Sovereign debt exposure and the bank lending channel: impact on credit supply and the real economy ☆

Margherita Bottero[1], Simone Lenzu[2,*], Filippo Mezzanotti[3,*]

Abstract

In the context of the European crisis, we show that the security portfolio of banks plays an important role in the propagation of financial shocks across countries. Using Italian loan-level data, we show that the shock to the banks' sovereign portfolio caused by the 2010 Greek bailout was passed on to Italian firms through a credit contraction. This was particularly the case for banks with a lower capital and less stable funding. The contraction in credit was similar for both large and small firms, but it only negatively affected the investment and employment decisions of small firms.

Keywords: Banks, Credit, Financial Fragility, Security Markets, Sovereign Debt, Financial Contagion.
JEL: E5, G2, G3, G15

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1. Introduction

Financial intermediaries play a fundamental role in enhancing economic growth, lending to firms and households and reallocating capital to the highest-value use (Schumpeter, 1934; King and Levine, 1993). But loans are not the only assets held by banks. A large fraction of their portfolio is composed of securities, real properties, and equity holdings. While there are complementarities among these different investments, swings in the market price and riskiness of these assets may lead to adjustments in banks' credit supply, with potential adverse effects on the real economy.

This paper studies the role played by banks' security portfolio on the propagation of international macro-financial shocks to the real economy. We specifically focus on the role played by the bank's sovereign bonds - one of the most important security class held by financial intermediaries - during a period characterized by tensions in international sovereign markets. In particular, we analyze the credit market dynamics and firms' real economic

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activity in Italy around the 2010 Greek bailout event. The bailout directly concerned Greece and its investors, but it also sparked a widespread turmoil in global financial markets, including the Italian sovereign bond market. We show that Italian financial intermediaries with large exposures to government securities tightened their credit supply after the burst of the Greek sovereign crisis when compared to less exposed banks, and that the credit contraction negatively affected the investment and employment choices of the Italian SME corporate sector.

The Greek bailout is an ideal setting to study the role played by banks' security portfolios on the transmission of international shocks. First, we can examine the effects of financial contagion by focusing on one specific shock originating outside of the national borders that was not caused by a contemporaneous deterioration in economic fundamentals or political risk. As we discuss in the paper, the Greek events radically and unexpectedly changed the risk perception of government bonds issued by individual countries in Europe, including Italy. In fact, the sequence of events that culminated into Greece's bailout request was a "wake-up call" for investors, inducing an increase in the volatility of government bond yields in peripheral European countries and a widening of their spreads vis-a-vis the German Bund (Lane 2012; Giordano et al., 2013).[4] Second, the richness of our data allows us to assess the impact of the tensions in financial markets on credit supply, and then on real outcomes. Using administrative data, we analyze over 500,000 firm-bank credit relationships comparing the change in credit supply around the Greek bailout across banks differentially exposed to government bonds. Our data includes all Italian financial intermediaries and a large, representative sample of non-financial corporations operating in the time window around the first Greek bailout in April 2010.

To capture the exposure of financial institutions to the sovereign shock, we construct a bank-level proxy that exploits the cross-sectional heterogeneity in banks' holdings of Italian sovereigns measured before the Greek bailout (2010:Q1). The focus on pre-bailout holdings allows us to tackle concerns related to banks' endogenous portfolio adjustments that took place in response to the sovereign crisis itself and the unconventional measures adopted

[4]Italian banks were affected by the Greek bailout through the propagation of financial tensions to the Italian bond market. In fact, while sovereign securities represent a large fraction of banks' assets, the direct exposure of Italian banks to Greek bonds was minimal.

by the ECB to counteract the dysfunctions in sovereign markets (Broner et al. 2014; Acharya and Steffen 2015). Furthermore, taking advantage of the widespread presence of firms with multiple relationships with different financial institutions, we run within-firm difference-in-difference regressions that compare changes in credit supply to the same borrower from lenders with different exposure to Italian government debt around the Greek bailout (2009:Q2-2011:Q1).[5] This research design allows us to disentangle the effect of changes in credit supply from simultaneous changes in firms' credit demand and creditworthiness (Gan 2007a,b; Khwaja and Mian 2008; Amiti and Weinstein 2016).

We begin by documenting that the turmoil in the sovereign bond market had a negative, causal effect on bank lending due to banks' direct exposure of their security portfolio to the financial shock. When we compare lending to the same firm by two banks that are one standard deviation apart in terms of sovereign exposure, we find that the more exposed financial intermediary reduced its credit supply by 10% more relative to the less exposed. Not only did the more exposed banks cut lending more intensively, they were also more likely to break ongoing credit relationships or cut credit limits on lines of credit. The paper presents a number of robustness tests to support the causal interpretation of these results.

Investigating the channels of transmission of the financial shock to bank lending activity, we find that the tightening in credit supply is larger for poorly capitalized banks and intermediaries relying more heavily on interbank debt as a source of funding. This suggests that the sovereign shock affected lending because it unexpectedly increased the riskiness of bank assets, forcing financial intermediaries to adjust their behavior. Sovereign securities, considered to be almost riskless before the Greek bailout, started carrying a nontrivial amount of credit risk after spring 2010. As a result, banks concerned with the need to increase their capitalization or to raise funding preemptively tightened credit supply in order to adjust the riskiness of their assets (Peek and Rosengren 1997; 2000). Furthermore, the turmoil in the government bond market also impaired banks' operations by reducing the collateral value of sovereigns (Abbassi et al., 2014), which are used extensively to back up collateralized interbank lending transactions. As in

[5]In our sample, firms with multiple lending relationships represent the majority, about 2/3 of the sample.

the case of the recent financial crisis (Ivashina and Scharfstein 2010; Cingano et al. 2016), intermediaries' exposure to wholesale markets appears to be a catalyst for the transmission of the shock.

The contraction of credit supply by banks more exposed to sovereign securities led to an overall reduction of firms' access to bank financing. In fact, lenders' exposure at the onset of the sovereign crisis is highly predictive of the change in a firm's *total* bank credit spanning the burst of the sovereign crisis. A one standard deviation increase in lenders' average holdings of Italian sovereign securities before the sovereign shock corresponds to a reduction of 5% in the firm's total bank borrowing, compared to its pre-crisis amount. This suggests that because of credit-market imperfections, firms were unable to compensate for the reduction in credit from more exposed lenders by expanding their borrowing from less exposed financial intermediaries. Conducting a simple counterfactual exercise, our estimates suggest that the lending channel caused by banks' direct exposure to securities affected by the sovereign shock (i.e. the *security channel*) can account for a drop of almost 2% in aggregate lending during our period of analysis. Furthermore, we show that while credit declined for both large and small companies, the overall effect on smaller enterprises was substantially larger.

Finally, we document the transmission of the financial shock to the real economy. We find that the Greek bailout - through its effect on banks' lending - negatively affected firms' investment and employment policies. This effect is fully driven by small companies, which cut investments and payroll costs more than other equally exposed large firms. In particular, we estimate that one euro cut in funding to small firms decreased investments by 38 cent and payroll payments by 37 cent. At the same time, we find essentially no effect for larger firms. Importantly, we note that this result is not driven by a differentially credit tightening across large and small firms, but rather by relative inability of smaller businesses to smooth a similar credit shock across different lenders.[6]

This work provides new evidence of the real economic costs of a banking system encumbered with government debt.[7] Other studies explored the ef-

[6]This result is consistent with smaller companies being more affected by information frictions (Stiglitz and Weiss 1981, 1992) and therefore having more difficulty with establishing or reinforcing credit relationships (Petersen and Rajan 1994), especially during bad times.

[7]Some of these papers try to explain the increase in sovereign holdings on banks'

fects of the recent European sovereign crisis using data on large banks and large firms active in the syndicated loan market (Popov and Van Horen 2013; De Marco 2017; Acharya et al. 2018).[8] The granularity of our data allows us to improve upon the existing literature in terms of both internal and external validity. First, our estimation window is centered around the first event that triggered the European sovereign crisis, allowing us to examine the effect of an increase in sovereign risk in a period when a contemporaneous deterioration in local economic fundamentals, political risk, or banks' strategic adjustments are unlikely to be important confounding factors. Moreover, by combining loan-level data from the Italian Credit Register with bank-specific measures of sovereign exposure, we can effectively isolate the effects of the sovereign shock on banks' credit supply from the effects imputable to a reduction in credit demand (Bocola, 2016) or a change in country-specific risk (Bofondi et al. 2017). Second, the representativeness of our sample allows us to study the heterogeneous effects of the credit tightening across firms of different sizes, which is an advantage relative to previous studies focusing only on large firms (Acharya et al. 2018). As our results highlight, investment and employment elasticities to changes in credit supply estimated for small firms differ substantially from the ones estimated for large corporations. Small firms pay a disproportionately larger price in the event of a credit crunch, even when they are not a direct target of credit cuts.[9]

This paper also relates to the literature studying the role of banks in the international transmission of financial shocks. Previous research has focused

balance sheets (Angelini et al. 2014; Battistini et al. 2013; Acharya and Steffen 2015), while others examine the potential crowding out of private credit by government debt (Ahtik and Albertazzi 2014; Becker and Ivashina 2014b; Peydró et al. 2017). Gennaioli et al. (2014b) and Correa et al. (2014) analyze more generally the role of sovereign bonds on banks' balance sheets. Hanson et al. (2011) offers a broader discussion on sovereigns and financial stability.

[8] Another related paper is Baskaya and Kalemli-Ozcan (2016) - which takes advantage of an increase in sovereign risk caused by an earthquake in Turkey to estimate the impact on bank lending of a reduction in sovereigns value - provide complementary evidence to this question. Relative to that paper, our paper extends the analysis by examining the real effects caused by the credit contraction.

[9] This finding is consistent with the ones in the seminal work of Gertler and Gilchrist (1994) and with Chodorow-Reich (2014). In the context of the sovereign crisis, Balduzzi et al. (2018) shows that the real activity of small companies is disproportionally affected by a deterioration of banks' financial health using a survey of 5,000 Italian firms between 2007 and 2013.

on the relevance of international funding for domestic banks (Schnabl, 2012; Baskaya et al., 2017; Giovanni et al., 2017; Schnabl, 2012) or analyzed the importance of global financial intermediaries (Cetorelli and Goldberg, 2011; Kalemli-Ozcan et al., 2013; Peek and Rosengren, 2000). Complementing these studies, our results highlight the key role of financial intermediaries' security portfolio as a significant risk factor, exposing the real economy to shocks originating outside of national borders. While our focus is on sovereign bonds, the scope of our findings is much broader, since the security channel can be triggered by any marketable security held by banks.[10]

The remainder of the paper is organized as follows. In Section 2, we provide some institutional background on the European sovereign debt crisis and describe the data used in the paper. In Section 3, we introduce and discuss our identification strategy, provide evidence on the presence of the bank lending channel, and document its heterogeneous effects across firms and banks. In Section 4, we show that the sovereign shock impaired firms' access to bank credit, consequently affecting their investments and employment decisions. Section 5 concludes.

