIIPS sovereign debt to which a bank had the highest preexisting exposure
Gross Change Risk-Shifting Asset$_t$	Increase in gross holdings of the GIIPS sovereign debt to which a bank had the highest preexisting exposure
Net Change All GIIPS$_t$	Increase in net holdings of a bank's total GIIPS sovereign debt
Gross Change All GIIPS$_t$	Increase in gross holdings of a bank's total GIIPS sovereign debt
Crisis	Dummy equal to one if observation falls into sovereign debt crisis period of 2010 to 2012
Value Change GIIPS Sov Debt 2010$_t$	Change in value of the bank's preexisting (i.e., March 2010) sovereign debt holdings normalized by equity
Total Value Change GIIPS Sov Debt 2010	Sum of *Value Change GIIPS Sov Debt 2010*$_t$ over the crisis period
Risk Change GIIPS Sov Debt 2010$_t$	Change in risk of the bank's preexisting (i.e., March 2010) sovereign debt holdings normalized by equity
Total Risk Change GIIPS Sov Debt 2010	Sum of *Risk Change GIIPS Sov Debt 2010*$_t$ over the crisis period
No Hedge	Dummy equal to one if a bank increases gross and net holdings by at least the same amount (i.e., bank is not hedging)
GIIPS Sov Risk	Sum of fraction of GIIPS sovereign debt holdings weighted by the countries CDS over total assets
Bank level: Affected bank measures based on ex ante bank-level characteristics	
Low-Quality	Dummy equal to one if a bank has an above-median leverage ratio or a below-median rating in 2009
High-Exposure	Dummy equal to one if a bank's risk-shifting asset exposure is above median in March 2010 (separate medians for GIIPS/non-GIIPS banks)
Gov-Control	Dummy equal to one if in 2009 bank has positive government ownership or if its fraction of government-affiliated directors is above median
Firm level: Key explanatory variables	
Indirect GIIPS Sov Risk	Measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships
High (Low) Indirect GIIPS Sov Risk	Indicator variable equal to one if a firm's *Indirect GIIPS Sov Risk* is above (below) the sample median
Firm level: Dependent variables (winsorized at the 5% level)	
Net Debt	$\frac{Current + Non\text{-}Current\ Liabilities - Cash}{Total\ Assets}$
$\Delta Cash$	$\frac{Cash_{t+1} - Cash_t}{Total\ Assets_t}$
Interest Coverage Ratio (ICR)	$\frac{EBIT}{Interest\ Expense}$
Employment Growth (Emp Growth)	$ln(Employment_{t+1}) - ln(Employment_t)$
CAPX	$\frac{Fixed\ Assets_{t+1} - Fixed\ Assets_t + Depreciation}{Fixed\ Assets_t}$, set to 0 if negative
Sales Growth	$ln(Sales_{t+1}) - ln(Sales_t)$
Firm level: Control variables (winsorized at the 5% level)	
ln(*Assets*)	Natural logarithm of total assets
Leverage	$\frac{Total\ Assets - Total\ Equity}{Total\ Assets}$
Net Worth	$\frac{Total\ shareholder\ funds\&Liabilities - Current\&Non\text{-}Current\ Liabilities - Cash}{Total\ Assets}$
Tangibility	$\frac{Fixed\ Assets}{Total\ Assets}$
EBITDA/Assets	$\frac{EBITDA}{Total\ Assets}$
Cash Flow	$\frac{Cash\ Flow}{Total\ Assets}$

According to the moral suasion channel, GIIPS governments may have coerced their domestic banks into purchasing more domestic sovereign debt to alleviate their significant refinancing problems (see, e.g., Reinhart and Sbrancia 2015; Chari, Dovis, and Kehoe 2016; Ongena, Popov, and Van Horen 2016; and Becker and Ivashina 2018). Ultimately, if active, this channel led to a situation in which affected banks held more domestic sovereign debt than their desired optimal exposure (Chari, Dovis, and Kehoe 2016). Importantly, non-GIIPS banks were not affected by moral suasion from GIIPS governments (Drechsler et al. 2016). We use these stylized facts in our tests below.

The second crowding-out channel is the risk-shifting channel (see, e.g., Uhlig 2014; Acharya and Steffen 2015; Farhi and Tirole forthcoming; and Crosignani 2017). The incentive to engage in risk shifting arises whenever a bank has an investment opportunity that allows the bank to "shift" more returns in solvency states and any potential losses in insolvency states—in other words, a high-yield investment opportunity that causes substantial losses only in states of the world in which the bank is insolvent anyway due to a failure of its preexisting investments (see, e.g., Landier, Sraer, and Thesmar 2015; and Eisert and Eufinger forthcoming for models of this intuition in the context of real estate and interbank investments, respectively). A prime risk-shifting opportunity is thus to further load up on an asset whose failure would bring down the bank anyway given the current exposure to the asset. The December 2010 EBA stress test, which included a one-time disclosure of the banks' total exposures at default (EAD), shows that numerous banks had such "solvency-critical" exposures toward risky sovereign debt at the onset of the crisis.[7] For GIIPS banks, the highest exposure to a single GIIPS sovereign amounted to on average 11 times their equity and 1.35 for non-GIIPS banks, while their second largest GIIPS sovereign debt exposures were only 0.8 and 0.6 times their equity, respectively.

This highly concentrated exposure and the fact that sovereign debt did not carry any concentration limits, while EU regulations limit a bank's exposure to a single borrowing firm to 25% of its Tier 1 capital, thus made the risky GIIPS sovereign debt holdings to which the respective bank had the highest preexisting exposure the ideal risk-shifting asset (called a bank's "risk-shifting asset" in the following).[8] This concentrated sovereign exposure also rules out that Greek sovereign debt, which had the highest yield, was the ideal risk-shifting asset for all banks. For example, the Greek sovereign exposure/equity ratio for non-Greek GIIPS banks was on average only 0.06, implying that loading up on Greek debt would have significantly increased their downside

[7] Besides direct sovereign debt exposure, these EADs include exposures to sovereign guarantees, public sector entities, etc.

[8] The demand for sovereign bonds thus did not come purely from the demand for safe assets (as in Caballero and Farhi 2013), but from the demand of weak banks and their bias toward high covariance investments.

risk, which rules out that it can be used for risk shifting.[9] To tease out the importance of the risk-shifting channel, we thus focus first on the banks' risk-shifting asset before analyzing the evolution of their remaining GIIPS sovereign debt holdings for further robustness tests.

Since a bank's risk-shifting incentives with regard to an asset are higher (i) the lower the bank's quality (i.e., the bank is generally closer to insolvency) and (ii) the higher its preexisting asset exposure (i.e., implies a larger effect on solvency if the asset fails), we divide banks into four groups. We define a bank as low quality if in the last year before the crisis either its leverage ratio is above the sample median or it has a below median rating (see Drechsler et al. 2016 for a similar classification). Moreover, we classify a bank as high exposure if its exposure to its risk-shifting asset relative to its total assets as of March 2010 (the date of the first EBA stress test) is above the sample median, where we use separate median values for GIIPS and non-GIIPS banks. Accordingly, the four bank groups are permutations of the classifications low/high quality and low/high exposure.

As for all GIIPS banks the highest preexisting GIIPS sovereign debt exposure is domestic sovereign debt, an increase in these holdings could be driven by both risk shifting and moral suasion. In contrast, banks headquartered outside of the GIIPS countries (i.e., non-GIIPS banks) are not affected by moral suasion from GIIPS governments. Hence, for our first risk-shifting test, we focus only on non-GIIPS banks. Figure 1 plots the evolution of the sovereign debt holdings of the different non-GIIPS bank groups and shows that the banks with the highest risk-shifting incentives (i.e., low-quality/high-exposure banks) shifted their sovereign debt portfolio toward their risk-shifting asset (increase by roughly 30%; see panels A and B), and reduced all other GIIPS sovereign debt holdings (panels C and D). As a result, the overall GIIPS exposure of low-quality/high-exposure non-GIIPS banks increased by around 11%, as shown by panels A and B of Figure A3. In contrast, the other three groups of non-GIIPS banks all decreased their sovereign debt exposures toward all GIIPS countries. This behavior cannot be explained by moral suasion and can thus be considered as evidence for risk-shifting behavior.[10] Panel A of Table A2 and Panel A of Table A3 present regressions at the bank-time level that confirm that these changes in the banks' sovereign debt portfolios are also statistically significant.

Next, we track the evolution of the sovereign debt holdings of GIIPS banks. As low-quality GIIPS banks not only have high risk-shifting incentives, but

[9] Even the subset of GIIPS banks with a nonzero Greek exposure at default had only on average a 0.25 Greek sovereign exposure to equity ratio.

[10] This evidence also rules out that non-GIIPS banks were forced by their own governments to buy debt of GIIPS countries. Had this been the case, they would have been pressured to either buy sovereign debt of all GIIPS countries or focus on Greek bonds (as Greece had the biggest refinancing problems). Instead, low-quality/high-exposure non-GIIPS banks solely loaded up on their risk-shifting asset, which for none of these banks was Greek sovereign debt.

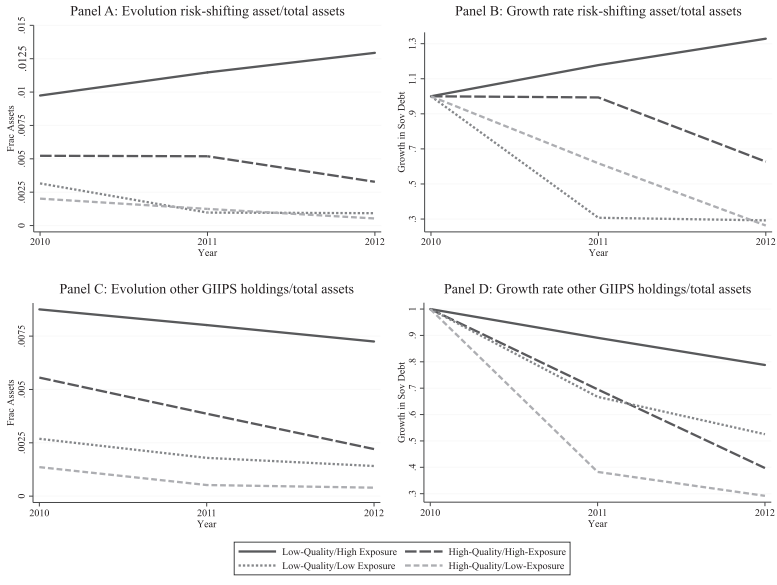

Figure 1
GIIPS sovereign debt holdings: Non-GIIPS banks
Panel A shows the evolution of the net risk-shifting asset holdings over total assets for non-GIIPS banks over the crisis period 2010 to 2012 (the growth rate is depicted in panel B). The risk-shifting asset is defined as the GIIPS sovereign debt to which a bank had the highest exposure at the beginning of the crisis. Panel C shows the evolution of the average of the remaining four GIIPS sovereign debt holdings (growth rate depicted in panel D). A non-GIIPS bank is classified as low quality if it has an above-median leverage ratio or a below-median rating in 2009. A non-GIIPS bank is classified as high exposure if its risk-shifting asset exposure as of March 2010, the date of the first EBA stress test, is above the sample median for non-GIIPS banks.

potentially also have the highest need for future government assistance, an increase in their domestic sovereign debt holdings is consistent with both risk shifting and moral suasion. We address this identification challenge in several steps.

First, we compare the evolution of domestic sovereign debt holdings again within low-quality banks that differ with regard to their existing sovereign debt exposure. This test exploits the fact that, while the banks' incentive to engage in risk shifting increases with their preexisting exposure to the risk-shifting asset, the moral suasion explanation provides no such differential prediction conditional on the banks being of similar quality.