2. Institutional background and data

2.1. The onset of the European sovereign crisis

The central event in our study is the bailout request advanced by Greece in April 2010, which represents a unique breaking point in sovereign markets and triggered the series of events that led to the European sovereign crisis (Lane, 2012).[11] Following a series of upward deficit revisions, the Greek government requested an EU/IMF bailout package to cover its financial needs for the remainder of the year on April 23 2010.[12] The Greek crisis was inter-

[10] In Italy, around one-third of the security portfolio is represented by securities that are not issued by sovereign entities. In the online Appendix OA.1 we show that non-sovereign securities represent an even larger fraction of banks' overall security portfolios in other developed countries. In general, relative to sovereign securities, non-sovereign securities tend to be less liquid. Therefore, the same economic mechanism at play with sovereigns should still be relevant for non-sovereign assets.

[11] Online Appendix OA.1 offers a more detailed discussion of the events that led to the burst of the European sovereign crisis.

[12] A few days after the bailout request, on April 27, Standard & Poor's downgraded Greece's sovereign debt rating to BB+ (junk bond). This downgrade was preceded by another downgrade of Greece by Fitch in December 2009, which brought Greek sovereign

preted as a *wake-up call* by investors (Giordano et al. 2013), which increased the sensitivity of sovereign assets to country-specific macroeconomic fundamentals and prompted a general reassessment of country-specific default risk across the euro area.[13] Shortly after the events in Greece, investors began to be concerned with the solvency and liquidity of the public debt issued by other European countries, starting with Ireland and Portugal and spreading soon thereafter to Spain and Italy (Angelini et al. 2014). The general public became aware of the risk of an imminent sovereign debt crisis, as shown by the sharp increase in Google searches of the key world "Euro crisis" (Figure 1, panel a, dotted line). In Italy, the spread between the BTP and the German Bund (henceforth BTP-Bund spread) increased from 85 bps at the end of the first quarter of 2010 to almost 160 bps in the third quarter of the same year (Figure 1, panel a, solid line), and it continued to rise afterwards. To put the economic magnitude of this change in perspective, this jump corresponds to an increase of almost two standard deviations in the spread measured between 2005 and 2009.[14]

The sudden change in the risk profile of government securities had a direct negative effect on the balance sheet of banks holding these assets. Soon after the Greek bailout, the CDS on bonds issued by Italian banks doubled (Figure 1, panel b), and Italian intermediaries started paying a higher cost for getting funding in the interbank market transactions (Abbassi et al. 2014).[15] As we discuss later in the paper, this shock affected banks because it decreased the market value and liquidity of these government bonds and reduced the ability

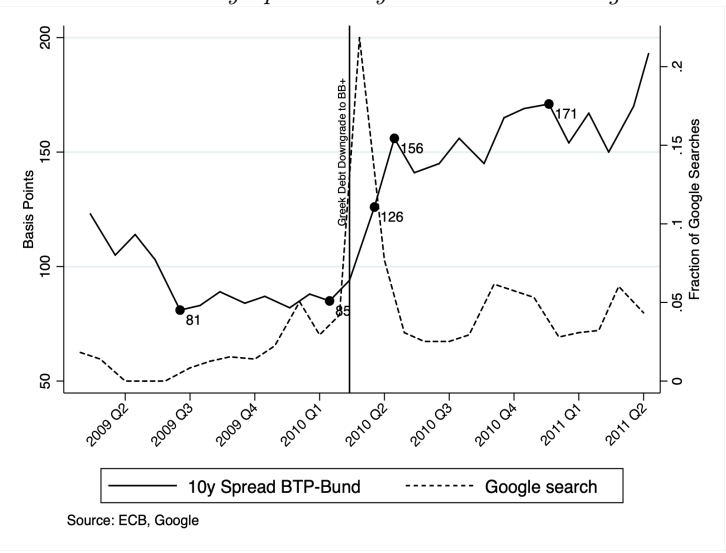
bonds ratings below A- for the first time in the decade.

[13]Giordano et al. (2013) offers evidence consistent with the "wake-up call contagion" but finds no evidence of other forms of contagion such as "pure contagion"and "shift contagion". See Pericoli and Sbracia (2003) for a review and Benzoni et al. (2014) for a theoretical model on how unexpected events - such as the Greek bailout - may trigger a widespread increase in uncertainty that has negative repercussions for other countries.

[14]In the online Appendix OA.1, we discuss additional evidence based on the correlation of the Bund spread across countries that is consistent with the wake-up call hypothesis. Other papers also look at the Greek bailout as the event that unexpectedly destabilized sovereign bond markets (see e.g. Acharya and Steffen 2015; Augustin et al. 2014; Abbassi et al. 2014).

[15]The average CDS spread of bonds issued by the top-five Italian banks rose by 78 percent in the quarters after the Greek bailout, which corresponds to about 2.3 times of the historical standard deviation of this measure. Albertazzi et al. (2014) confirm this result looking at a wider set of Italian financial institutions.

Panel a: 10y Spread Italy and Media Coverage



Panel b: Banks' CDS Spread

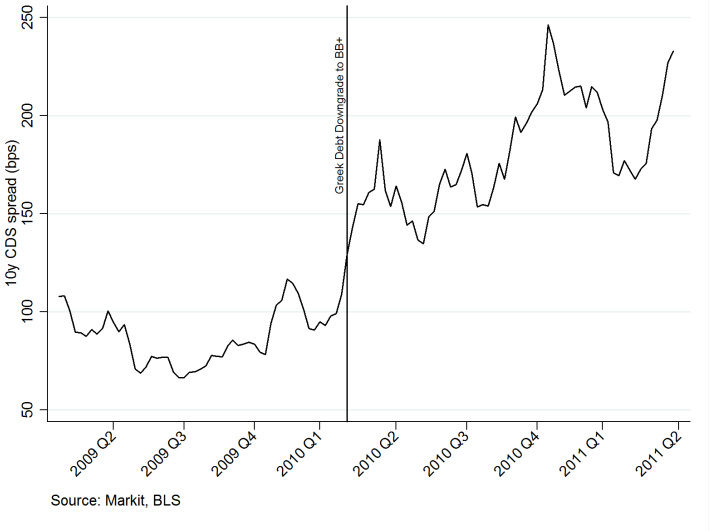


Figure 1: *The burst of the sovereign crisis.* Panel a shows, on the left-hand axis (solid line), the dynamics of the spread between the yield of 10-year Italian zero-coupon bonds and that of 10-year zero-coupon bonds issued by Germany. Data from ECB. The right-hand axis (dashed line) displays the frequency of Google searches of key words "Euro Crisis" using Google Trends. The y-axis reports the Google searches in every week between the beginning of 2008:Q1 and the end of 2011:Q2 as a fraction of the total Google searches of the key words over the same period. Panel b reports the time series of the average of the CDS spreads on unsecured senior debt of the top 5 Italian banks. Data are taken from Markit database and include only the CDS issued in Euro.

of financial intermediaries to use these securities as collateral in the wholesale funding market (Angelini et al. 2014). Consistent with this idea, survey data shows market participants stated that the fear originating from sovereign markets was the biggest threat to bank share prices and ranked banks in countries most affected by the sovereign shock – Italy, Greece, and Portugal – among the financial institutions with the worst expected performance (Figure OA.2, online Appendix).

2.2. Data

The building block for our database is the Italian corporate Credit Register, which contains detailed information on the credit relationships entertained by intermediaries operating in Italy. We match the Credit Register data with the Italian Census of corporations to obtain the balance sheet, income statement, industry, and headquarter location of borrowing firms.[16] The Bank of Italy supervisory records provide us with quarterly accounting information on balance sheets, income statements, and with a detailed picture on sovereign-bond holdings of each bank operating in Italy.

We restrict most of our analysis to a two-year window around the Greek bailout. This window is split into a pre-crisis period (from 2009:Q2 to 2010:Q1) and a post-crisis period (from 2010:Q2 to 2011:Q1). After applying standard filters and consolidating bank balance-sheet items, our final data set includes 527 different bank holding companies, over 185 thousand non-financial firms, and 534 thousand unique firm-bank credit relationships, for a total of more than 4.5 million observations between 2009:Q2 and 2011:Q1. Of this sample, 141 thousand firms established multiple lending relationships around the shock. Table 1 displays the summary statistics of the variables of interest, focusing on the subsample of firms with multiple lending relationships.[17] In this sample, the average firm is 16 years old at the end of 2009, and it has assets with book value of 6 million euros and around 5.5 million

[16]In the Credit Register, we observe relationships *in bonis* that exceeds the threshold of 30,000 euros. Positions in default need to be reported irrespective of their amount. The Census of corporations is a proprietary database collected by Cerved Group S.p.A. (Cerved). See Appendix A.1 for a discussion about the data-construction process and variables used in this work.

[17]Appendix A.2 reports a detailed description of all variables and further details about the distribution of the most important variables. Table A.3 reports summary statistics for the full sample of firms that includes both multiple- and one-lending relationships firms.

	Obs	Mean	Sd	Pc10	Pc90
Panel a: Relationship-specific variables					
g(Loans)	478235	0.019	0.659	-0.556	0.667
g(Tot Credit)	478235	0.026	0.593	-0.462	0.657
g(Cred Lines)	478235	0.003	0.624	-0.545	0.605
1(Cut Credit)	478235	0.388	0.487	0.000	1.000
Δ ln(Loans)	478235	0.019	0.540	-0.474	0.627
Length Relationship	478235	31.016	21.378	7.491	62.569
Share Relationship	478235	10.214	5.780	2.000	17.000
Num Relationship	478235	3.721	1.528	2.000	6.000
Panel b: Firm-specific variables					
Total Assets	141372	6061.865	59452.404	405.000	9478.000
Revenues	141372	5530.914	46158.986	382.000	8905.000
Wage Bill	141372	844.320	6071.124	54.000	1383.000
Age	141372	16	12	3	32
Bank Leverage	141372	40.830	27.303	9.199	77.331
Credit Score	141372	5.130	3.782	2.000	7.000
gr(Empl)	141372	0.034	0.480	-0.399	0.453
gr(Inv)	141372	-0.003	0.630	-0.615	0.669
Panel c: Bank-specific variables					
Sovereigns	527	0.245	0.299	0.039	0.521
Sovereigns/Assets	527	0.143	0.106	0.028	0.284
Sovereigns/Tier1	527	1.429	1.171	0.263	2.799
ROA	527	0.000	0.002	-0.001	0.002
Size	527	5.619	1.622	3.754	7.490
Tier1	527	0.166	0.095	0.086	0.267
Deposits	527	0.801	0.389	0.465	1.278
Liquidity	527	0.008	0.006	0.003	0.015
Net Interbank Debt	527	-0.084	0.149	-0.213	0.019
Bad Loans	527	0.039	0.033	0.007	0.075
BCC	527	0.776	0.417	0.000	1.000
Tot Sovereigns	527	0.248	0.301	0.040	0.521
Sovereigns PIIGS	527	0.246	0.299	0.039	0.521
Sovereigns PIGS	527	0.001	0.006	0.000	0.000
Sovereigns DE	527	0.001	0.006	0.000	0.000

Table 1: *Summary Statistics.* This table reports the summary statistics of the relationship-specific (panel a), firm-specific (panel b), and bank-specific variables (panel c) used in our analysis. It refers to the subsample of firms that established multiple lending relationships in the one-year window centered around the Greek bailout. See Section 2 and Appendix A.2 for a detailed description of the variables.

euros in revenues. Companies with revenues below 2 million – our definition of a small firm in line with the European Statistical agency – account for 67 percent of the sample. This sample is close to the full population of Italian banks and corporations, and thus well suited for investigating the transmission of credit-supply shocks across heterogeneous types of firms. In particular, it allows us to cast light on the real effects on small firms, which are not monitored by rating agencies or the financial press, and are typically under-sampled in the literature (e.g. Acharya et al. 2018; Chodorow-Reich, 2014).

We use the stock of Italian government bonds at the end of 2010:Q1 scaled by risk-weighted assets (Sovereigns) as a bank-specific measure of a financial institution's exposure to the sovereign shock.[18] In 2010:Q1, the average exposure of Italian banks to sovereigns was 25 percent, with a standard deviation of about 30 percent. Italian sovereign debt amounts, on average, to almost 99 percent of the banks' sovereign portfolio during this period.[19] These statistics are indicative of a high average exposure to the sovereign shock across the financial intermediaries. As we discuss later, alternative definitions of our treatment provides a similar picture of the banks' sovereign exposure and the relationship between sovereign holdings and credit supply during the crisis.

In the first part of the paper, our main dependent variable is the percentage change in average outstanding loans between the pre- and post-shock periods for every firm–bank credit relation in our data set. More precisely, we collapse the quarterly amount of credit granted to firm j by bank b to a pre-shock average (2009:Q2-2010:Q1) and a post-shock average (2010:Q2-2011:Q1). Then, we calculate the standardized growth rate between the two averages (Davis et al., 1996; Chodorow-Reich, 2014):

[18] Alternative measures confirm the high exposure of the Italian banking sector to the sovereign shock (like total sovereign holdings and sovereign holdings of "peripheral" European countries) and different scaling variables (either scaling by Tier1 or total assets). More discussion later, see Table 5 and Table 4.

[19] The high concentration of Italian bonds in banks' sovereign portfolios is confirmed when we look at banks with the most diversified portfolios of sovereign bonds. A bank holding company located at the first percentile of the distribution of Italian sovereigns over total sovereigns allocated 58 percent of its sovereign portfolio to Italian government bonds in 2010:Q1. Appendix OA.1 shows that the strong home bias of financial institutions in our sample is not a unique feature of Italian banking system, but rather a common feature across many European countries like Germany, France and Spain.

$$g(\text{Loans}_{bj}) = \frac{\text{Loans}_{bj,Post} - \text{Loans}_{bj,Pre}}{0.5 \cdot [\text{Loans}_{bj,Post} + \text{Loans}_{bj,Pre}]}$$

This growth rate is a second-order approximation of the log difference growth rate around 0. It is bounded in the range [–2,2], limiting the influence of outliers, and it accounts for changes in credit along both the intensive and extensive margins. We also construct a growth rate that considers only the change along the intensive margin ($\Delta ln(\text{Loans}_{bj})$ and a dummy variable that flags those relationships in place before the Greek bailout but cut afterwards (Cut Credit_{bj}). Our empirical models include the following set of bank-level controls: bank profitability, size, capitalization, retail funding, interbank funding, liquidity, quality of lending portfolio, and status of the bank as a cooperative bank (BCC).[20] Furthermore, we also control for the length of the lending relationship between a borrower and each of its lenders and for the contribution of each lender to the total bank debt of the borrower (relationship-level controls). All bank-specific and relationship-specific controls are measured at the end of the first quarter of 2010, i.e., the last quarter of the pre crisis period.

In the second part of the paper, we look at firm-level outcomes. We measure investment as the log change in fixed assets between 2009 and 2011 (gr(Inv)) and change in employment as the log change in wage bill (gr(Empl)). Information on firms' balance sheet, industry, age, revenues, credit rating, and geographical location comes from the Cerved database. To limit the influence of outliers, we winsorize the growth rate of credit, investment and employment at 1% level.

3. The bank lending channel during sovereign crisis

3.1. Identification strategy

We investigate the lending channel triggered by the sovereign shock by studying changes in the credit supply from before to after the Greek bailout

[20] Appendix A provides a detailed description of the bank-level variables. We scale all bank variables by RWA because this measure allows us to scale all balance sheet variables by an appropriate common denominator which accounts for both size and risk of banks' assets. This feature is particularly important when scaling liability items. We also experimented scaling bank-level variables by total assets, and obtain similar results.

(April 2010) across banks with different pre-bailout exposure to sovereign assets. We estimate the following first-difference regression model:

$$g(\text{Loans}_{bj}) = \beta_0 + \beta_1 \text{Sovereigns}_{b,2010Q1} + \Gamma \cdot X_{b,2010Q1} + \rho_j + \epsilon_{bj} \qquad (1)$$

where $g(\text{Loans}_{bj})$ measures the change in loans from bank b to firm j before to after the Greek bailout; $\text{Sovereigns}_{b,2010Q1}$ is a measure of bank exposure to sovereign securities. $X_{b,2010Q1}$ is a set of bank controls, measured right before the Greek bailout (2010:Q1): bank profitability, size, capitalization, funding (both retail deposit and wholesale measured separately), liquidity, quality of lending portfolio, and status of the bank as a cooperative bank.[21] These controls are particularly important in this setting, because pre-bailout sovereign assets are not randomly assigned across banks. Instead, the holding of these securities is a function of bank characteristics (Gennaioli et al. 2014a), which in turn can also be correlated with changes in the propensity to lend (Table 2).[22] To economize on notation, in the rest of the analysis and in the tables we omit the subscripts on all varaibles, unless needed.

A standard difference-in-difference estimator would deliver biased estimates of the bank lending channel coefficient β_1 when credit supply contractions caused by sovereign exposure are correlated with unobservable firm-specific changes in credit demand. For example, if banks with high sovereign exposure systematically lend to firms with negative demand shocks, estimates of β_1 will be biased downward. This negative sorting between firms and banks may arise because of geographical or industry segmentation in credit markets, and it could falsely lead us to attribute demand-driven drops in credit to movements in credit supply.[23] This is particularly concerning in this setting given the importance of credit demand in Europe during this period (Bocola, 2016). Following Khwaja and Mian (2008), we address the

[21] In our main specification, we measure reliance on wholesale funding as net interbank borrowing (interbank debt minus interbank assets). Results are qualitatively the same if we control for gross interbank debt.

[22] See online Appendix OA.2 for more discussions on the relationship between sovereign holdings and other bank characteristics.

[23] For example, consider the case of poor areas within a country. In these areas, banks may end up holding more sovereign assets on average because of lower investment opportunities. At the same time, they will lend to local firms, which may be weaker and therefore more sensitive to sovereign shocks. A similar argument can be developed for banks specialized in specific industries.

	Below Median of Sovereigns	Above Median of of Sovereigns	Difference Below-Above	Correlation with Sovereigns
ROA	0.000	0.001	-0.001	-0.010
	(0.002)	(0.002)	(0.000)	(0.820)
Size	6.233	5.002	1.230***	-0.324***
	(1.734)	(1.236)	(0.131)	(0.000)
Tier1	0.138	0.195	-0.057***	0.541***
	(0.082)	(0.100)	(0.008)	(0.000)
Deposits	0.615	0.987	-0.372***	0.721***
	(0.252)	(0.414)	(0.030)	(0.000)
Liquidity	0.006	0.010	-0.003***	0.322***
	(0.005)	(0.006)	(0.000)	(0.000)
Interbank Debt	-0.060	-0.108	0.049***	-0.239***
	(0.157)	(0.135)	(0.013)	(0.000)
NPL	0.032	0.045	-0.013***	0.202***
	(0.023)	(0.040)	(0.002)	(0.000)
BCC	0.655	0.897	-0.242***	0.136***
	(0.476)	(0.304)	(0.035)	(0.002)

Table 2: *Banks Characteristics and Sovereign Holdings.* This table shows the relation between intermediaries' exposure to the sovereign crisis (i.e. Sovereigns) and a host of bank-specific characteristics. All variables are measured at the end of 2010:Q1. The first and second column report, respectively, the mean and standard deviation (in parenthesis) of bank's characteristics sorting bank into two groups: below and above the median exposure. The third column shows the difference between the first and the second column and the standard errors of a two-sample t-test of the equality of the means (in parenthesis). The fourth column shows the pairwise correlation between Sovereigns and banks characteristics and the corresponding p-value (in parenthesis). *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

identification problem by focusing on firms with multiple lending relationships and adding firm fixed effects (ρ_j).[24] This approach is equivalent to a within-firm difference-in-differences model, where intermediaries with lower exposure to government debt are used as the control group for banks with higher exposure. A negative and statistically significant value of the coefficient β_1 indicates the presence of the lending channel triggered by banks' sovereign holdings. While our results still hold on a longer time-horizon (see Figure 2), our main analysis focuses on a two-year window centered around the Greek bailout event (2009:Q2–2011:Q1). This choice leaves us with a sufficient number of observations to estimate the causal effects of interest and, at the same time, it allows us to exclude periods characterized by important regulatory interventions and political instability which might confound the results of our analysis.[25] In our preferred specification, we cluster standard errors at the bank level, which is the level of the treatment (Bertrand et al. 2004). However, the results are robust to alternative assumptions about the correlation of the errors.[26]

The validity of this identification strategy relies on the following conditions. First, financial institutions should not have anticipated the imminent transmission of the sovereign crisis to Italian debt and therefore adjusted their sovereign portfolio beforehand. If the shock to Italian sovereigns had been expected before the downgrade of Greece, holdings at 2010:Q1 might reflect strategic or precautionary adjustments undertaken in expectation of the imminent crisis. This adjustment would be a relevant confounding factor in our analysis. The stylized facts presented in Section 2.1 suggest that this was not the case. Before the downgrade of Greek debt, neither financial mar-

[24]Consistent with Ongena and Smith (2000) and Detragiache et al. (2000), firms with multiple lending relationships are the majority of the firms in our sample.