A possible concern with this test is that GIIPS banks with a highly concentrated portfolio (i.e., high-exposure GIIPS banks) might have incurred a bigger balance sheet hit than other GIIPS banks, implying a higher likelihood for the need of government assistance. This concern is alleviated by the fact that, while low-quality/high-exposure GIIPS banks had a higher domestic sovereign exposure and thus higher losses on domestic bonds as a fraction of equity than low-quality/low-exposure GIIPS banks (11.2% vs. 9.8%), their overall sovereign debt losses (i.e., their hit on balance sheet) was comparable

(13% vs. 12.6%) due to their lower foreign sovereign debt exposure (especially their lower exposure to Greek sovereign debt, which recorded the largest value decrease). As a result, the banks' quality did not differ significantly over the crisis period, as shown in Figure A5: neither their ratings, CDS spreads, nor leverage levels were significantly different.

Second, we use the stylized fact that, while banks that act on risk-shifting incentives deliberately increase their risky sovereign debt exposure, banks that are affected by moral suasion are pressured to increase their domestic exposure above their preferred optimal level (Chari, Dovis, and Kehoe 2016). Consequently, these banks should have reacted by at least partially hedging this unwanted exposure, while banks with risk-shifting incentives do not seek to hedge additional exposure.

To test this implication, we use detailed information on the banks' gross and net sovereign debt exposures, which allows us to infer information about their hedging behavior. These data are collected from disclosures by the EBA that we augment with hand-collected information from the banks' annual and quarterly reports. According to the EBA technical background explanatory note (2011), these reported exposures "focus on cash (e.g., debt securities) gross direct long exposures toward sovereigns. ... Net direct positions represent the gross long positions of the banks held in the different books (trading, banking) net of cash short positions."[11] The EBA also clarifies that for stress testing purposes, "the exposures to be stressed should be gross exposures (long) net of cash short position of sovereign debt ..., i.e., direct positions net of cash short positions." Hence, regulators consider the reported net exposure as the true economic exposure of a bank.

Accordingly, if banks show a stronger increase in their gross than in their net exposure, this behavior is consistent with moral suasion, but not risk shifting. In contrast, if gross and net increase are more or less equal, this is more consistent with risk shifting. Figure 2 plots the evolution of the domestic sovereign debt holdings (scaled by total assets) for the different subgroups of low-quality GIIPS banks. Panels A and B show that low-quality/high-exposure GIIPS banks increased both their gross and net domestic exposure by more (both increase by around 48%) than low-quality/low-exposure GIIPS banks (gross 32% vs. net 23% increase). The stronger and unhedged increase for low-quality/high-exposure GIIPS banks suggests that risk-shifting behavior played a role for the portfolio reallocation of these banks. This evidence is confirmed by the regression results in Table A2, panels B and C. Panel B focuses on all GIIPS banks and documents that the increase in domestic sovereign debt holdings was most pronounced for low-quality/high-exposure GIIPS banks

[11] Regarding derivative positions, we observe only the net fair value of all positions combined and not the amount of derivatives used for hedging or speculating. However, omitting derivatives does not seem to qualitatively affect our results, as the net fair value is zero for the median bank, and only around 2% of gross exposure for a bank at the 95th percentile. This suggests that banks do not use derivatives on a large scale to manage sovereign risk.

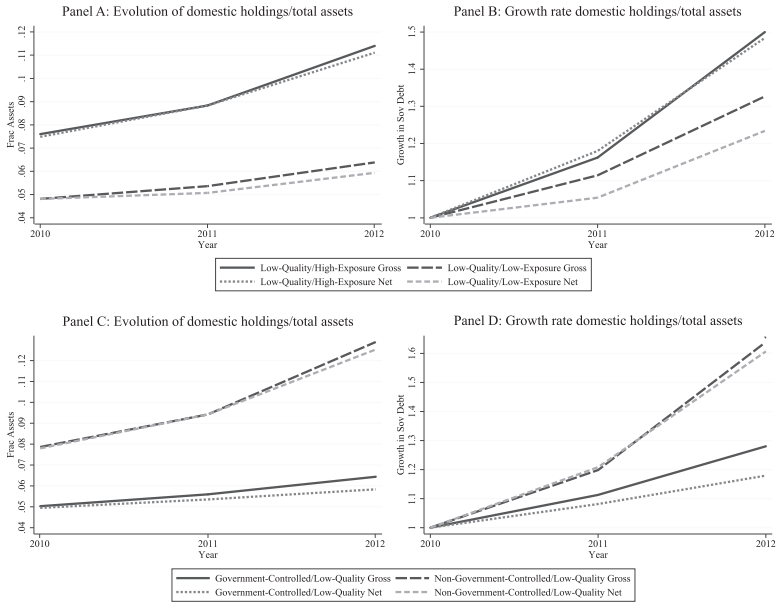

Figure 2
Domestic sovereign debt holdings: Low-quality GIIPS banks
Panels A and B show the evolution of gross and net domestic sovereign debt holdings over total assets for low-quality GIIPS banks over the crisis period 2010 to 2012 (the growth rate is depicted in panels B and D). A GIIPS bank is classified as low quality if it has an above-median leverage ratio or a below-median rating in 2009. A GIIPS bank is classified as high exposure if its risk-shifting asset exposure as of March 2010, the date of the first EBA stress test, is above the sample median for GIIPS banks. We classify a GIIPS bank as being government controlled if it has either positive government ownership or an above-median fraction of government-affiliated directors in 2009.

(Columns 1 and 2). Panel C shows that within low-quality GIIPS banks, the increase in the risk-shifting asset was significantly larger for high-exposure banks.

Next, we focus on the nondomestic GIIPS sovereign exposures of GIIPS banks to provide further evidence on the importance of the risk-shifting channel. In particular, since the moral suasion hypothesis predicts that GIIPS governments influence solely the banks' domestic government debt holdings, any difference in the change of nondomestic GIIPS sovereign bond holdings between low- and high-quality GIIPS banks is evidence for risk-shifting behavior.

Figure A4 shows that low-quality GIIPS banks indeed decreased their foreign GIIPS sovereign debt exposure less than high-quality GIIPS banks. Hence, low-quality banks chose to remain significantly more exposed to nondomestic GIIPS sovereign debt, which is consistent with risk-shifting behavior. This graphical evidence is supported by the regressions results in Table A4.[12]

[12] Note that despite the decrease in their nondomestic GIIPS holdings, the total GIIPS sovereign debt holdings of low-quality/high-exposure GIIPS banks increased by 38% due to their increased domestic holdings, as shown by panels C and D of Figure A3 and panels B and C of Table A3.

Finally, to specifically analyze the moral suasion channel, we follow the literature that identifies the susceptibility to government coercion by using data on direct government ownership and other measures of government control (see, e.g., Reinhart and Sbrancia 2015; and Becker and Ivashina 2018). In particular, we classify a GIIPS bank as being government controlled if it has either positive government ownership or an above-median fraction of government-affiliated directors in 2009. Presumably, government-controlled banks can be pressured more easily to buy domestic sovereign debt. Furthermore, one could argue that it is easier to pressure low-quality banks to buy domestic sovereign debt since these banks potentially have the highest need for future government assistance.

Hence, we divide GIIPS banks into four groups, which are permutations of low/high-quality and government-controlled/non-government-controlled, and again track the evolution in their sovereign debt holdings during the crisis period (2010 to 2012).[13] If there was indeed moral suasion, we expect a higher (and at least partially hedged) increase in domestic sovereign debt holdings over the crisis period for low-quality/government-controlled GIIPS banks compared with the other GIIPS bank groups. Importantly, Table A1 shows that weak banks did not have on average stronger government affiliations, alleviating concerns that their behavior was driven by risk-shifting incentives.

Figure 2, panels C and D, shows that for low-quality/government-controlled GIIPS banks, the increase in gross domestic sovereign debt holdings (increase of around 30%) was stronger than the increase in their net holdings (only about 18%), while non-government-controlled GIIPS banks increased their gross and net exposure by roughly the same amount. This evidence suggests that low-quality/government-controlled banks hedged the increased economic risk associated with the newly acquired sovereign bonds. However, the overall increase of these banks was much smaller than that of low-quality/non-government-controlled GIIPS banks. Consistent with this graphical evidence, we do not find a significant increase in the domestic sovereign holdings for low-quality/government-controlled GIIPS banks (see panel B of Table A2, Columns 3 and 4). Hence, moral suasion does not seem to have been an important driver for the banks' purchases of domestic sovereign debt.

Finally, within the group of low-quality GIIPS banks, the change in the banks' net holdings relative to the change in their gross holdings is significantly higher for high-exposure GIIPS banks and significantly lower for government-controlled GIIPS banks (see panel C of Table A2, Columns 5 and 6). This evidence again suggests that low-quality/government-controlled GIIPS banks at least partially hedged the economic risk associated with the increase in their gross sovereign debt holdings, while low-quality/high-exposure GIIPS banks were eager to take on the economic exposure.

[13] Note that we are able to investigate the behavior of low-quality/high-exposure and low-quality/government-controlled GIIPS banks separately as only one low-quality GIIPS bank belongs to both groups.

Taken together, we interpret these findings as consistent with the notion that the increase in domestic sovereign debt holdings of GIIPS banks is driven by risk-shifting incentives, while moral suasion does not seem to be an important factor. A possible explanation for the large risk-shifting effect is that, on top of being per se an attractive risk-shifting asset, European regulators do not require banks to hold any capital against potential losses on European government bonds although they are clearly risky. Thereby, regulators implicitly encourage risk shifting toward this asset class. This weaker indirect form of moral suasion makes risky GIIPS sovereign debt very attractive for low-quality banks: By shifting from corporate loans to sovereign bonds, these banks can improve their risk-weighted capital ratio and, in turn, appear better capitalized from a regulatory perspective.

3. Bank Lending

To test the importance of the different channels for the reduction in bank lending observed during the European sovereign debt crisis, we follow the methodology developed in Khwaja and Mian (2008), which exploits multiple bank-firm relationships to control for loan demand and other observed and unobserved borrower characteristics. However, while we observe a large number of firms borrowing from multiple banks, we face two constraints in data availability that require us to modify the original Khwaja and Mian (2008) estimator.

First, our data set contains information only at the time when the loan is originated. Hence, we do not observe changes over time for a particular loan (e.g., on credit line drawdowns). Second, the loans in our sample generally have long maturities. Hence, a large number of observations in our sample experience no significant year-to-year change in bank-firm lending relationships. To generate enough time-series bank lending heterogeneity, we thus aggregate firms into clusters and track the evolution of the banks' lending volume and loan spreads to these firm clusters.

To this end, we form firm clusters based on the following three criteria: (i) country of incorporation, (ii) industry, and (iii) firm rating. The first two criteria are motivated by the fact that firms in a particular industry and country share many characteristics and were thus affected similarly by macroeconomic developments. Forming clusters based on ratings follows from studies that show that credit quality is an important driver for a firm's loan demand (e.g., Diamond 1991).

We follow Standard & Poor's and assign ratings on the basis of the three-year median interest coverage ratio (ICR) of each firm, where the median is calculated from the period preceding the sovereign debt crisis.[14] This approach exploits the fact that our measure of credit quality, which is based on accounting information, is monotone across rating categories (Standard & Poor's 2006).

[14] Note that only a small fraction of all firms in our sample have a rating from one of the rating agencies.