[25]We exclude from the estimation window the second half of 2011, which is when the ECB re-activated its Securities Markets Programme (SMP) and political tensions led to the establishment of a technocratic government in Italy. Furthermore, our main estimation window also excludes the activation of the longer-term refinancing operations programs (LTRO), announced in December 2011 (Carpinelli and Crosignani, 2015), and the Outright Monetary Transactions program (OMT), announced in July 2012 (see Casiraghi et al. 2013).

[26]Clustering standard errors at the bank level is the most appropriate, since the variation of the shock variable is at the bank level. For completeness, Table OA.4 in online Appendix shows our main results clustering standard errors at the firm level. If anything, this alternative approach gives us even smaller standard errors.

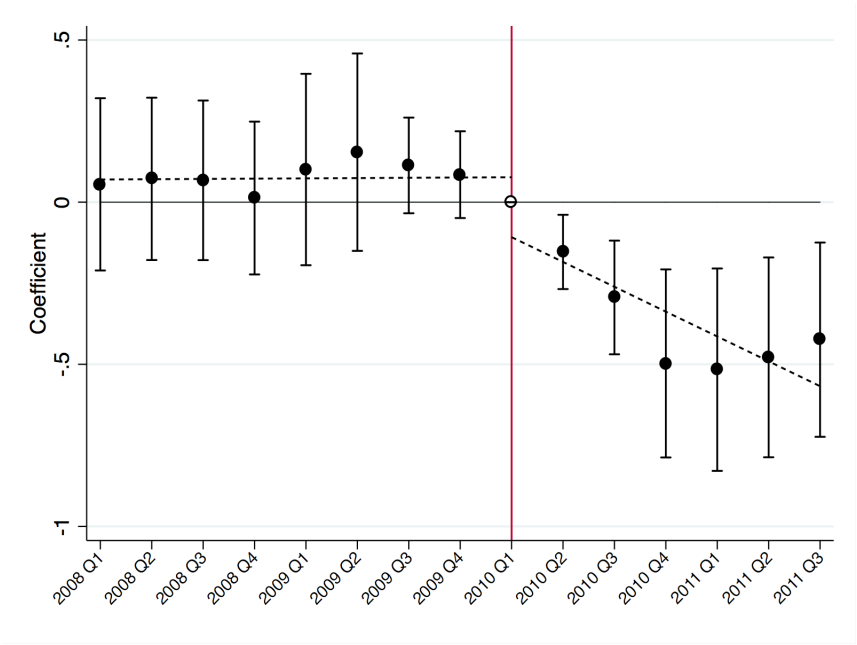


Figure 2: *Pre-trending test.* This figure presents a graphical test of the parallel trends assumption behind our identification strategy. It plots the coefficient that captures the correlation of sovereign bonds holdings in 2010:Q1 ($\text{Sovereigns}_{b,2010Q1}$) and the growth rate of credit between quarter t and the last quarter before the sovereign shock: $g(\text{Loans}_{bj,t}) = \frac{\text{Loans}_{bj,t} - \text{Loans}_{bj,2010Q1}}{0.5 \cdot [\text{Loans}_{bj,t} + \text{Loans}_{bj,2010Q1}]}$. Quarter t is reported on the x-axis. All regressions are run on the sample of firms who established multiple lending relationships, and include bank-level and relationship-level controls measured in 2010:Q1 and firm fixed-effects. 95% confidence intervals are displayed. Standard errors are clustered at bank level.

kets nor the media were pricing the scenario of an imminent sovereign debt crisis in Italy and other peripheral European countries. Moreover, the origin of the tensions on Italian sovereigns can be traced back to large government deficits and high public debt rather than a structural weakness of the country's banking system (Acharya et al. 2011; Angelini et al. 2014; Lane 2012). Lastly, there is no evidence across Europe of large adjustments in banks' sovereign holding before the Greek bailout (see Acharya and Steffen, 2015 and the pattern in Figure OA.3 in the online Appendix of the paper), leaving us confident about the validity of this first identification assumption.

The second identifying assumption of our design is the parallel-trend assumption. In other words, it must be true that, in the absence of the sovereign crisis, financial institutions with higher sovereign holdings (the treated group) would have displayed a credit supply trend comparable to banks with lower holdings (the control group). While the parallel trend assumption is fundamentally untestable due to the lack of an observable counterfactual, the next section presents extensive indirect evidence that supports it.

3.2. The bank lending channel

We start by presenting our main results in Table 3. In the first column, we investigate the relationship between sovereign exposure and credit supply in a simple OLS model. In other words, we estimate the regression model in (1) without including the firm fixed effect ρ_i, but adding firm level controls (measured in the pre-bailout period) as well as detailed industry and province fixed-effects.[27] We find that the exposure to the sovereign market before the Greek bailout significantly predicts lower credit to firms. As previously explained, this result could potentially be driven by a contemporaneous, unobservable decline in firms' credit demand, which may not be captured by the firm-level controls. To address this concern, we augment our model with firm fixed effects (Column 2). This specification only exploits within-firm variation, comparing changes in credit provided to the same firm by different intermediaries. Also in this case, we find a negative relationship between sovereigns and credit, with a similar magnitude compared to Column 1.

Next, we shows that this result is not affected by heterogeneity across intermediaries in the nature of the credit relationship established between banks and firms. Because information about firms' fundamentals is durable

[27]The inclusion of these firm controls do not significantly affect our result.

	(1)	(2)	(3)	(4)
	g(Loans)			
Sovereigns	-0.260***	-0.259***	-0.345***	-0.364***
	(0.098)	(0.098)	(0.129)	(0.133)
ROA	6.559	8.913	7.324	6.390
	(9.560)	(10.679)	(11.534)	(10.446)
Size	0.005	0.004	0.006	0.009
	(0.007)	(0.007)	(0.008)	(0.008)
Tier1	0.759***	0.748***	0.905***	0.920***
	(0.259)	(0.258)	(0.282)	(0.280)
Deposits	0.180***	0.171***	0.168**	0.173**
	(0.061)	(0.065)	(0.074)	(0.072)
Liquidity	5.319	5.382	5.574	5.247
	(3.918)	(4.667)	(5.314)	(4.583)
Interbank Debt	0.195*	0.197*	0.126	0.087
	(0.104)	(0.112)	(0.174)	(0.180)
NPL	-0.738***	-0.706***	-0.339	-0.262
	(0.207)	(0.207)	(0.349)	(0.364)
BCC	0.043	0.043	0.068*	0.084**
	(0.029)	(0.030)	(0.036)	(0.034)
Relationship Controls	N	N	Y	Y
Firm Controls	Y	N	N	Y
Firm FE	N	Y	Y	N
Industry FE	Y	N	N	Y
Province FE	Y	N	N	Y
Observations	478235	478235	478235	506482
R-squared	0.023	0.372	0.387	0.058

Table 3: *The Bank Lending Channel*. This table examines the transmission of the sovereign shock to credit supply via the bank lending channel. The outcome variable is the normalized growth rate in loans (g(Loans)) granted by bank b to firm j between (2010:Q2-2011:Q1) and (2009:Q2-2010:Q1). The main independent variable is the stock of Italian sovereigns held by the lender at the end of 2010:Q1 scaled by RWA (Sovereigns). All regressions include a set of bank-specific controls measured at the end of2010:Q1. Columns 1 and 4 include a constant and a set of firm-specific controls, industry fixed effects, and province fixed effects. Columns 2 and 3 are within-firm estimates and include firm fixed effects. The models in Columns 1-3 are estimated on the sample of firms with multiple lending relationships. The model in Column 4 includes single- and multiple-relationship firms. Column (3) and (4) include relationship-specific controls measured at the end 2010:Q1. Standard Errors are clustered at bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

and not easily transferable, firms with strong lending relationships are expected to be rationed less than others (Hoshi et al. 1990, 1991; Petersen and Rajan 1994; Lenzu and Manaresi 2019). Thus, our previous results may be biased upwards if banks with higher sovereign holdings systematically establish "weak" credit relationships with their borrowers. Augmenting our regressions with a set of relationship-specific variables that capture the pre-shock length and strength of the lending relationship between bank b and firm j strengthens the estimated lending-channel effect (Column 3).[28]

These findings suggest that exposure to distressed sovereigns had a sizable impact on the credit supply. On average, if we compare lending to the same firm by two banks that are one standard deviation apart in terms of exposure to distressed sovereigns, we find that the more exposed lender cut credit by about 10% more than the less exposed lender. This increase corresponds to more than 20% of the (within-firm) standard deviation in credit over this period. Importantly, since we are exploiting only within-firm variation, this effect is only capturing variation in the supply of credit holding constant the firm's credit demand.[29]

Before moving on with our analysis, we want to highlight two additional important results. First, the lending channel triggered by banks' exposure to sovereigns is not confined to firms that engage in multiple lending relationships. To make this point, we estimate the model without firm fixed effects on the full sample, including both firms with one and multiple lenders in the pre-shock period (Table 3, Column 4). Because we cannot include firm fixed effects in this sample of firms, we control for a set of firm-level characteristics and include a battery of industry and province fixed effects. The relationship is still highly significant and comparable in terms of magnitude to the main estimates.[30] Second, adding or removing firm fixed effects does not signif-

[28]Table OA.8, in the online Appendix, shows that the response to the shock does not present any significant heterogeneity across these measures of strength of the firm-bank relationship. In the online Appendix OA.2.5, we explain how this evidence could be potentially used to exclude the importance of bank-specific demand shock in explaining our results.

[29]To improve readability, we do not report the estimated coefficients of the control variables. The sign and magnitude of these coefficient are similar to the ones reported in Table 3 and are consistent across specifications.

[30]When we compare the coefficient of Column 2 to the coefficient in Column 4, we find a larger point estimate of the lending channel effect when single-relationship firms are includes in the regression. In interpreting these results, it is important to consider

icantly affect the magnitude of the lending channel coefficient. This result does not imply that credit demand was unimportant to explain the variation of credit during this period. Instead, it suggests that the level of correlation between changes in credit demand and the supply shock at the firm level is not sizable in our setting. We discuss the implication of this result for the identification of the real effects of the sovereign shock (Section 4).

Robustness tests

As discussed in the previous section, a causal interpretation of our analysis relies on the validity of the parallel-trend assumption. We now provide evidence in favor of this hypothesis by showing that (i) banks' differential exposure to sovereigns did not predict differential lending patterns before the Greek bailout; (ii) right after the shock, banks more exposed to sovereigns started decreasing their supply of credit.

We start by showing that these patterns hold at the aggregate level. First, we sort banks into a "*High Sovereign*" group and a "*Low Sovereign*" group based on whether their pre-shock (conditional) holdings of Italian sovereigns place them above or below the median. Second, for consistency with the rest of the analysis, we extrapolate the quarterly variation in credit of bank b to firm j that cannot be explained by bank characteristics. Then, we aggregate the residuals of corporate loans granted by "High Sovereign" and those granted by "Low Sovereign" banks, and plot them over time (Figure 3).[31] Overall, we find that aggregate credit provided by the institutions with high and low holdings displays a very similar dynamic before the sovereign shock. However, after April 2010, the two groups start to diverge. More exposed intermediaries cut lending more extensively, while the credit supply of less exposed banks does not react. These patterns present first evidence in favor of the parallel-trend assumption.

To address the concern that more exposed banks might have experienced a more severe reduction in credit demand, we turn to the micro-data. Using

that single- and multi-relationship firms are not immediately comparable. In particular, single-relationship firms in our sample tend to be smaller and younger on average. For completeness, Table OA.3 in the online Appendix replicates all the different specifications with the full set of firms.

[31]The two time series are normalized such that aggregate lending is zero in 2010:Q1 for each group. Online Appendix OA.2.1 provides a detailed description of the procedure followed to construct this semi-parametric test.

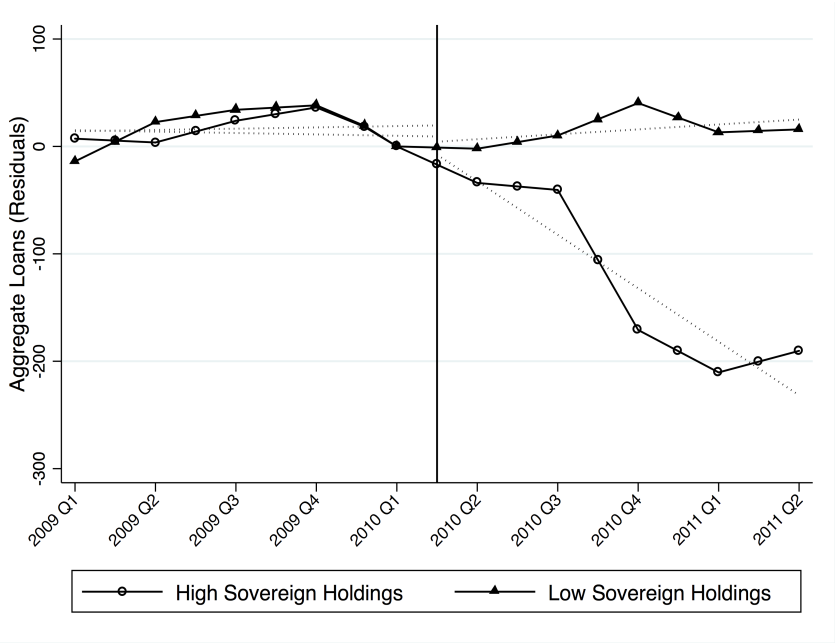


Figure 3: *The bank lending channel*. This figure illustrates the bank lending channel semi-parametrically by comparing lending to firms from banks with high holdings of Italian sovereign bonds, the most exposed to the sovereign shock, and banks with lower holdings. See online Appendix OA.2.1. for a detailed description of the procedure used to construct this figure.

the econometric model in (1) we perform the following parametric test of the parallel trend assumption:

$$g(\text{Loans}_{bj,\tau}) = \beta_{0\tau} + \beta_{1\tau}\text{Sovereigns}_{b,2010Q1} + \Gamma_\tau \cdot X_{b,2010Q1} + \rho_{j\tau} + \epsilon_{bj\tau}$$

where the left-hand-side variable now measures the growth rate of credit from bank b to firm j between quarter τ and quarter 2010:Q1. Figure 2 plots the coefficient β_1 over time. Coefficients are reported as z-scores to facilitate comparison across periods. The results are in line with the intuition provided by the aggregate test of Figure 3. Before the Greek bailout, we find no significant difference in credit supply between banks who were differently exposed to sovereigns at the onset of the crisis. Conversely, the graph displays a significant (and long-lasting) effect of the balance sheet shock immediately after the Greek bailout. All in all, this evidence suggests that banks with lower sovereign holdings represent a valid control group for more exposed intermediaries, providing strong support for the identifying assumptions behind our empirical strategy.

We conduct several tests to evaluate the robustness of our results.[32] First, we show that our results are similar when looking at alternative outcomes (Table 4, panel a). Focusing on the intensive margin ($\Delta ln(\text{Loan}_{bj})$), we find effects that are similar in magnitude to our main results. Repeating the same comparison across two banks one standard deviation apart in terms of exposure to distressed sovereigns, the more exposed lender cut credit by about 10% more than the less exposed lender. Along the extensive margin, we also find that more exposed banks were more likely to cut credit. In particular, one standard deviation in exposure led to an increase by 8% in the probability of a decrease in the loan balance. Furthermore, we show in Table 4, panel a that our main results are unchanged when looking at alternative definitions of bank credit. While our main results are estimated using term loans, the same analysis using only credit lines or total credit, i.e., credit lines plus term loans, is very similar in both statistical and economic magnitude.[33]

[32] Most of the results in this section are presented in the online Appendix OA.2.1, where we also provide more detail about the analysis.

[33] The data from the Italian Credit Register are in line with the patterns documented in Sufi (2009), as more than 90% (85% in the US) of the firms in our sample have at least one line of credit available.

	(1)	(2)	(3)	(4)
Panel a: Alternative Outcomes				
	g(Cred Lines)	g(Tot Credit)	1(Cut Credit)	Δ ln(Loans)
Sovereigns	-0.357***	-0.324**	0.276***	-0.339***
	(0.128)	(0.128)	(0.092)	(0.121)
Bank Controls	Y	Y	Y	Y
Relationship Controls	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
Observations	478235	478235	478235	389007
R-squared	0.443	0.412	0.388	0.515
Panel b: Alternative Definitions of Sovereign Explosure				
	g(Loans)			
Sovereigns/Assets	-0.399**	-0.450***	-0.516**	-0.520**
	(0.164)	(0.171)	(0.245)	(0.243)
Bank Controls	Y	Y	Y	Y
Relationship Controls	N	N	Y	Y
Firm Controls	Y	N	N	Y
Firm FE	N	Y	Y	N
Industry FE	Y	N	N	Y
Province FE	Y	N	N	Y
Observations	478235	478235	478235	506482
R-squared	0.019	0.372	0.387	0.057

Table 4: *Alternative Outcomes and Alternative Definition of Sovereign Exposure.* In this table we explore several robustness tests. In Panel a, we consider four alternative measures of bank credit as outcome. In Column 1, we construct our growth rate as usual but using only credit lines, while in Column 2 we use the total amount of bank credit, including credit lines and term loans; in Column 3, the dependent variable is a dummy variable equal one when a relationship in place in the pre-shock period is terminated in the post shock period; in Column 4, we consider as outcome the log-change in term loans. The main independent variable is the exposure of the lender to Italian sovereigns (Sovereigns. All regressions include firm fixed-effects, the bank controls, and the relationship controls, and they are estimated on the sample of firms with multiple credit relationships. In Panel b and c, we replicate the main results (i.e. Table 3) using two alternative measures of the sovereign shock incurred by each lender: the stock of Italian sovereigns held by the lender at the end of 2010:Q1 scaled by total assets (Panel b) and by Tier1 (Panel c). The sample and fixed-effects mirror Table 3. Standard Errors are clustered at bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

	(1)	(2)	(3)	(4)
Panel c: Alternative Definitions of Sovereign Explosure				
	g(Loans)			
Sovereigns/Tier1	-0.023***	-0.030***	-0.042***	-0.035***
	(0.008)	(0.010)	(0.013)	(0.013)
Bank Controls	Y	Y	Y	Y
Relationship Controls	N	N	Y	Y
Firm Controls	Y	N	N	Y
Firm FE	N	Y	Y	N
Industry FE	Y	N	N	Y
Province FE	Y	N	N	Y
Observations	478235	478235	478235	506482
R-squared	0.003	0.372	0.387	0.044

Table 4 (cotinued).