Our empirical strategy is to compare changes in lending to a particular firm cluster from banks that are affected to a different degree through the three channels. In our main analysis, we measure the degree to which a bank is affected through the different channels with the granular sovereign debt holdings data provided by the EBA stress test disclosures, that is, precrisis holdings and portfolio adjustments during the crisis. As a robustness check, in Section A.1.1, we use the bank-level characteristics that we also employ in Section 2 to measure the banks' affectedness by the different channels in a standard difference-in-differences setting.

First, to measure the size of the balance sheet hit for each bank (i.e., the value loss it incurred during the crisis on the GIIPS sovereign debt it was holding at the onset of the crisis), we construct the variable *Value Change GIIPS Sov Debt 2010*$_t$. In particular, we hold the banks' sovereign debt portfolio constant at the precrisis level and determine the change of its value using price changes of the sovereign bonds during the crisis. The variable is normalized by a bank's equity capital. As an alternative measure, we multiply the banks' preexisting sovereign debt holdings with the CDS spreads of the respective sovereign bonds and denote it *Risk Change GIIPS Sov Debt 2010*$_t$.

Second, as pointed out in Section 2, banks that engaged in risk-shifting behavior increased their net exposure toward their risk-shifting asset. We thus employ this net exposure increase, denoted *Net Change Risk-Shifting Asset*$_t$, to proxy for the extent of the banks' risk-shifting behavior.[15]

However, for GIIPS banks, the proxy *Net Change Risk-Shifting Asset*$_t$ could capture both, risk shifting and moral suasion, if moral-suasion-prone banks did not fully hedge the imposed increase in their domestic sovereign debt holdings. Hence, for GIIPS banks we employ a further refinement test that again exploits the fact that these two channels provide different predictions about the evolution of the banks' net and gross domestic sovereign debt holdings to more clearly distinguish between the lending impact of the risk-shifting and moral suasion channels. While the risk-shifting theory predicts that the increase in gross and net sovereign debt exposure should be of similar magnitude (banks deliberately increase their exposure and have no incentive to hedge), the moral suasion explanation implies that banks increase their net exposure by less than their gross exposure (banks partially hedge the gross increase). Hence, we first determine the gross increase in the GIIPS sovereign bonds to which each bank had the highest preexisting exposure (denoted *Gross Change Risk-Shifting Asset*$_t$), then interact this measure with a dummy equaling one if the bank did not hedge its additional exposure and compare the lending reduction of hedger vs. nonhedger banks.

[15] Potentially, a shift from corporate lending toward risky government bonds could also be due to a higher intrinsic return of these assets. However, we then should see neither significant cross-sectional differences in the investment behavior of banks, nor significant differences across banks' investments into the five GIIPS countries' sovereign bonds.

Finally, as a robustness check, we use the change in the banks' overall GIIPS sovereign debt holdings, instead of focusing only on the exposure to the risk-shifting asset. This allows us to ensure that the increased overall exposure to risky sovereign debt affects the banks' lending decisions.

With these proxies for bank affectedness, we run the following panel regression to estimate different loan outcome variables for loans provided by bank b to firm cluster m in period t:

$$\begin{aligned} Loan\ Outcome_{bmt+1} = {} & \beta_1 \times Bank\ Affectedness_{bt} + \gamma \times X_{bt} \\ & + Firm\ Cluster_m \times Year_{t+1} \\ & + Firm\ Cluster_m \times Bank_b + u_{bmt+1}, \end{aligned} \tag{1}$$

where *Loan Outcome* is either the change in loan volume, a dummy for whether the bank decreased lending to a firm cluster, or the change in the average spread paid by firms in the cluster, respectively. As the EBA provides the granular sovereign holdings data only after March 2010, we have to restrict our sample period for this test to the crisis period (i.e., 2010 to 2012).

The unit of observation is a bank-year-firm cluster. Besides controlling for bank characteristics (the logarithm of total assets, equity/assets, impaired loans/equity, and return on assets), we add firm-cluster-year fixed effects. This allows us to control for any observed and unobserved characteristics that are shared by firms in the same cluster and that might influence loan outcomes. Moreover, we interact firm-cluster and bank fixed effects. This controls not only for any unobserved characteristics that are shared by firms in the same cluster and bank heterogeneity, but also for relationships between firms in a given cluster and the respective bank.

3.1 Non-GIIPS banks test

First, we focus the analysis on non-GIIPS banks, which allows us to better evaluate the risk-shifting channel, as these banks are not affected by moral suasion from GIIPS governments (see Section 2).

The results for the effect of risk shifting on loan outcomes are presented in Table 2. Column (1) documents that banks with a larger *Net Change Risk-Shifting Asset*$_t$ reduced lending volume more, had a higher propensity of a loan decrease, and charged higher spreads compared to banks with a lower net increase.[16] For example, a one-SD-larger net change (0.34) led to a 0.93 pp reduction in loan volume and a 1.4 pp higher likelihood of a loan decrease. This loan volume decrease corresponds to 10% of the SD of the precrisis loan growth.

Moreover, changing the increase in the risk-shifting asset from the 10th percentile to the 90th percentile of the distribution implies a 2.6 pp higher

[16] The results are qualitatively similar if we use *Gross Change Risk-Shifting Asset*$_t$ instead of *Net Change Risk-Shifting Asset*$_t$, as shown in Columns (4) and (5) of Table 2.

Table 2
Bank lending regressions (sovereign debt holdings data): Non-GIIPS banks

Panel A: Change in loan volume

	(1) ΔVolume	(2) ΔVolume	(3) ΔVolume	(4) ΔVolume	(5) ΔVolume
Net Change Risk-Shifting Asset	−2.683**		−3.011***		
	(−2.75)		(−3.47)		
Gross Change Risk-Shifting Asset				−2.647**	−2.971***
				(−2.75)	(−3.47)
Value Change GIIPS Sov Debt 2010		0.329**	0.332**		0.332**
		(2.16)	(2.28)		(2.28)
R^2	0.779	0.795	0.800	0.779	0.800
N	2,384	2,384	2,384	2,384	2384

Panel B: Loan decrease

	Loan Decrease	Loan Decrease	Loan Decrease	Loan Decrease	Loan Decrease
Net Change Risk-Shifting Asset	0.040**		0.044**		
	(2.38)		(2.37)		
Gross Change Risk-Shifting Asset				0.039**	0.043**
				(2.38)	(2.37)
Value Change GIIPS Sov Debt 2010		−0.004**	−0.005**		−0.005**
		(−2.08)	(−2.60)		(−2.60)
R^2	0.792	0.794	0.803	0.792	0.803
N	2,384	2,384	2,384	2,384	2,384

Panel C: Change in loan spread

	ΔSpread	ΔSpread	ΔSpread	ΔSpread	ΔSpread
Net Change Risk-Shifting Asset	10.762*		10.888***		
	(1.71)		(3.81)		
Gross Change Risk-Shifting Asset				10.972*	11.098***
				(1.71)	(3.81)
Value Change GIIPS Sov Debt 2010		−1.145**	−1.289***		−1.289***
		(−2.02)	(−3.24)		(−3.24)
R^2	0.784	0.734	0.826	0.784	0.826
N	1,419	1,419	1,419	1,419	1,419
Bank Level Controls	YES	YES	YES	YES	YES
Firm Cluster-Bank Fixed Effects	YES	YES	YES	YES	YES
Firm Cluster-Time Fixed Effects	YES	YES	YES	YES	YES

This table presents the results of a modified Khwaja and Mian (2008) bank lending channel regression for the subsample of non-GIIPS banks. The unit of observation is a bank-year-firm cluster. The dependent variable is the change in loan volume (panel A), a dummy for whether a bank decreased lending to a firm cluster (panel B), or the change in the average spread paid by firms in the cluster (panel C), respectively. The variable *Gross (Net) Change Risk-Shifting Asset*$_t$ measures the gross (net) increase in the banks' risk-shifting asset holdings. The variable *Value Change GIIPS Sov Debt 2010*$_t$ tracks the change in the value of the banks' preexisting (i.e., March 2010) sovereign debt holdings using price changes of the sovereign bonds over the crisis period (normalized by equity). Bank level controls include the logarithm of total assets, equity/assets, impaired loans/equity, and return on assets. Standard errors are clustered at the bank level. t-statistics are reported in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

likelihood of a loan decrease. The predicted likelihood of a loan decrease at the 90th percentile of the distribution was 8.6%, implying a decrease in the probability of a loan decrease of 30% when borrowing from a bank at the 10th percentile instead of a bank at the 90th percentile of the distribution. This evidence is consistent with the notion that a risk shifting induced increase in

GIIPS sovereign debt holdings during the crisis period led to tighter lending conditions. The robustness check in Table A5 shows that the lending crowding-out results are qualitatively similar if we employ the change in the banks' total GIIPS sovereign debt holdings instead of the change in their risk-shifting asset.

Next, we analyze the contribution of the hit-on-balance-sheet channel to the lending reduction during the sovereign debt crisis. The results in Column (2) of Table 2 indicate that banks that faced larger negative *Value Change GIIPS Sov Debt 2010*$_t$ tightened their lending conditions significantly more. For example, a one-SD-larger loss on preexisting sovereign debt holdings (3.61) led to a 1.2 pp reduction in loan volume and a 1.4 pp higher likelihood of a loan decrease. This loan decrease corresponds to 12.5% of the SD of the precrisis loan growth.[17]

Furthermore, changing the *Value Change GIIPS Sov Debt 2010*$_t$ from the 90th to the 10th percentile of the distribution led to a 3.6 pp higher likelihood of a loan decrease. The predicted value for a loan decrease at the 10th percentile was 10.3%, implying a reduction in the probability of a loan decrease of 35% when borrowing from a bank at the 90th percentile of the distribution instead of a bank at the 10th percentile.

In a final step, we run a horse race between the proxies for the risk-shifting and hit-on-balance-sheet channels to evaluate their relative contributions to the lending contraction. The results in Table 2, Column (3), show that both *Net Change Risk-Shifting Asset*$_t$ and *Value Change GIIPS Sov Debt 2010*$_t$ remain statistically and economically significant when combined in one regression.

These results suggest that the risk-shifting and the hit-on-balance-sheet channel were both important for the lending reduction of non-GIIPS banks during the crisis. Moreover, these results also provide evidence for an add-on effect of risk shifting over a pure hit-on-balance-sheet effect.

3.2 GIIPS banks test

Next, we test the impact of the different channels on lending by GIIPS banks during the crisis period. Column (1) of Table 3 presents the results for the *Gross Change Risk-Shifting Asset*$_t$, while Column (2) provides results for the *Net Change Risk-Shifting Asset*$_t$. Several observations are noteworthy. First, both coefficients are significant, which shows that GIIPS banks with a larger increase in domestic sovereign debt holdings cut lending significantly more, had a higher propensity to not extend a new loan, and charged higher spreads. Second, the magnitude of the *Net Change Risk-Shifting Asset*$_t$ coefficient is larger than the coefficient of *Gross Change Risk-Shifting Asset*$_t$, which suggests that risk shifting was more important for the lending reduction than was moral suasion.

Regarding the economic significance of the two crowding-out channels, Column (1) shows that a one-SD-larger *Gross Change Risk-Shifting*

[17] Note that this measure is negative for banks that experienced a hit-on-balance-sheet. Table A7 shows that all results are qualitatively the same for our alternative balance-sheet-hit proxy, *Risk Change GIIPS Sov Debt 2010*$_t$.