Second, we show that the estimates presented above are not driven by our measure of banks' sovereign exposure. Table 4, panels b and c show that the effects of the balance-sheet shock on credit supply is still significant and similar in economic magnitude if we scale banks' exposure to Italian sovereigns by alternative size proxies – Total Assets and Tier1 capital. Similarly, our results are unchanged if we measure sovereign exposure using the overall sovereign portfolio or using government debt issued by Greece, Ireland, Italy, Portugal, Spain (GIIPS), all of them experiencing tensions during the post-bailout period (Table 5). At the same time, we also find that holdings of non-GIIPS countries had no effect on lending (Column 5). These results are reassuring because they suggest that banks' holdings of distressed sovereigns cause the credit contraction, rather than sovereign holdings per-se. Our main result is also stable when we examine the effect of the exposure to Italian sovereigns while controlling simultaneously for exposure to other distressed countries – Greece, Ireland, Portugal and Spain – and non-GIIPS holding separately (Column 6).[34]

[34]In this specification, we find that exposure to other sovereign assets experiencing distress over this period also negatively affects the credit supply. This effect is only marginally significant, probably because the majority of Italian banks hold a negligible amount of non-

	(1)	(2)	(3)	(4)	(5)	(6)
	g(Loans)					
Sovereigns	-0.345***					-0.302**
	(0.129)					(0.123)
Sovereigns GIPS		-0.580**				-0.480*
		(0.282)				(0.272)
Sovereigns GIIPS			-0.344***			
			(0.130)			
Tot Sovereigns				-0.344***		
				(0.129)		
Sovereigns Non-GIIPS					-0.893	0.022
					(0.922)	(0.818)
Bank Controls	Y	Y	Y	Y	Y	Y
Relationship Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Observations	478235	478235	478235	478235	478235	478235
R-squared	0.387	0.387	0.387	0.387	0.386	0.387

Table 5: *Different Sovereign Holdings*. This table examines the bank lending channel using alternative measures of sovereign exposure. The outcome variable is the normalized growth rate in loans (g(Loans)). The main independent variables are different measures of bank's exposure to the sovereign crisis. In Column 1, we use the stock of Italian sovereigns over RWA; In Column 2, the stock of total GIPS sovereigns (Greece, Ireland, Portugal, and Spain) over RWA; in Column 3, the stock of GIIPS sovereigns (GIPS plus Italy) over RWA; in Column 4, we use total the stock of sovereign securities over RWA; in Column 5 we use the sovereign issed by non GIIPS countries. Lastly, Column 6 includes the Italian sovereigns, GIPS sovereigns, and the non-GIIPS sovereigns. All proxies of exposure are measured at the end of 2010:Q1. All regressions include firm fixed-effects, the bank controls, and the relationship controls, and they are estimated on the sample of firms with multiple credit relationships. Standard Errors are clustered at bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

Lastly, we run a battery of placebo tests to rule out the possibility that the results presented in this paper reflect a "structural" negative correlation between holding of sovereigns in period $t-1$ and future credit supply. In fact, one might argue that a reduction in credit supply typically follows an increase in sovereign holdings, independent of the conditions of sovereign markets. Using our preferred specification (model 1), Figure 4 plots the coefficient capturing the correlation of sovereign-bond holdings in quarter $t-1$ ($\text{Sovereigns}_{b,t-1}$) and the average growth rate of credit $g(\text{Loans}_{ib,t})$ in the four quarter before and after t. All regressions include bank-level and relationship-level controls measured at time $t-1$ and firm fixed effects, as in the main specification. Before the burst of the sovereign crisis, a period characterized by no tensions in sovereign markets, we find a weak and statistically insignificant correlation between sovereign holdings in $t-1$ and changes in credit supply before the Greek default. A joint significance test fails to reject the null hypothesis that the battery of yearly coefficients associated with $\text{Sovereigns}_{b,t-1}$ are zero. Furthermore, the main coefficient is actually positive on average.[35] Instead, it is only after the events in Greece that banks' holdings of sovereign securities predict a subsequent credit tightening. This result confirms that our estimates truly reflect the effects of a change in sovereign market conditions on bank lending, and does not capture some structural relationship between sovereigns and lending.

Alternative explanations

So far, our analysis has provided robust evidence of the connection between the direct holdings of distressed sovereign securities and the contraction of credit at the onset of the sovereign crisis. As we discuss in the next section, our argument is that this contraction is explained by the impact that the exposure to distressed sovereign bonds had on banks' capital and funding activity. Before doing so, we discuss and rule out alternative explanations that may rationalize why sovereign holdings caused a credit tightening after

Italian sovereign assets. In 2010:Q1, Italian debt represented about 99% (100%) of the sovereign assets for the average (median) Italian bank. The small variation in the variables measuring non-Italian sovereign holdings suggest that these robustness tests should be interpreted with caution.

[35]Therefore, if anything, these results suggest that, in normal times, financial institutions use government bonds as a storage of liquidity in expectation of future investment opportunities (Gennaioli et al. 2014b).

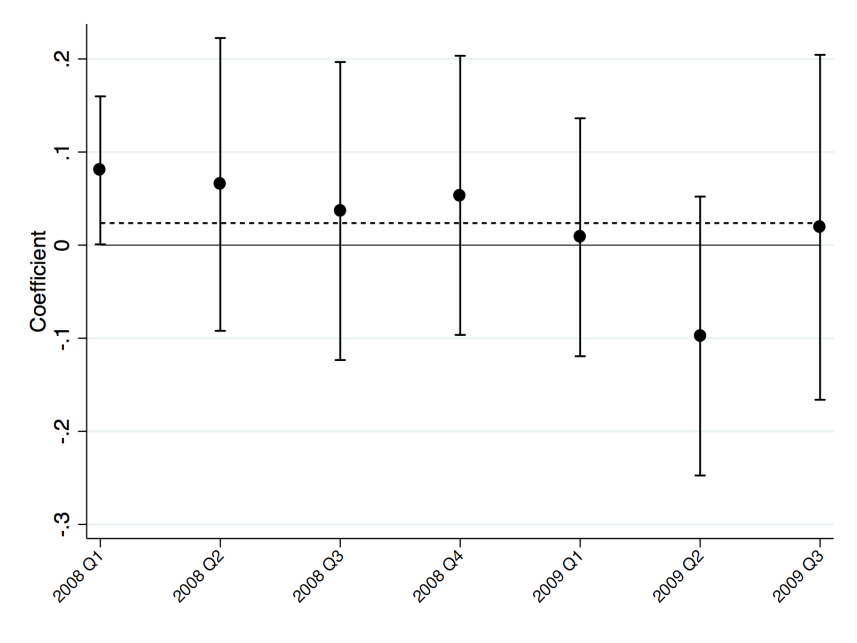


Figure 4: *Sovereign holdings and credit supply dynamics.* This figure investigates the relationship between the stock of sovereigns in banks' portfolio and credit supply dynamics. It plots the coefficient capturing the correlation of sovereign bonds holdings in quarter $t-1$ ($\text{Sovereigns}_{b,t-1}$) and the the moving average growth rate of credit: $g(\text{Loans}_{bj,t}) = \frac{\bar{\text{Loans}}_{bj,t\to t+3} - \bar{Loans}_{bj,t-4\to t-1}}{0.5\cdot\left[\bar{\text{Loans}}_{bj,t\to t+3} + \bar{Loans}_{bj,t-4\to t-1}\right]}$, where $\bar{\text{Loans}}_{bj,t\to t+3} = 0.25 \cdot \sum_{\tau=0}^{3} \text{Loans}_{ib,t+\tau}$ and $\bar{\text{Loans}}_{bj,t-4\to t-1} = 0.25 \cdot \sum_{\tau=-1}^{-4} \text{Loans}_{ib,t+\tau}$. Quarter t is reported on the x-axis. All regressions are run on the sample of firms who established multiple lending relationships, and include bank-level controls and relationship-level measure in quarter t, and firm fixed effects. 95% confidence intervals are displayed. Standard errors are clustered at bank level.

the burst of the crisis. We summarize these tests here and we refer to Section OA.2.4 and Table OA.5 of the online Appendix for a detailed discussion.

Previous literature has highlighted the importance of portfolio rebalancing to understand lending behavior by banks, in particular during periods characterized by tensions in financial markets (Abbassi et al., 2014; Peydró et al., 2017). In our context, one might worry that the pre-crisis amount of sovereigns in banks' portfolio is in fact a proxy of their ability and incentives to trade sovereign assets, which in turn affects credit supply. If this were the case, then the negative effect that we attribute to sovereigns' contraction may be driven by the changes in trading strategies by banks.[36] We find that our point estimates do not significantly change when we control for the scaled amount of sovereigns purchased by banks in the immediate aftermath of the bailout (2010Q2) or controlling for proxies of trading expertise. On a second and related point, our results are also not driven by differences in the governance structure across banks more and less exposed to sovereign securities, in particular considering differences between traditional and cooperative banks and foreign versus domestic banks.[37]

Third, our results are also not explained by the contraction in bond markets, which characterized the European economy during this time. This shock may have been particularly important for banks, since financial intermediaries were among the main issuers of corporate bonds in Italy.[38] To the extent that the ability to raise funding in the bond markets and the decision to invest in sovereign assets are correlated, this change in funding markets may explain our main result. To verify this relationship, we augment our regression model with a measure of bank's dependence on bond financing in the pre-shock period. We find that adding this extra control does not significantly affect neither the significance nor the magnitude of our main coefficient. We return to the importance of bond financing in the following

[36] A first suggestive evidence against the portfolio adjustment channel comes from the time-series dynamics of the Italian banking system's sovereign holdings. Figure OA.3 in the online Appendix of the paper shows in the early part of the sovereign crisis, the aggregate sovereign holdings of the Italian banking system remained stable.

[37] This result contrasts with the findings of Bofondi et al., 2017, which highlights the importance of country-specific risk in the second phase of the sovereign crisis. More discussion on this point is presented in online Appendix OA.2.3.

[38] Between 2000-2016, almost 75 percent of corporate bond issuances by Italian firms were done by Depository Institutions (Source: Thomson Reuters SDC Platinum). We thank one of the anonymous referees for this information.

section when we analyze the channels of transmission of the sovereign shock.

Finally, a strand of the literature has explored the role played by government pressure in sovereign markets. Previous evidence suggests that banks more connected with the government are systematically more likely to hold or purchase sovereign assets during periods of fiscal stress (Becker and Ivashina, 2014b; Ongena et al., 2018). One concern for our analysis is that the sovereign exposure may in part capture this moral suasion mechanism. We provide three pieces of evidence against this potential confounding factor. First, our results are not explained by differences between national and foreign banks or by the heterogeneity in trading activity across banks, as moral suasion would predict. Second, we find that variation in the extent to which a bank can potentially be influenced by politicians does not explain our results. Our test exploits variation in the ownership share of the Italian banking foundations to identify those banks that are more likely influenced by political parties (De Marco and Macchiavelli, 2016).[39] We find that the inclusion of these proxies of direct government connection does not significantly change either the magnitude or significance of the security channel. Third, we find consistent results when we use institutions that act as primary dealers in the Italian sovereign market as an alternative way to identify moral suasion (Williams 2018).[40] Also in this case, we find that controlling for this variable does not affect our key result. In the last column, we also show that our results are consistent when we include all the control for alternative explanations together.

[39]Banking foundations are private entities created in the early 1990s during the privatization process of the Italian financial sector (Jassaud, 2014). Despite their private nature, these entities are generally controlled by the local government and they still retain an important ownership stake in the banking sector. In 2009-2010, foundations retained significant control power in the board of a number of financial institutions in Italy. For each banking foundation, we manually collected it from annual report information on its shareholders' compsition and data on its stake on financial instutions as of December 2019. Section Appendix A.3 in the Appendix contains an extensive discussion on the data collection as well as backround information on banking foundations in Italy.

[40]Williams (2018) finds that market makers are more likely to be targets of financial repression. We identify primary dealers using the official list of primary dealers as of February 2010 that is available in the Italian Government website (http://www.dt.tesoro.it/en/debito_pubblico/specialisti_titoli_stato/).

3.3. The transmission mechanism of the sovereign shock

In this section, we investigate why banks more exposed to sovereign securities tighten their credit supply more than other, less exposed institutions. In a standard bank-lending channel model (e.g. Kashyap and Stein, 1994; Stein, 1998), a shock to a bank's assets could affect lending policies in several ways.[41]

One hypothesis is that a bank with large sovereigns exposure may be affected by the Greek bailout shock because it does not have a sufficient buffer of capital that could be used to absorb the potential losses from its sovereign portfolio (*capital channel*). A weaker balance sheet might induce bank managers – who are concerned with the future funding costs or long-term insolvency of the institution – to reduce the amount of assets at risk by shrinking the loan portfolio (Peek and Rosengren 1997; Peek and Rosengren 2000). In principle, one may think that the capital channel should not be particularly large for sovereign assets, as these securities were not always required to be marked-to-market. However, there are two important factors to consider when evaluating this argument. First, even if accounting capital is unchanged, a decline in the economic value of the assets should still trigger a reaction from the bank, since the economic capital is what matters for medium- and long-run portfolio choices of financial intermediaries (Angelini et al. 2014).[42] Second, only sovereign assets classified in the held-to-maturity (HTM) portfolio were exempted from being marked-to-market, while sovereigns in the trading portfolio and available-for-sale (AFS) were valued based on market conditions (IAS 39).[43] Consistent with this logic, we have shown that our effects are in large part driven by sovereign securi-

[41]The mechanisms discussed here are not unique of the bank-lending channel models only. For instance, you could derive similar type of results on the heterogeneity of the effects in models where a shock to assets affect lending because of a net worth channel (e.g. Bernanke and Gertler, 1989; Moore and Kiyotaki, 1997; Bernanke et al., 1999). A recent example of this type of model applied to sovereigns is Arellano et al. (2019).

[42]Referring precisely to the Euro crisis, Angelini et al. (2014) highlights that "whether securities are booked at market value or amortized cost makes little difference when bank's creditors become concerned about a possible default of the bank. In that case, creditors will look through accounting conventions, assessing the solidity of the bank based on its assets at market value (...)."

[43]However, note that Bank of Italy - with a temporary provision - decided that since June 2010 banks had the option to to neutralize gains and losses on ASF securities by accounting them at (historical) cost.

ties that are not held in the HTM portfolio. Considering these caveats, the economic importance of the capital channel remains an empirical question.

Alternatively, direct exposure to distressed sovereigns may affect a bank's ability to raise funds, with a consequent impact on its lending policy (*funding channel*). A drop in the market value of banks' security portfolio reduces the amount and quality of collateral available for borrowing in the inter-bank network (the collateral channel, Ivashina and Scharfstein 2010; Cingano et al. 2016). However, it might also more broadly affect the ability to tap into bond markets as investors might become concerned with the solvency of the institution (Balduzzi et al. 2018).

To test the relative importance of these explanations, we examine how the response to the shock was exacerbated by a weaker capital position or by banks' funding stability. To proxy for the weakness of the balance sheet, we use a measure based on banks' Tier1 ratio. In particular, we define a dummy variable (Low Capital Ratio) which takes a value of one when the Tier1 ratio is below 10%, very close to the regulatory boundary at the time (8%). This variable accounts for the fact that the importance of bank capital is nonlinear and it is expected to be stronger for those institutions closer to the regulatory threshold. To evaluate the relevance of the funding channel, we exploit banks' heterogeneous liability structure, studying whether banks that are active borrowers in inter-bank markets or that have access to less stable funding (less deposits or more bond financing) respond more strongly to the sovereign shock.[44]

Examining one interaction at a time, we find evidence in support of both channels (Table 6).[45] The effect of the shock is magnified by the lack of capital at bank level: a financial intermediary that is close to the regulatory boundary tightens credit supply almost three times more than that experienced by more capitalized banks (Column 1).[46] However, the funding

[44] *A priori*, it is unclear whether having a large share of funding coming from bonds would positively or negatively affect banks response to the sovereign shock. On the one hand, Italian banks tend to issue bonds of relatively long maturity (see Coletta et al., 2016), which can help to limit funding risk during the shock period. On the other hand, the dry-up of bond markets that happened around the same time as the sovereign crisis might have exacerbated the response to the shock because of an increase in roll over risk.

[45] Table 6 reports only the interaction terms for expositional purposes, but each regression also includes the non-interacted variable.

[46] In an unreported regression, we find a qualitatively similar result from the interaction sovereign exposures with a continuous measure of capital ratio. However, we prefer to

structure seems to matter as well for determining the size of the effects. In particular, we find a much larger credit contraction by banks that were more active as borrowers in the interbank market (Column 2). Comparing two banks with similar exposure to distressed sovereigns but one standard deviation apart in terms of reliance on interbank borrowing, we find that the more active bank in the wholesale market cuts credit by one-third more than the less active bank. Reliance on more stable sources of funding also mitigates the negative effects of the sovereign shock. This is true for both reliance on retail deposits (Column 3) and on bond funding (Column 4). The positive effect on bond funding is consistent with the relatively long-term maturity of bonds issued by Italian banks (Coletta et al., 2016). Finally, Column 5 reports the estimated interaction effects of an horse-race regression among the different proxies. The horse-race confirms that both channels seem to be at work. In particular, we find that the coefficients associated with the capital measure and interbank market exposure are similar in both significance and magnitude whereas deposits and bond funding lose statistical significance.

Altogether, there are two main takeaways from this analysis. First, both the collateral channel and the funding channel appear to be economically relevant forces. The increase in sovereign risk affected credit both because it raised concerns about the future funding conditions of poorly capitalized banks and because it reduced the availability of the collateral needed to tap into interbank funding.[47] Second, our analysis shows that, among the possible drivers of the funding channel, the main source of instability during this turbulent period was the reliance on wholesale funding rather than retail deposits or bond financing. As in the case of the recent financial crisis (Ivashina and Scharfstein 2010; Cingano et al. 2016), financial intermediaries' exposure to interbank markets appears to be a catalyst for the transmission of macro-financial shocks to the real economy.

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focus on the categorical version of this measure because regulatory constraints introduce a salient non-linearity in the relationship between capitalization and banks' response to balance sheet shocks.

[47] This result is consistent with previous evidence (Abbassi et al., 2014; De Marco 2017), which highlights the importance of wholesale markets–and funding more generally–in explaining the effects of the sovereign crisis (Crosignani et al., 2016).

	(1)	(2)	(3)	(4)	(5)
			g(Loans)		
Sovereigns	-0.169*	-0.416***	-0.593***	-0.473***	-0.053
	(0.098)	(0.122)	(0.169)	(0.149)	(0.178)
Interaction with:					
Low Capital Ratio	-0.439***				-0.290**
	(0.160)				(0.138)
Net Interbank Debt		-0.990***			-1.338**
		(0.274)			(0.551)
Deposits			0.202***		-0.164
			(0.065)		(0.124)
Bond financing				0.251***	-0.101
				(0.082)	(0.136)
Firm Fixed Effect	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y
Relationship Controls	Y	Y	Y	Y	Y
Observations	478235	478235	478235	478235	478235
R-squared	0.387	0.388	0.387	0.387	0.388

Table 6: *Transmission Mechanism of the Bank Lending Channel.* This table investigates the channels of transmission of the sovereign shock through banks' balance sheet. We interact exposure to the sovereign shock with a set of bank characteristics which are proxies for different balance sheet channels of transmission, always including also the direct effect. The independent variables of interest are the exposure of the lender to Italian sovereigns (Sovereigns), and its interactions with different proxies of the transmission channels. The interaction variables include: low capital (dummy equal 1 if Tier1 ratio is less than 10 percent); net interbank debt; deposit; bond liabilities (all scaled by RWA). All regressions include firm fixed-effects, the bank controls, and the relationship controls, and they are estimated on the sample of firms with multiple credit relationships. Standard Errors are clustered at bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

4. Credit supply and corporate behavior

The previous results confirm the presence of a sizable contraction in credit triggered by the turmoil in sovereign markets. In fact, we find that the shock to sovereign assets impaired the ability of banks to provide credit to firms. The next step is to evaluate whether this event had actual consequences on firms' behavior. Economic theory suggests that a tightening of credit supply can impair companies' ability to invest if they cannot compensate for the lower credit from exposed lenders with funding from other sources, either inside or outside of the banking sector. Our analysis confirms that financial frictions prevented firms from fully smoothing out the reduction in credit from intermediaries more exposed to the sovereign shock. Furthermore, we show that the credit contraction led to a reduction in firms' investment rates and employment, but only among small firms.[48]

In order to study how the the turmoil in sovereign markets affected firm activity, we examine whether a firm's exposure to the sovereign shock has any predictive power on changes in funding, investment, and employment decisions of the companies in our sample. We start by constructing a measure of firm-level exposure to the sovereign shock by computing the average exposure that firm j experiences through the connection with its lenders. Formally, let $\mathcal{B}_j$ be the set of all lenders to firm j in 2010:Q1. Then, we construct firm j's average exposure as:

$$\text{Sovereigns}_j^{AVE} = \sum_{b \in \mathcal{B}_j} \omega_{bj} \cdot \text{Sovereigns}_b$$

where Sovereigns_b is the stock of Italian sovereigns over RWA held by lender b in 2010:Q1.[49] Lenders' exposures are *weighted* by the share of total bank credit the firm received from the bank before the Greek bailout (ω_{bj}). Using this measure, we study how different firm-level outcomes (y_j) are affected by the firm-specific exposure to the sovereign shock:

[48] Even if the firms had been able to completely undo the bank-lending channel by borrowing from banks less exposed to the shock or resorting to other forms of financing, the sovereign crisis still could have propagated to the real economy through other channels. See, for example, Bocola (2016) or Neri and Ropele (2013).