Table 3
Bank lending regressions (sovereign debt holdings data): GIIPS banks

Panel A: Change in loan volume

	(1) ΔVolume	(2) ΔVolume	(3) ΔVolume	(4) ΔVolume	(5) ΔVolume	(6) ΔVolume
Gross Change Risk-Shifting Asset	−1.010***			−0.740**		0.421
	(−3.44)			(−2.04)		(1.01)
Net Change Risk-Shifting Asset		−1.501***			−1.278**	
		(−3.40)			(−2.65)	
Value Change GIIPS Sov Debt 2010			0.152**	0.121**	0.115**	0.121**
			(2.76)	(2.09)	(2.00)	(2.81)
Gross Change Risk-Shifting Asset×No Hedge						−1.730**
						(−2.24)
R^2	0.822	0.812	0.843	0.845	0.844	0.847
N	1,514	1,514	1,514	1,514	1,514	1,514

Panel B: Loan decrease

	Loan Decrease	Loan Decrease	Loan Decrease	Loan Decrease	Loan Decrease	Loan Decrease
Gross Change Risk-Shifting Asset	0.012**			0.011**		−0.007
	(2.25)			(2.15)		(−1.19)
Net Change Risk-Shifting Asset		0.019***			0.017**	
		(3.36)			(2.36)	
Value Change GIIPS Sov Debt 2010			−0.002**	−0.002**	−0.002**	−0.003**
			(−2.20)	(−2.21)	(−1.97)	(−2.60)
Gross Change Risk-Shifting Asset×No Hedge						0.036**
						(2.70)
R^2	0.765	0.766	0.779	0.795	0.780	0.814
N	1,514	1,514	1,514	1,514	1,514	1,514

Panel C: Change in loan spread

	ΔSpread	ΔSpread	ΔSpread	ΔSpread	ΔSpread	ΔSpread
Gross Change Risk-Shifting Asset	4.268**			5.210**		−2.894
	(2.20)			(2.08)		(−1.54)
Net Change Risk-Shifting Asset		6.195**			6.568*	
		(2.24)			(2.04)	
Value Change GIIPS Sov Debt 2010			−0.615***	−0.529*	−0.517*	−0.541***
			(−2.98)	(−1.81)	(−1.87)	(−3.04)
Gross Change Risk-Shifting Asset×No Hedge						6.900**
						(2.33)
R^2	0.842	0.832	0.815	0.840	0.835	0.867
N	769	769	769	769	769	769
Bank Level Controls	YES	YES	YES	YES	YES	YES
Firm Cluster-Bank Fixed Effects	YES	YES	YES	YES	YES	YES
Firm Cluster-Time Fixed Effects	YES	YES	YES	YES	YES	YES

This table presents the results of a modified Khwaja and Mian (2008) bank lending channel regression for the subsample of GIIPS banks. The unit of observation is a bank-year-firm cluster. The dependent variable is the change in loan volume (panel A), a dummy for whether a bank decreased lending to a firm cluster (panel B), or the change in the average spread paid by firms in the cluster (panel C), respectively. The variable *Gross (Net) Change Risk-Shifting Asset*$_t$ measures the gross (net) increase in the banks' risk-shifting asset holdings. The variable *Value Change GIIPS Sov Debt 2010*$_t$ tracks the change in the value of the banks' preexisting (i.e., March 2010) sovereign debt holdings using price changes of the sovereign bonds over the crisis period (normalized by equity). *No Hedge* is an indicator variable equal to one if a bank increases gross and net holdings by at least the same amount (i.e., bank is not hedging). Bank-level controls include the logarithm of total assets, equity/assets, impaired loans/equity, and return on assets. Standard errors are clustered at the bank level. t-statistics are reported in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

$Asset_t$ (1.94) leads to a 1.96 pp reduction in loan volume, which corresponds to 21% of the SD of precrisis loan growth and a 2.3 pp higher likelihood of a loan decrease. Moreover, a one-SD-larger *Net Change Risk-Shifting* $Asset_t$ (1.73) implies a reduction in loan volume by 2.6 pp and a 3.3 pp higher likelihood of a loan decrease. This loan volume decrease corresponds to 28% of the SD of precrisis loan growth.

Changing the *Net Change Risk-Shifting* $Asset_t$ from the 10th percentile to the 90th percentile of the distribution leads to a 9.5 pp higher likelihood of a loan decrease. The predicted likelihood of a loan decrease at the 90th percentile was 17.6%, implying a reduction in the probability of a loan contraction of 53% when borrowing from a bank at the 10th instead of the 90th percentile. Table A6 shows that the lending crowding-out results are again robust to employing the change in the banks' total GIIPS sovereign debt holdings instead of the change in their risk-shifting asset.

Regarding the hit-on-balance-sheet channel, Column (3) of Table 3 shows that, consistent with the evidence for non-GIIPS banks, GIIPS banks that experienced bigger losses during the crisis also cut lending more. For example, a one-SD-larger reduction in *Value Change GIIPS Sov Debt* 2010_t (11.51) led to a 1.75 pp loan volume reduction and a 2.4 pp higher likelihood of a loan decrease. This loan decrease corresponds to 19% of the SD of precrisis loan growth.[18]

Changing the value decrease from the 90th percentile to the 10th percentile of the distribution led to a 6.6 pp higher likelihood of a loan decrease. The predicted likelihood of a loan decrease at the 10th percentile of the distribution was 13.9%, implying a decrease in the probability of a loan contraction of 47.3% when borrowing from a bank at the 90th instead of the 10th percentile. This evidence suggests that the hit-on-balance-sheet channel significantly affected GIIPS banks as well.

Columns (4) and (5) of Table 3 provide a horse race between the hit-on-balance-sheet channel and the gross and net increase in sovereign debt holdings, respectively. Results show that both the losses incurred during the crisis and the increase in sovereign debt holdings contributed to the lending reduction of GIIPS banks observed during the sovereign debt crisis.

Finally, Column (6) of Table 3 presents the hedger versus nonhedger test. The results show that there is only a significant effect of the gross sovereign debt holdings increase for the subset of banks that did not hedge this additional exposure. Hence, only banks whose behavior is consistent with risk shifting (i.e., banks that did not hedge their increased sovereign debt exposure) significantly tightened their lending conditions, while banks that show behavior consistent with moral suasion (i.e., banks that hedged the additional sovereign exposure) did not adjust their loan supply.

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[18] As shown in Table A8 all results remain qualitatively the same for our alternative balance sheet hit proxy, *Risk Change GIIPS Sov Debt* 2010_t.

This evidence in favor of the risk-shifting explanation and against the moral suasion hypothesis is further supported by our robustness test in Section A1.1, which shows that low-quality/high-exposure banks from both GIIPS and non-GIIPS countries tightened their lending conditions more than other banks, while low-quality/government-controlled GIIPS banks did not significantly change their lending behavior.

Taken together, our results confirm that banks' risk-shifting incentives and the losses incurred on preexisting sovereign debt holdings contributed to the credit crunch, while moral suasion seems to have played no role for the lending reduction. There are two possible explanations for this result. First, GIIPS banks with high government ownership only slightly increased their domestic sovereign debt holdings and thus it did not affect their lending behavior. Second, while low-quality/government-controlled banks increase their gross debt holdings toward their domestic sovereign, they do not bear the full economic risk, as the increase is partially hedged (see Section 2).

4. Real Effects

In a final step, we determine the impact of the banks' loan supply reduction induced by the European sovereign debt crisis on firm policies of nonfinancial corporations. The evidence in the previous sections shows that the increase in GIIPS sovereign debt holdings and the increase in risk of the banks' holdings are both important determinants for the transmission of the sovereign debt crisis to the banks' lending decisions. Hence, to study how the "indirect exposure to sovereign risk through their lenders" is associated with a change in firm outcomes, we construct a measure, denoted *Indirect GIIPS Sov Risk*, that captures both determinants and thus all channels.

In particular, for each year t and bank b, we first take the CDS-weighted sum of the different GIIPS sovereign debt holdings k of the bank as a fraction its total assets:

$$GIIPS\ Sovereign\ Risk_{bt} = \frac{\sum_k GIIPS\ Sov\ Bondholdings_{bkt} \times Sov\ CDS_{kt}}{Total\ Assets_{bt}}. \quad (2)$$

Second, for each loan syndicate, we compute the weighted average of this measure across all banks that act as lead arranger in the syndicate, using the loan share of each lead arranger as weight. We denote this variable *Average GIIPS Sov Risk*. We focus our analysis on lead arrangers since the sovereign debt holdings data is available only for European banks included in the EBA stress tests, which accounts for 73% of lead arrangers, but only 35% of participants.[19]

[19] We follow Ivashina (2009) and identify lead arrangers according to definitions provided by Standard & Poor's, which for the European loan market are stated in Standard & Poor's (2010). We classify a bank as a lead arranger if its role is "mandated lead arranger," "mandated arranger," or "bookrunner."

Third, we compute for each firm-year the weighted average (using the respective loan amount as weight) of this measure across all loans in the loan portfolio $L_{ijh\tau}$ of firm i in country j, and industry h:

$$\textit{Indirect GIIPS Sov Risk}_{ijht} = \frac{\sum_{l \in L_{ijh\tau}} \textit{Average GIIPS Sov Risk}_{lijht} \times \textit{Loan Amount}_{lijh\tau}}{\textit{Total Loan Amount}_{ijh\tau}}, \quad (3)$$

where τ is the last year before the crisis (i.e., 2009). We thus keep the precrisis syndicate composition constant during the crisis to alleviate concerns that weak borrowers switch to weaker banks.

This measure accounts for the fact that sovereign debt portfolios differ across banks with regard to the composition of the different GIIPS sovereign bonds and the fact that the GIIPS countries are affected differently by the sovereign debt crisis. Finally, the fact that the measure varies over time and across banks in the same country allows us to better identify the transmission of the sovereign debt crisis through the bank lending channel to the real economy.

We construct the measure *Indirect GIIPS Sov Risk* using two different data sources for sovereign debt holdings. First, for the period starting in 2010, we use data from the EBA, which began disclosing the exact breakdown of sovereign debt holdings by country for each bank in March 2010. Having this granular breakdown across countries becomes crucial after 2010, when CDS spreads of GIIPS countries started to diverge significantly.

Second, for the period before 2010, we follow Kalemli-Ozcan, Laeven, and Moreno (2015) and Gennaioli, Martin, and Rossi (2016) and rely on data from Bankscope, which reports the banks' total sovereign debt holdings, but unfortunately not a breakdown by country. To calculate our variable of interest, we assume that for the years prior to 2010 the fraction of country-specific sovereign debt holdings over total sovereign debt holdings is similar to March 2010 (date of the first EBA stress test). Hence, to get the individual country exposure of a bank for the pre-2010 period, we multiply its total sovereign debt holdings reported in Bankscope with the bank's country specific fraction of sovereign holdings, which we get from the March 2010 stress test.

This approach should not bias our results for two reasons. First, using confidential data from the ECB's IBSI database, Kalemli-Ozcan, Laeven, and Moreno (2015) conclude that the banks' country-specific composition of their sovereign debt holdings before 2010 is very similar to the composition reported in March 2010. Second, CDS spreads of sovereign debt were very similar across the European countries before 2010 and started to diverge only with the start of the sovereign debt crisis (see Figure 3). This implies that even if the estimated country composition of a bank's sovereign debt portfolio for the pre-2010 period does not exactly match its actual composition, this misclassification would not significantly affect the risk attributed to the bank's sovereign debt portfolio.

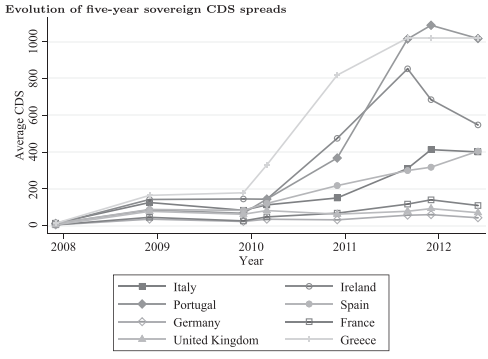

Figure 3
Evolution of five-year sovereign CDS spreads
This figure plots the evolution of the five-year sovereign CDS spreads for European countries.

Before testing the effect of the firms' indirect exposure to sovereign risk through their lenders, we confirm that our bank-level proxy from Equation (2), *GIIPS Sovereign Risk*, has a significant impact on lending outcomes. For both GIIPS and non-GIIPS banks, we find that banks with a higher *GIIPS Sovereign Risk* reduced lending more, had a higher propensity to not extend a loan, and charged higher spreads compared to banks with lower *GIIPS Sovereign Risk* (see Column 4 of Table A9 for non-GIIPS banks and Column 7 of Table A10 for GIIPS banks).

The evolution of *Indirect GIIPS Sov Risk* is presented in Figure 4, panel A. We split firms into two categories according to whether they are above or below the precrisis median of *Indirect GIIPS Sov Risk*. The plot shows that the *Indirect GIIPS Sov Risk* for both subgroups of firms remains roughly constant throughout the precrisis period. However, starting in early 2010, the *Indirect GIIPS Sov Risk* of the two groups begins to diverge, resulting in a three times larger gap between the two groups by the end of 2011. Panel B of Figure 4 shows that the evolution of *Indirect GIIPS Sov Risk* is driven mainly by the banks' risk-shifting asset, reconfirming the highly concentrated sovereign exposures of their sovereign debt holdings.

Moreover, while the trend of *Indirect GIIPS Sov Risk* for both groups is similar in the precrisis period, the level is not. This level difference in *Indirect GIIPS Sov Risk* (which focuses on GIIPS sovereign debt) can be explained by the fact that firms mainly with a below-median *Indirect GIIPS Sov Risk* are firms that have lending relationships with non-GIIPS banks, which hold on average fewer GIIPS sovereign bonds as a share of total sovereign debt compared with GIIPS banks.

Panel C of Figure 4 plots the evolution in the indirect exposure to sovereign risk through the firms' lending relationships for the case where we use the banks' total sovereign portfolio to determine the firms' indirect exposure. The figure shows that for the resulting measure, which we denote *Indirect Sov Risk*,

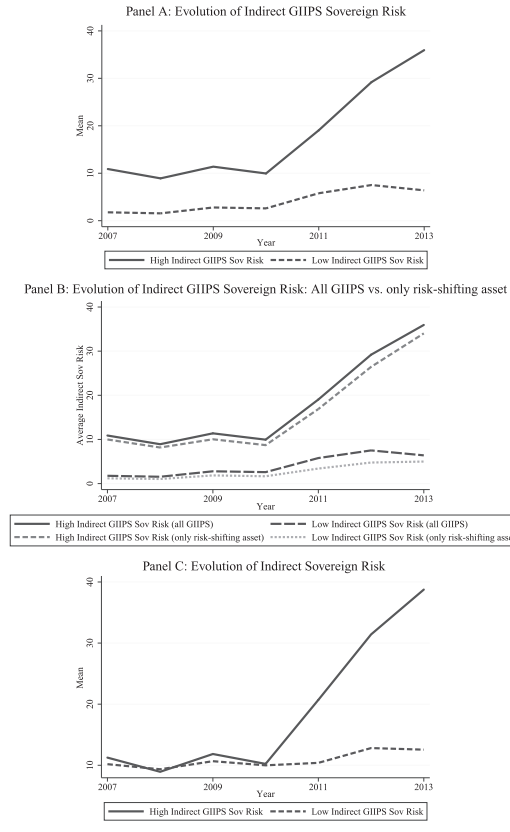

Figure 4
Evolution of indirect sovereign risk
This figure shows the evolution of the firms' indirect exposure to sovereign risk. Panel A shows the evolution of the firms' *Indirect GIIPS Sovereign Risk*, which measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships, Panel B shows in addition the evolution of only the indirect exposure to the risk-shifting asset, and panel C the evolution of the firms' indirect exposure to all sovereign debt. The risk-shifting asset is defined as the GIIPS sovereign debt to which a bank had the highest exposure at the beginning of the crisis. In all panels we split firms into high (i.e., above the precrisis median) and low (i.e., below the median) *Indirect GIIPS Sov Risk* firms.

there is no difference in either the precrisis level or the precrisis trend between below- and above-median *Indirect GIIPS Sov Risk* firms. However, there is a difference during the crisis period where sovereign risk grows much more for firms with an above-median *Indirect GIIPS Sov Risk*. Since this increase is driven by the banks' GIIPS sovereign debt holdings, we present only the results for the measure *Indirect GIIPS Sov Risk* in this section and provide the results for *Indirect Sov Risk* in the Appendix (see panel B in Table A12). All results remain similar when we use *Indirect Sov Risk* instead of *Indirect GIIPS Sov Risk*.

4.1 Empirical results for main specification

We start our analysis by testing the association between *Indirect GIIPS Sov Risk* and the firms' financial policies. We follow the methodology proposed by Almeida, Campello, and Weisbach (2004), who show that firms that expect to be financially constrained in the future respond by saving more cash out of their cash flow today. We run the following firm-level regression for firm i in country j, and industry h in year t:

$$\begin{aligned}\Delta Cash_{ijht+1} = {} & \beta_1 \times Indirect\ GIIPS\ Sov\ Risk_{ijht} \\ & + \beta_2 \times Indirect\ GIIPS\ Sov\ Risk_{ijht} \times Cash\ Flow_{ijht} \\ & + \beta_3 \times Cash\ Flow_{ijht} + \gamma \times X_{ijht} + Firm_{ijh} \\ & + Industry_h \times Country_j \times Year_{t+1} \\ & + ForeignBankGIIPSCountry_{k \neq j} \times Year_{t+1} \\ & + u_{ijht+1}. \end{aligned} \tag{4}$$

The unit of observation is a firm-year. Our key variable of interest in Equation (4) is the impact of the *Indirect GIIPS Sov Risk* on the relation between a firm's cash flow and its change in cash holdings (β_2 in Equation 4). If firms with higher *Indirect GIIPS Sov Risk* became financially constrained during the sovereign debt crisis, we expect that they saved more cash out of their generated cash flows to build up a liquidity buffer against the possibility of not being able to obtain future funding; that is, we expect β_2 in Equation (4) to be positive.

We include firm fixed effects to capture unobserved time-invariant firm heterogeneity and firm-level control variables to capture other determinants of the firms' corporate policies, loan demand, and loan supply. These controls include firm size, leverage, net worth, the fraction of tangible assets, the ICR, the ratio of EBITDA to total assets, a firm's cash flow, and capital expenditures.

GIIPS countries experienced a severe recession starting in 2010 (2009 in the case of Greece), while non-GIIPS European countries were not significantly affected by economic downturns. To alleviate concerns that our results are driven by different aggregate demand fluctuations in our sample countries and/or in particular industries within these countries, we add interactions between industry, year, and country fixed effects, to control for time-varying shocks to an industry in a given country that may have affected the credit demand of borrowing firms, as well as their real outcomes.

Another concern is that firm-bank relationships might be determined by whether a firm has business in the country where the particular bank has its headquarters. For example, a German firm might choose to borrow from a bank headquartered in Spain because it has business in Spain. If this is the case, we could potentially overestimate the negative real effects that can be attributed to the bank lending channel.

To address this concern, we include in our main specification foreign bank GIIPS country-year fixed effects. Consider the example of a German firm borrowing from both a German and a Spanish bank. Besides the industry-country-year fixed effect, we include for this firm a Spain-year fixed effect to capture its potential exposure to the recession in Spain during the European debt crisis.[20]

In the following sections, we will not always include all fixed effects due to the sometimes smaller sample size resulting from various sample splits. In general, all specifications will include firm and foreign bank GIIPS country-year fixed effects. Additionally, whenever the sample size becomes too small to control for industry-country-year fixed effects, we will add either industry-year fixed effects (in cases where we focus exclusively on either non-GIIPS or GIIPS borrowers, since these country subsets had a similar exposure to macroeconomic developments) or country-year fixed effects (in cases when our subsample includes both GIIPS and non-GIIPS borrowers).

Column (1) of Table 4 presents results for the degree to which firms saved cash out of their cash flow. The coefficient of the interaction of *Indirect GIIPS Sov Risk* with cash flow (β_2 in Equation 4) is positive and statistically significant at the 1% level. The effect is also economically significant: a one-SD-higher *Indirect GIIPS Sov Risk* implies that these firms save 5.3 cents more per euro of cash flow which compares well to the 5–6 cents per dollar of cash flow found by Almeida, Campello, and Weisbach (2004). This result indicates that firms with high *Indirect GIIPS Sov Risk* became financially constrained during the crisis.

We next analyze the effect of the lending contraction on the firms' net debt ((current + noncurrent liabilities – cash)/total assets) and their ICRs by running the following firm-level regression:[21]

$$\begin{aligned} y_{ijht+1} = {} & \beta_1 \times Indirect\ GIIPS\ Sov\ Risk_{ijht} \\ & + \gamma \times X_{ijht} + Firm_{ijh} + Industry_h \times Country_j \times Year_{t+1} \\ & + ForeignBankGIIPSCountry_{k \neq j} \times Year_{t+1} + u_{ijht+1}. \end{aligned} \tag{5}$$

Column (2) of Table 4 provides results for net debt. The coefficient of *Indirect GIIPS Sov Risk* (β_1 in Equation 5) is negative, indicating that firms facing a larger indirect exposure to sovereign risk through their lending relationships had lower levels of external debt financing during the crisis period compared with less exposed firms.[22] Similarly, Column (3) of Table 4 shows that firms with a higher *Indirect GIIPS Sov Risk* had significantly lower ICRs. Therefore,

[20] Table A11 provides less restrictive specifications and confirms that the coefficients remain very similar, both economically and statistically. Alternatively, in Section 4.2, we use the Amadeus data on geographic segments and focus on domestic firms borrowing from foreign banks to isolate the supply effects of the bank lending channel.

[21] For this analysis, we exclude a firm's cash flow and its capital expenditures as control variables.

[22] Results are qualitatively similar if we use the leverage ratio instead of net debt as the dependent variable.

Table 4
Real effects: Entire sample

	(1) ΔCash	(2) Net Debt	(3) ICR	(4) Credit Line	(5) Undrawn	(6) Emp Growth	(7) CAPX	(8) Sales Growth
Indirect GIIPS Sov Risk	−0.000	−0.008**	−0.656**	−0.012**	−0.016**	−0.007**	−0.009**	−0.008**
	(−0.74)	(−2.30)	(−2.16)	(−2.10)	(−2.27)	(−2.17)	(−2.12)	(−2.34)
Indirect GIIPS Sov Risk×Cashflow	0.007***							
	(3.15)							
R^2	0.462	0.856	0.833	0.876	0.813	0.610	0.716	0.610
N	3,853	4,272	4,518	491	491	3,630	4,250	4,055
Firm Controls	YES	YES	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Country-Year Fixed Effects	NO	NO	NO	YES	YES	NO	NO	NO
Industry-Country-Year Fixed Effects	YES	YES	YES	NO	NO	YES	YES	YES
Foreign Bank GIIPS Country-Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES

This table presents firm-level regression results. The dependent variables are the change in cash holdings, net debt, ICR, the fraction of the total amount of outstanding credit lines, the fraction of undrawn credit lines, employment growth, investment, and sales growth, respectively. *Indirect GIIPS Sov Risk* measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships. Firm-level control variables include the logarithm of total assets, leverage (not in Column 2), net worth, tangibility, ICR (not in Column 3), EBITDA/total assets, and for the cash regression, a firm's cash flow and capital expenditures. All firm-level control variables are lagged by one period. Standard errors are adjusted for heteroscedasticity and clustered at the firm level. t-statistics are reported in parentheses. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

by becoming financially constrained during the crisis period, firms were also suffering from a deterioration in credit quality. The estimates suggest that a one-SD-higher *Indirect GIIPS Sov Risk* results in a 5.4-pp-lower (18.1% of precrisis SD) net debt ratio and a 4.35-pp-lower (20.6% of precrisis SD) ICR.

Acharya et al. (2014) show that firms with higher liquidity risk are more likely to use cash rather than bank credit lines for liquidity management. The reason is that the cost of credit lines increases with liquidity risk because banks retain the right to revoke access to liquidity precisely in states where a firm's need for liquidity is highest. Since banks themselves faced a substantial liquidity shock during the sovereign debt crisis, we expect that firms with a higher *Indirect GIIPS Sov Risk* could have lost access to their bank credit lines because they were either not prolonged or revoked. We thus expect to see an increased reliance on cash rather than credit lines for firms with high indirect exposure to sovereign risk through their lenders.

To test this implication, we follow Acharya et al. (2014) and match our sample to the Capital IQ database. This enables us to obtain detailed information on total outstanding and undrawn bank credit lines for a subsample of firms. We construct two measures for the liquidity composition of borrowing firms from these data. First, we consider the fraction of the total amount of outstanding credit lines over the sum of the amount of total outstanding credit line and cash.

Second, we construct a measure that captures the fraction of undrawn credit lines (i.e., the amount of a firm's credit line that is still available and can be drawn in case of liquidity needs) over undrawn credit lines and cash. Column (4) of Table 4 reports regression results for a firm's overall credit line, whereas Column (5) reports results for the undrawn credit lines. Across both specifications, we find that firms with a higher *Indirect GIIPS Sov Risk* were less able to rely on funding from credit lines.[23] A one-SD increase in *Indirect GIIPS Sov Risk* led to a reduction in the fraction of outstanding (undrawn) credit lines by 7.8 pp (10.9 pp), respectively, which corresponds to 33.1% (36.2%) of the precrisis SD.

Overall, our results show that firms with higher *Indirect GIIPS Sov Risk* behaved like financially constrained firms during the crisis. They had lower ICRs and leverage, a significantly positive cash flow sensitivity of cash, and relied more on cash holdings for their liquidity management, as the possibility of getting liquidity from their bank lines of credit became more uncertain.

Next, we examine the change in corporate policies of firms in response to tighter financial conditions during the crisis period. In a first step, we explore graphically the effect of the change in the banks' lending behavior during the sovereign debt crisis on several firm outcomes.[24] In Figure 5, we plot the time series of the average employment growth rates, the investment levels, and sales

[23] Given the lower number of observations when using Capital IQ we have to resort to country-year instead of industry-country-year fixed effects for this analysis.

[24] Note that we control for observable firm characteristics such as industry, country, and size in the figures.

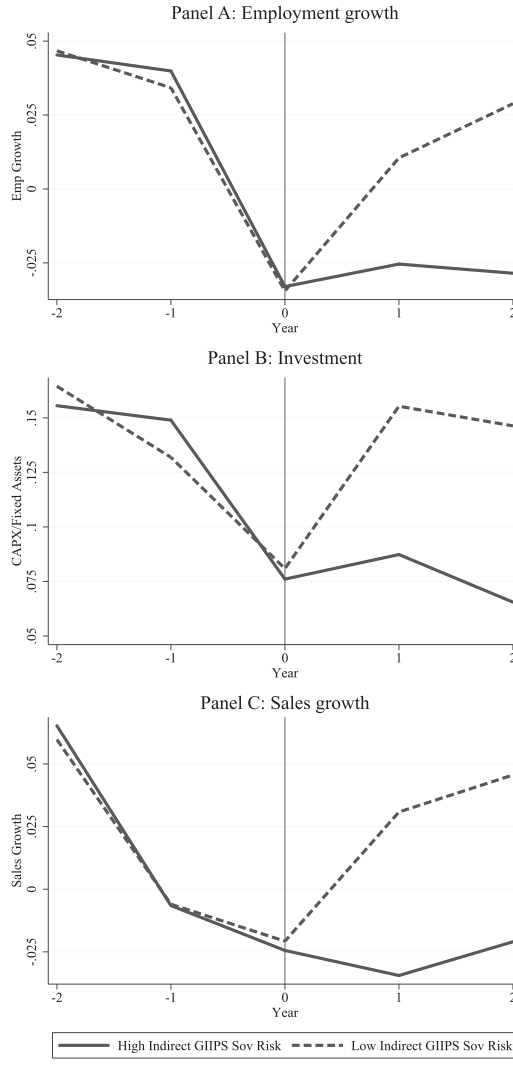

Figure 5
Evolution of real outcome variables for entire firm sample
This figure plots the evolution of employment growth, investment, and sales growth in the precrisis period (years –2 and –1) and the crisis period (starting in year 0) for the full sample of firms, separately for high (i.e., above the precrisis median) and low (i.e., below the median) *Indirect GIIPS Sov Risk* firms. *Indirect GIIPS Sov Risk* measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships.

growth rates, respectively, for firms with high (i.e., above-median) and low (i.e., below-median) *Indirect GIIPS Sov Risk*.

Figure 5 shows that, while the precrisis trend was similar for the two groups of firms, a higher indirect exposure to GIIPS sovereign risk through their

lenders led to larger negative real effects during the crisis. For example, employment growth rates for borrowing firms with a high *Indirect GIIPS Sov Risk* did not recover during the crisis, while employment rates for firms with a lower *Indirect GIIPS Sov Risk* increased. Similar results can be found for the other dependent variables.

To test this formally, we run firm-level regressions (see Equation 5) where y_{ijht+1} measures employment growth (Δlog *Employment*), investment (*CAPX/Tangible Assets*), or sales growth (Δlog *Sales*), respectively.[25] Columns (6)–(8) in Table 4 present the results. Consistent with the suggestive evidence from Figure 5, the regressions show that firms with higher *Indirect GIIPS Sov Risk* experienced a significantly lower employment growth rate and a larger reduction in investment and sales growth. More precisely, a one-SD-higher *Indirect GIIPS Sov Risk* led to a 4.7 pp reduction in employment growth (28.1% of precrisis SD), a 5.9 pp decrease in capital expenditures (29.1% of precrisis SD), and a 5.6 pp decrease in sales growth (24.4% of precrisis SD).

Descriptive statistics confirm that our identifying assumptions are plausible. Panels A and B of Table 5 show precrisis differences for the dependent and explanatory variables that we use in our corporate policies regressions. Firms with high *Indirect GIIPS Sov Risk* tend to have more tangible assets, whereas there are no significant differences in other observable firm characteristics. Moreover, firms do not differ significantly with respect to our outcome variables (employment growth, investment, sales growth) in the precrisis period.

These descriptive statistics help us to rule out an endogenous matching of firms and banks in the precrisis period that is driven by firm quality. If low-quality firms were more likely to enter into business relationships with banks more exposed to GIIPS sovereign debt before the crisis period, our results could be driven by the fact that these firms are generally less resilient against the crisis. However, the fact that there is no systematic difference between firms with high and low *Indirect GIIPS Sov Risk* before the crisis and that the correlation between *Indirect GIIPS Sov Risk* and the firm control variables is generally very low alleviates this concern. We conduct further robustness checks in Section A1.2 of the Online Appendix that show that our results are driven by neither differences in the firms' bank dependency nor the banks' precrisis health.

4.2 Alternative identification strategy using firms' business exposure

In our main specification (see Equations 4 and 5), we ensure that our real effects results are not driven by the possibility that firm-bank relationships might be determined by whether a firm has business in the country where the particular

[25] Since Amadeus does not report capital expenditures, we construct a proxy for investments using the following formula: $(Fixed\ Assets_{t+1} - Fixed\ Assets_t + Depreciation)/(Fixed\ Assets_t)$. We set *CAPX* to zero if the proxy is negative. Moreover, since roughly 90% of our observations have no information on R&D expenses in Amadeus, we cannot investigate the impact of *Indirect GIIPS Sov Risk* on R&D.

Table 5
Descriptive statistics precrisis

	Panel A: Dependent variables			Panel B: Explanatory variables					
	Emp Growth	CAPX	Sales Growth	Total Assets (mn)	Tangibility	ICR	Net Worth	EBITDA/Assets	Leverage
High Indirect GIIPS Sov Risk									
Mean	0.054	0.195	0.055	3640	0.572	2.997	0.223	0.110	0.617
Median	0.032	0.115	0.055	572	0.611	1.440	0.192	0.097	0.650
Std. Dev.	0.156	0.243	0.217	7510	0.263	4.100	0.179	0.103	0.181
Low Indirect GIIPS Sov Risk									
Mean	0.045	0.192	0.048	3220	0.551	3.069	0.219	0.117	0.606
Median	0.022	0.113	0.053	565	0.574	2.020	0.252	0.105	0.577
Std. Dev.	0.156	0.246	0.199	6870	0.264	3.359	0.175	0.102	0.219
Diff. (*t*-stat)	0.009 (1.10)	0.003 (0.27)	0.007 (0.69)	420 (1.32)	0.021 (1.84)	−0.415 (−0.07)	0.482 (0.01)	−0.007 (−1.52)	0.011 (1.27)
Correlation with Indirect GIIPS Sov Risk				−0.02	0.04	−0.08	−0.03	−0.06	0.07

Panel A (panel B) presents descriptive statistics of dependent variables (explanatory variables) split into high (i.e., above the precrisis median) and low (i.e., below the median) *Indirect GIIPS Sov Risk* firms.

bank has its headquarters by controlling for foreign bank GIIPS country-year fixed effects. In this section, we alternatively deploy a strategy similar to that of Peek and Rosengren (1997) that relies on domestic firms borrowing from foreign banks to isolate the supply effects of the bank lending channel.[26] In particular, we track the change in corporate policies of non-GIIPS firms that had a precrisis relationship with a GIIPS bank.

Additionally, we take two further precautionary steps to ensure that the results are not driven by the possibility that non-GIIPS firms with a high *Indirect GIIPS Sovereign Risk* through their banks are also more likely to have direct business exposure to GIIPS countries. First, we restrict our sample to firms that were not directly affected by the macroeconomic shock in the periphery of the eurozone or any other part of the world. In particular, we restrict our sample to non-GIIPS firms without subsidiaries in a GIIPS country or any other non-EU country (e.g., a German firm without subsidiaries).[27] To this end, we collect information on all foreign and domestic subsidiaries of the borrowing firms in our sample from Amadeus data on geographic segments, along with information about the revenues generated by their subsidiaries.[28]

To enhance our understanding of the firm-bank matching between non-GIIPS firms without GIIPS subsidiaries and GIIPS banks (i.e., banks with the highest *Indirect GIIPS Sovereign Risk*), we investigate the history of these lending relationships prior to our sample period. Two main reasons stand out, which can jointly explain roughly 90% of these firm-bank relationships.

First, bank mergers or acquisitions can explain roughly 68% of links between non-GIIPS European firms and GIIPS banks in our sample. That is, the firm had a relationship to a domestic bank that was later acquired by a GIIPS bank. Consider as an example the German catering firm Menu Manufaktur Hofmann, a firm located in southern Germany that delivers food to cafeterias. Figure A8 shows that its business activities are limited to Germany and Austria. Prior to our sample period, this company obtained a loan from the Bavarian-based Bayerische Hypo- und Vereinsbank AG, which was later acquired by the Italian bank UniCredit in 2005. After 2005, all of its syndicated loans were originated by UniCredit. Such acquisitions were an exogenous shock to the respective firms' *Indirect GIIPS Sovereign Risk*, as they increased the indirect exposure a firm has to GIIPS sovereign debt through its lenders in the precrisis period, without being related to a firm's geographical business exposure.[29]

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[26] Peek and Rosengren (1997) track the behavior of U.S. firms borrowing from Japanese banks.

[27] Ideally, we would also like to control for the export/import dependence of our firms to specific countries. This data, however, is available only for a very small subsample of our firms in Amadeus.

[28] Bartram and Karolyi (2006) use this data to investigate whether stock return volatility, market risk, and foreign exchange rate risk exposures took place around the launch of the euro in 1999.

[29] Note that we consider only acquisitions that were completed before the start of our sample period. Karolyi and Taboada (2015) show that an important motive for cross-border acquisitions is "regulatory arbitrage."

The second explanation for the firm-bank links between non-GIIPS firms and GIIPS banks is that the Bank of Ireland had always had a large presence in the United Kingdom, which explains roughly 22% of non-GIIPS firm/GIIPS bank links. For example, in 2006 it was the fifth largest bank in number of U.K. dealings.

As a second precautionary step, we thus restrict our analysis to non-GIIPS firms whose lending relationship to a GIIPS firm can be explained by one of these two main reasons, neither of which is related to the geographical distribution of the firms' business exposure. Applying these preventive measures alleviates the concern that a non-GIIPS firm's *Indirect GIIPS Sovereign Risk* might be determined by whether it has business in the periphery of the eurozone.

In Figure 6, we plot the time series of the average employment growth rates, the investment levels, and sales growth rates, respectively, of the firms in this subsample. The figure shows that again firms with higher *Indirect GIIPS Sov Risk* suffered larger negative real effects during the crisis period compared to firms with lower *Indirect GIIPS Sov Risk*. Precrisis trends, on the other hand, were comparable among the two subgroups of firms.

For the formal analysis, we apply specifications that are very similar to our main specifications from Equations (4) and (5). However, the reduced sample size requires us to include only industry-year and foreign bank GIIPS country-year fixed effects, assuming that the industry-specific shocks in the different non-GIIPS European countries were similar. The results reported in panel A of Table 6 show that all real effect results continue to hold, confirming that the decline in the loan supply of banks that were adversely affected by the sovereign debt crisis had negative real effects for borrowing firms.[30] Panel A of Table A14 confirms that firms with high and low *Indirect GIIPS Sov Risk* did not significantly differ along observable proxies for their quality in the precrisis period, which alleviates the concern that the precrisis firm-bank matching was driven by firm quality.

We conduct two further robustness checks. First, we restrict the sample to relationships between non-GIIPS firms and GIIPS banks that were established through presample M&A transactions. This analysis yields qualitatively similar results (see panel B of Table 6). Second, to rule out that our results are driven by firms incorporated in export dependent industries, panel C of Table 6 restricts the analysis to non-GIIPS firms without subsidiaries in GIIPS or any other non-EU country that are operating in nontradable sectors. We follow Mian and Sufi (2014) to identify tradable and nontradable sectors. All results continue to hold for this test.

[30] Due to the reduced sample size, we are unable to provide results for the firm outcome variables based on Capital IQ, i.e., for the usage of credit lines in the liquidity management of firms.

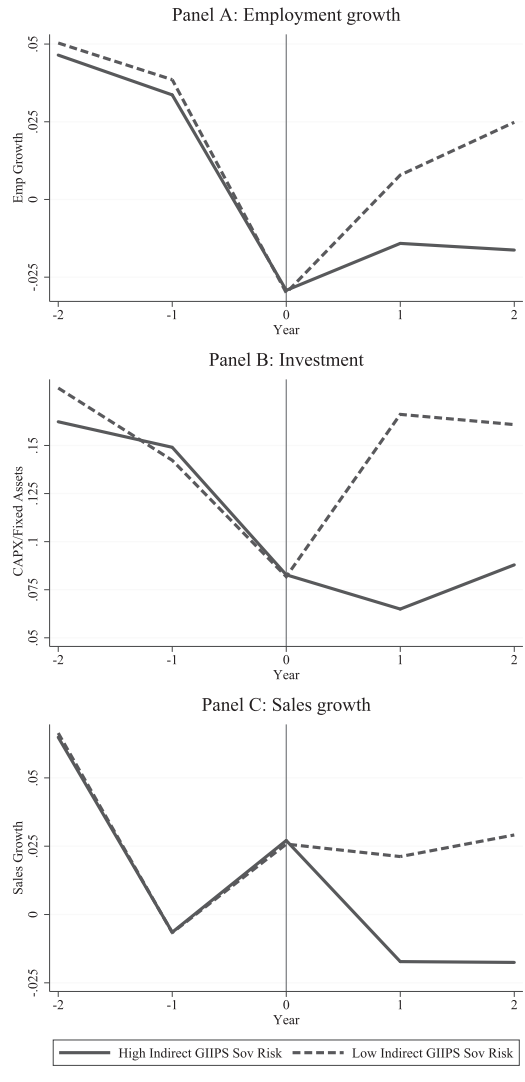

Figure 6
Evolution of real outcome variables for non-GIIPS firms without GIIPS or other non-EU subsidiaries
This figure plots the evolution of employment growth, investment, and sales growth in the precrisis period (years –2 and –1) and the crisis period (starting in year 0) for the sample of non-GIIPS firms without GIIPS or other non-EU subsidiaries, separately for high (i.e., above the precrisis median) and low (i.e., below the median) *Indirect GIIPS Sov Risk* firms. *Indirect GIIPS Sov Risk* measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships.

4.3 Supply and demand factors of bank lending

If the real effects documented in this section were indeed caused by a reduction in loan supply from banks affected by the European debt crisis, we would expect that the negative real effects from having a higher *Indirect GIIPS Sov Risk*

Table 6
Real effects: Subsidiaries

	ΔCash	Net Debt	ICR	Emp Growth	CAPX	Sales Growth
Panel A: Non-GIIPS firms without GIIPS or other non-EU subsidiaries						
Indirect GIIPS Sov Risk	−0.001	−0.005**	−0.407**	−0.005**	−0.009**	−0.008**
	(−0.69)	(−2.38)	(−2.55)	(−2.47)	(−2.46)	(−2.29)
Indirect GIIPS Sov Risk× Cashflow	0.006***					
	(3.83)					
R^2	0.629	0.900	0.922	0.756	0.801	0.671
N	934	1,098	1,192	832	1,039	1,021
Panel B: Non-GIIPS firms without GIIPS subsidiaries (M&A only)						
Indirect GIIPS Sov Risk	−0.002	−0.007**	−0.393**	−0.006**	−0.008**	−0.008**
	(−1.21)	(−2.60)	(−2.47)	(−2.14)	(−2.38)	(−2.14)
Indirect GIIPS Sov Risk× Cashflow	0.006**					
	(2.46)					
R^2	0.598	0.896	0.926	0.735	0.789	0.666
N	832	999	1,056	746	931	909
Panel C: Non-GIIPS firms without GIIPS subsidiaries (nontradable sectors)						
Indirect GIIPS Sov Risk	−0.001	−0.007***	−0.462**	−0.006**	−0.007**	−0.008**
	(−0.81)	(−3.01)	(−2.51)	(−2.29)	(−2.41)	(−2.52)
Indirect GIIPS Sov Risk× Cashflow	0.007***					
	(5.12)					
R^2	0.633	0.909	0.953	0.731	0.804	0.697
N	811	950	1,012	693	884	863
Panel D: Non-GIIPS firms with GIIPS subsidiaries						
Indirect GIIPS Sov Risk	−0.001	0.000	−0.206	0.001	0.002	−0.002
	(−0.69)	(0.00)	(−0.55)	(0.72)	(1.61)	(−0.73)
Indirect GIIPS Sov Risk× Cashflow	0.002					
	(0.47)					
R^2	0.511	0.866	0.750	0.584	0.705	0.575
N	1,242	1,274	1,291	1,151	1,263	1,261
Firm Controls	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Industry-Time Fixed Effects	YES	YES	YES	YES	YES	YES
Foreign GIIPS Bank-Country-Time Fixed Effects	YES	YES	YES	YES	YES	YES

This table presents firm-level regression results. The dependent variables are the change in cash holdings, net debt, ICR, employment growth, investment, and sales growth, respectively. Panels A–C include only non-GIIPS firms without GIIPS or other non-EU subsidiaries. Panel B restricts the sample further to firms that have their GIIPS bank relationships due to a bank M&A, whereas panel C restricts it to firms active in nontradable sectors. Panel D includes only firms in non-GIIPS countries that have at least one GIIPS subsidiary. *Indirect GIIPS Sov Risk* measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships. Firm-level control variables include the logarithm of total assets, leverage (not in Column 2), net worth, tangibility, ICR (not in Column 3), EBITDA/total assets, and for the cash regression a firm's cash flow and capital expenditures. All firm-level control variables are lagged by one period. Standard errors are adjusted for heteroscedasticity and clustered at the firm level. t-statistics are reported in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

were less pronounced for firms that were less prone to becoming financially constrained. In particular, we should observe smaller or no significant real effects of having a business relationship with a bank affected by the crisis (i) for firms that, relative to the decrease in loan supply, experienced an even

larger decrease in loan demand and (ii) for firms that were likely able to substitute the reduction in loan supply with other means of financing.

We start with testing whether firms that had a relatively low demand for bank loans during the crisis period suffered fewer real effects through the bank lending channel compared with firms that had a high demand for loans. In particular, firms with significant exposure to the negative macroeconomic shock in the periphery of the eurozone had presumably a very low or no demand for additional bank loans as a firm's demand for bank financing is strongly influenced by its investment and growth opportunities. Hence, for these firms, the reduction in loan supply due to business relationships with banks affected by the crisis should be smaller than the decrease in their loan demand, and thus these firms should not be significantly affected by their banks' credit tightening.

For this analysis, we again use the revenue information for all foreign and domestic subsidiaries of the firms in our sample from the Amadeus database to determine each firm's geographical revenue distribution. First, we compare the effect of *Indirect GIIPS Sov Risk* on non-GIIPS firms with and non-GIIPS firms without revenue generated from business in GIIPS countries (e.g., German firms with and without subsidiaries in Italy). We rerun the regressions applied in Section 4.2 and present results for non-GIIPS firms with GIIPS business exposure in panel D of Table 6. In line with our prediction, we find no significant impact of *Indirect GIIPS Sov Risk* on financial and real outcomes for non-GIIPS firms with GIIPS business exposure, while there is a significant impact for non-GIIPS firms without such exposure (see panel A of Table 6).

Second, we redo the analysis for GIIPS firms and divide these firms according to their business exposure to non-GIIPS countries. In particular, we expect that the real effects through the bank lending channel were larger for GIIPS firms that generate a large fraction (highest tercile) of their revenue from subsidiaries located in non-GIIPS countries compared to GIIPS firms that generate their revenue mainly in GIIPS countries. Panel A of Table A13 shows that GIIPS firms with significant non-GIIPS business exposure experienced significant negative real effects as a result of having a high *Indirect GIIPS Sov Risk*, while GIIPS firms without non-GIIPS business exposure incurred much weaker effects (see Panel B of Table A13).[31]

Next, we investigate whether firms that were better able to substitute a reduction in loan supply with other means of financing experienced smaller negative real effects from having a higher *Indirect GIIPS Sov Risk*. In particular, we interact a firm's *Indirect GIIPS Sov Risk* with a dummy variable equal to one if the firm is unlisted or unrated, respectively. For these firms it is difficult to raise additional equity or issue bonds, implying that they are more bank dependent than listed and/or rated firms (see, e.g., Sufi 2007). Moreover, there

[31] Panel B of Table A14 shows that firms with high and low *Indirect GIIPS Sov Risk* in this subsample did not differ across their observable firm characteristics in the precrisis period, which again suggests that firm quality was not an important determinant for the bank-firm matching.

is less publicly available information for these firms, requiring more monitoring and information collection by banks.

The results presented in panels A and B of Table 7 show that the negative effects of having a higher *Indirect GIIPS Sov Risk* are solely borne by unlisted (panel A) and/or unrated firms (panel B), as only the interaction terms of *Indirect GIIPS Sov Risk* with the unlisted/unrated dummy variables are significant in these regressions. Therefore, in line with the findings of Becker and Ivashina (2018), firms with alternative funding sources thus seem to be able to compensate for the lack of bank financing, whereas unlisted firms and unrated firms cannot easily alter their funding sources and thus suffered significant real effects if they had a high dependency on banks affected by the sovereign debt crisis. Panel C of Table 7 confirms this evidence by showing that all effects are driven by firms that were not able to issue bonds during the crisis period.[32]

Taken together, these results indicate that the limited access to funding due to lending relationships with banks affected by the European sovereign debt crisis seem to have played an important role in causing the negative real effects experienced by the affected borrowing firms.

4.4 Aggregate effects

We can use our real effect results to inform the debate about the aggregate effects of the loan supply shock of the European sovereign debt crisis. Our strategy to estimate the aggregate effects is similar in spirit to the approach applied in Chodorow-Reich (2014). More specifically, for each borrower, we estimate its counterfactual performance if it had borrowed from the least affected syndicate, which we consider to be a syndicate at the 5th (or 10th in a robustness check) percentile of the *Indirect GIIPS Sov Risk* distribution. We then employ a partial equilibrium analysis to determine the aggregate effects; that is, we assume that the overall real effect equals the sum of the real effects at the firm level. Furthermore, we assume that the least affected loan syndicate did not shift its lending supply function during the crisis.

In the following, we explain our strategy to estimate aggregate effects using employment growth rates as an example. The analysis for investment and sales growth rates is similar. We start by defining the counterfactual employment growth rate of firm_{ijh} if it had borrowed from a syndicate at the 5th percentile of the *Indirect GIIPS Sov Risk* distribution (we denote this value $\widetilde{\textit{Indirect GIIPS Sov Risk}}_{5th,t}$ or short $\widetilde{IGSR}_{5th,t}$):

$$\widetilde{y_{ijht}} = \widehat{y_{ijht}} - \beta_1 \times [\textit{Indirect GIIPS Sov Risk}_{ijht} - \widetilde{\textit{Indirect GIIPS Sov Risk}}_{5th,t}], \quad (6)$$

[32] Additionally, we find that only firms that were not able to switch to other banks had negative financial and real effects, whereas firms that were able to switch banks had no negative real effects. Since the ability to switch banks is strongly correlated with whether a firms is publicly listed, we do not report these results.

Table 7
Real effects: Firms' ability to substitute loan supply decrease

	ΔCash	Net Debt	ICR	Emp Growth	CAPX	Sales Growth
Panel A: Listed vs. unlisted firms						
Indirect GIIPS Sov Risk	0.000	0.000	−0.100	−0.000	−0.000	−0.001
	(0.62)	(0.63)	(−0.88)	(−0.04)	(−0.08)	(−0.21)
Indirect GIIPS Sov Risk×Cashflow	−0.002					
	(−1.22)					
Indirect GIIPS Sov Risk×Private	−0.001	−0.011**	−0.767**	−0.009**	−0.011**	−0.011***
	(−0.91)	(−2.15)	(−2.51)	(−2.26)	(−2.51)	(−2.63)
Indirect GIIPS Sov Risk× Private×Cashflow	0.010**					
	(2.16)					
R^2	0.467	0.849	0.847	0.610	0.727	0.603
N	3,853	4,272	4,518	3,630	4,250	4,055
Panel B: Rated vs. unrated firms						
Indirect GIIPS Sov Risk	0.000	0.002	0.020	0.000	0.001	0.000
	(0.54)	(1.30)	(0.18)	(0.55)	(1.17)	(0.70)
Indirect GIIPS Sov Risk×Cashflow	0.001					
	(0.28)					
Indirect GIIPS Sov Risk×No Rating	−0.001	−0.012**	−0.856***	−0.010***	−0.012***	−0.012***
	(−1.17)	(−2.06)	(−3.01)	(−2.90)	(−3.07)	(−3.00)
Indirect GIIPS Sov Risk× No Rating×Cashflow	0.009**					
	(2.05)					
R^2	0.467	0.858	0.851	0.612	0.738	0.604
N	3,853	4,272	4,518	3,630	4,250	4,055
Panel C: Firms with vs. without bond issues						
Indirect GIIPS Sov Risk	0.000	0.002	−0.043	0.000	0.001	0.000
	(0.30)	(1.23)	(−0.39)	(0.11)	(1.32)	(0.30)
Indirect GIIPS Sov Risk×Cashflow	−0.002					
	(−0.84)					
Indirect GIIPS Sov Risk×No Bond Outstanding	−0.001	−0.012**	−0.801***	−0.009**	−0.012***	−0.011**
	(−0.92)	(−2.12)	(−2.59)	(−2.29)	(−3.13)	(−2.05)
Indirect GIIPS Sov Risk×No Bond Outstanding×Cash Flow	0.008**					
	(2.04)					
R^2	0.477	0.858	0.851	0.610	0.735	0.604
N	3,853	4,272	4,518	3,630	4,250	4,055
Firm Controls	YES	YES	YES	YES	YES	YES
Firm Fixed Effects	YES	YES	YES	YES	YES	YES
Industry-Country-Time Fixed Effects	YES	YES	YES	YES	YES	YES
Foreign Bank GIIPS Country-Time Fixed Effects	YES	YES	YES	YES	YES	YES

This table presents firm-level regression results. The dependent variables are the change in cash holdings, net debt, ICR, employment growth, investment, and sales growth, respectively. In Panel A the variable of interest is interacted with a dummy equal to one if a firm is not listed, in Panel B with a dummy equal to one if a firm is unrated, and in Panel C with a dummy equal to one if a firm did not issue bonds during the sample period. *Indirect GIIPS Sov Risk* measures the GIIPS sovereign risk each firm is exposed to via its bank lending relationships. Firm-level control variables include the logarithm of total assets, leverage (not in Column 2), net worth, tangibility, ICR (not in Column 3), EBITDA/total assets, and for the cash regression, a firm's cash flow and capital expenditures. All firm-level control variables are lagged by one period. Standard errors are adjusted for heteroscedasticity and clustered at the firm level. t-statistics are reported in parentheses. Significance levels: * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

where $\widehat{y_{ijht}}$ denotes the fitted value from the respective regression and β_1 is the negative regression coefficient from the respective regression for employment growth. In the case of employment, we then use the counterfactual employment growth rate to calculate the counterfactual employment level $\widetilde{Emp_{ijht}}$ and similarly the fitted value employment level $\widehat{Emp_{ijht}}$. The total losses due to the bank lending shock during the crisis period are then given by

$$\sum_{t \in Crisis} \left(\sum_{IGSR_{ijht} > \widetilde{IGSR}_{5th,t}} [\widetilde{Emp_{ijht}} - \widehat{Emp_{ijht}}] \right), \tag{7}$$

where the $Crisis$ period is again defined as 2010–2012. The fraction of the sample net employment change during the crisis that is caused by banks' lending behavior is then given by

$$\frac{\sum_{t \in Crisis} \left(\sum_{IGSR_{ijht} > \widetilde{IGSR}_{5th,t}} \left[\widetilde{Emp_{ijht}} - \widehat{Emp_{ijht}} \right] \right)}{\sum_{ijh} \left[Emp_{ijh,2010} - Emp_{ijh,2012} \right]}. \tag{8}$$

In the following, we present our results for the aggregate effects that can be attributed to the firms' indirect exposure to sovereign risk through their lending relationships. We focus on two subsamples of firms, where we are best able to disentangle the macroeconomic shock from the bank lending shock. Looking at the results for non-GIIPS firms without subsidiaries in GIIPS or other non-EU countries presented in panel A of Table 6, we find that overall employment decreased by 1.6% during the European sovereign debt crisis. Our effect accounts for 49% of this decline. Similarly, firm investment fell by 2%, and 46% of this decline in investment can be explained by the contraction in bank lending. Finally, sales decreased by 2%, and 44% of this reduction in sales can be attributed to the loan supply shock.

Considering the results for the sample of GIIPS firms with a high fraction of revenue generated by non-GIIPS subsidiaries reported in panel A of Table A13, we find that overall employment fell by 5.6% during the crisis period. We can attribute 66% of this decline to the lending supply shock. Similarly, investment fell by 13%, of which 62% can be explained by banks' lending behavior. For the evolution of sales, we find an overall decrease of 3.6% over the crisis period, of which we can explain 61% by the contraction in bank lending.

To give some perspective on the size of the effect, we compare the evolution of employment in the GIIPS countries in our sample to the economy-wide evolution using data from Eurostat. According to Eurostat, employment across the GIIPS countries decreased on average by around 8% with the largest effect in Greece (decline of 21.5%). The average across the other four GIIPS countries amounts to a 6% decline in employment, which matches our overall effect of 5.6% quite well. These numbers become more striking when considering the increase in the unemployment rate that corresponds to this decrease in the

number of employed people. The 6% decline in employment corresponds to an increase in the unemployment rate of around 37% in the four GIIPS countries (excluding Greece).

Similarly, we compile investment data from the World Bank for our sample countries. Italy, Ireland, Portugal, and Spain, which make up the majority (95%) of our sample of GIIPS firms, show an average decline in investment of 20%. In our sample of very large companies we find a slightly lower investment decline of 13%, most likely since SMEs were affected more strongly by the loan supply reduction than the large firms in our sample, and thus had to cut their investment levels more than large companies. Our estimates thus serve as a lower bound for the real effects suffered by European firms.

5. Conclusion

In this paper, we show that the credit crunch following the European debt crisis was an important contributor to the severity of the crisis. In particular, we find that European firms that had a precrisis lending relationship with banks that suffered from the sovereign debt crisis became financially constrained during the crisis. As a result, these firms had, on average, lower employment growth rates, lower levels of investment, and lower sales growth rates.

Moreover, we examine the mechanisms by which the European debt crisis induced a contraction in bank lending and the resulting real effects for European borrowing firms. We document that the negative real effects that can be attributed to the bank lending channel are primarily associated with (i) European banks facing losses on their substantial GIIPS sovereign bond holdings, and (ii) the resulting incentives of weakly capitalized banks that had a high preexisting exposure to engage in risk-shifting behavior by buying even more risky sovereign bonds, thereby crowding out corporate lending. In contrast, moral suasion does not seem to have affected corporate lending by banks in the syndicated loan market.

Our findings foster the understanding of the unfolding of the European debt crisis and yield important insights on how to overcome the recession in Europe's periphery. Our results indicate that an effective bank recapitalization could significantly contribute to the economic recovery in Europe, since the pressure to deleverage due to the banks' weakened financial health and the resulting risk-shifting incentives of undercapitalized banks seem to be the most important determinants for the stagnation of bank lending in Europe and, in turn, the low investment levels of European firms.

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