[49] In our data set, on average, the exposure of firms to the sovereign crisis is 22 percent (mean of Sovereigns^{AVE}), with a standard deviation of 23 percent (standard deviation of Sovereigns^{AVE}).

$$y_j = \alpha_0 + \alpha_1 \text{Sovereigns}_j^{AVE} + \Gamma \cdot X_j^{AVE} + \Lambda \cdot Z_j^{AVE} + \tau_{province} + \tau_{industry} + u_j \quad (2)$$

Mirroring the relationship-level analysis, we control for the (weighted average) of bank-specific and relationship-specific variables (X^{AVE}) described in Section 3.[50] Furthermore, the vector Z^{AVE} includes a battery of firm-level controls: log revenues, log age, leverage, and credit score (Altman Z-score); $\tau_{province}$ and $\tau_{industry}$ are a set of province fixed effects and industry fixed effects (NACE 2-digits).[51] In line with previous literature (e.g., Khwaja and Mian, 2008), we cluster the standard errors at the level of the lead bank, which is the largest lender during the pre-bailout period.

The intuition behind this test is as follows. If the sovereign shock had no effect on firms' operations, then the lenders' exposure to sovereign securities should not predict any change in outcomes ($\hat{\alpha}_1 = 0$). If instead relationships are sticky and difficult to build, the exposure of firms' lenders before the shock would still predict changes in y_j. For example, looking at change in total bank loans, an estimate $\hat{\alpha}_1$ significantly lower than zero would suggest that firms were unable to take actions to effectively neutralize the credit tightening by their current lenders. Similar to the within-firm model presented above, the identification of α_1 requires orthogonality between the banks' exposure to sovereign securities and firms' credit demand or investment opportunities. For instance, geographic or industry clustering might induce a sorting between banks more exposed to the sovereign shock and firms with worse investment opportunities. Unlike the first part of the paper, here we cannot directly control for unobservable demand-side shocks since we can only rely on between-firm variation.

We argue that the econometric model in (2) can still provide reliable

[50] The weighted averages of bank-specific and relationship-specific variables are constructed similar to Sovereigns^{AVE}. The only exception is the dummy for cooperative banks, which is equal to one if the major bank is a cooperative bank. For consistency, we define relationship-level controls –which similarly vary at bank level within a specific firms – as part of the set of bank controls.

[51] The sample used is identical to the one used in the previous part of the paper, which is the sample of firms with loans reported in the Credit Register and for which firm-level information is available in CERVED. The usual filters are applied as described in Section (2). Furthermore, given the nature of the estimator, we require our firms to appear in the data both before and after the shock.

estimates of the causal effect of the sovereign shock on firm outcomes for three main reasons. First, our previous analysis has provided no evidence of a systematic sorting between highly exposed banks and firms whose credit demand is shrinking. In particular, we have shown that the loan-level estimates with and without the firm fixed effects are not statistically different, and therefore the bias induced by demand is either nonexistent or relatively small (see Columns 1 and 2 in Table 3).[52] Second, the industry and province fixed effects help directly address the correlated demand bias. Industry fixed effects control for the specialization of exposed lenders in industries suffering more severe contractions of economic activity. Province fixed effects control for the spatial clustering of banks and borrowers. If the sorting between banks and firms is caused by industry or geographical specialization in the banking sector, this set of fixed effects would be sufficient to address any concern related to the identification of α_1. Third, we augment our model with a set of firm-level controls measured before the shock: firm size, credit rating, age, and leverage. These controls absorb variation in the LHS not directly imputable to firms' exposure to the shock and, to the extent that they correlate with firms' unobservable changes in investment opportunities and credit demand, they help address the sorting bias discussed previously.[53] We provide further evidence against the presence of a bias in our results in the robustness section below.

Supply shock and access to credit

The shock to sovereign holdings triggered a decline in credit supply via the bank lending channel. However, firms may have been able to limit the economic impact of the shock by borrowing from alternative, less exposed financial intermediaries. To investigate this issue, we estimate the regression model in (2) looking at the change in total bank loans. Our outcome variable is $g(\text{Loan}_j)$, which is the symmetric growth rate of bank credit one year before to one year after the Greek bailout. In Table 7, we show that firms have been unable to fully undo the decline in credit from exposed borrowers, as the average exposure of their lenders at the onset of the sovereign shock is predictive of the change in total bank credit. This effect is both statistically

[52] This result also holds when we do not control for firm-level variables as well, as industry and location fixed-effects in the specification without firm fixed-effects.

[53] The estimates of a model without firm controls are qualitatively identical. Results are available upon request.

and economically significant. On average, one standard deviation increase in banks' holdings of Italian sovereign securities corresponds to a reduction of 5% in bank credit in the year following the burst of the sovereign crisis.

A number of frictions can explain why firms cannot fully undo the effects of the bank-lending channel. Economic theory suggests that the value of established credit relationships should be increasing in the degree of information asymmetry between firms and new financiers. Because transparency, amount of pledgeable collateral, and average monitoring costs fall with firm size, we expect small firms to be particularly vulnerable to balance sheet shocks that affect the credit supply of their existing lenders (e.g., Gertler and Gilchrist 1994; Petersen and Rajan, 1994). To test this hypothesis, we examine the heterogeneity of the treatment effect across firms of different sizes. We use two proxies of firm size, both measured at the end of 2009: a continuous measure (Ln(Revenues)) and a discrete measure (Small Firm). A firm is considered small if its revenue is below 2 million euros, which is a standard definition adopted by EuroStat.[54]

Table 7 shows that both large and small firms suffered from the credit contraction passed on by their lenders. However, the effect for small firms is significantly larger in magnitude. For any level of the shock, small firms suffered a reduction in credit almost twice as large as the reduction for larger firms. The result is also confirmed by the continuous variable, and it is robust to the extra tests that we discuss at the end of this section.

A natural question is whether this heterogeneous treatment effect across firms of difference sizes is driven by variation in credit tightening or by the heterogeneous ability to react to a similar shock. In other words, in order to claim that this result is due to the inability of smaller firms to counteract the credit tightening of existing lenders, we have to exclude the possibility that banks cut lending more aggressively to smaller firms in response to the sovereign shock. The within-firm regressions presented in the first part of the paper allow us to test this alternative hypothesis. We augment model (1) with an interaction between lenders' sovereign exposure and borrowers size. Table OA.7 in the online Appendix shows that banks did not cut lending more extensively for smaller firms in our sample. The interaction between

[54]See EuroStat for the definition of small firms based on revenues (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32003H0361). Results are similar when using a dummy at the median of the distribution of the same variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	g(Tot Loans)			gr(Empl)			gr(Inv)		
Sovereigns^{AVE}	-0.181***	-0.476***	-0.111*	-0.045	-0.431**	0.030	-0.037	-0.506***	0.059
	(0.057)	(0.183)	(0.059)	(0.041)	(0.193)	(0.047)	(0.038)	(0.141)	(0.067)
Sovereigns^{AVE}		0.041*			0.054**			0.066***	
× ln(Revenues)		(0.022)			(0.025)			(0.020)	
Sovereigns^{AVE}			-0.100*			-0.109***			-0.139**
× Small Firm			(0.057)			(0.041)			(0.063)
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	141372	141372	141372	141372	141372	141372	141372	141372	141372
R-squared	0.111	0.111	0.112	0.026	0.026	0.026	0.012	0.012	0.012

Table 7: *Real Effects of Sovereign Shock*. This table examines the real effects of the sovereign shock. In Columns 1-3, the outcome variable is the normalized growth rate of total bank loans granted to firm j before-to-after the onset of the sovereign crisis (g(Tot Loans)); in Columns 4-6, the outcome variable is the growth rate in firm's wage bill between 2009 and 2011 (gr(Empl)); in Columns 7-9, the outcome variable is the change in firms' fixed assets (tangibles and intangibles) between 2009 and 2011 (gr(Inv)). The main independent variables are the weighted average of the exposure to Italian sovereign scaled by RWA of firm j's lenders (Sovereigns^{AVE}) and its interactions with two proxies of firm size: the logarithm of firm's revenues and a dummy identifying firms below the 2 million Euros in revenue (Small Firm$_{2009}$). All regressions include the (weighted averaged) bank and relationship controls at 2010:Q1, province fixed effects and industry fixed effects. This analysis is estimated on the sample of firms with multiple credit relationships. Standard Errors are clustered at lead-bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

our treatment variable and size measures are both non significant and small in size relative to the main effect. This implies that the differential effect in credit contraction across large and small firms is driven by the relative inability of smaller businesses to smooth the credit shock across different lenders, rather than being the result of a larger credit tightening.

While our results show that the tensions in sovereign markets significantly reduced the available credit to firms, these micro estimates are not directly informative of the aggregate effect of the shock on credit markets. To put our analysis into perspective, we use the results from the between-firm analysis (Table 7) to calculate the drop in aggregate credit due to the transmission of the sovereign shock via the bank-lending channel (see online Appendix OA.2.2). With respect to a counterfactual amount of credit constructed under the assumption that the sovereign shock had no effect on credit supply ($\hat{\alpha}_1 = 0$), we estimate that aggregate corporate lending dropped by 2% within a year following the Greek bailout due to the detrimental effect of distressed sovereigns on the balance sheets of financial institutions. While this exercise does not allow us to quantify the overall aggregate effects of a sovereign crisis (Arellano et al. 2019), it helps to gauge the aggregate effects that can be imputed to the detrimental effect of distressed sovereign securities in intermediaries' portfolios – the security channel –, which appears to be substantial.[55]

Real effects on investments and employment

In this section we investigate whether the credit shock triggered by the burst of the sovereign crisis had any effect on investment and employment policies. On the one hand, firms facing credit tightening from lenders exposed to distressed securities may be able to substitute with financing from an alternative sources and undo the bank-lending-channel effects (Adrian et al. 2012; Becker and Ivashina 2014a). On the other hand, credit market frictions may prevent credit-worthy borrowers in need of external financing from tapping into alternative sources of financing (Khwaja and Mian 2008; Chodorow-Reich 2014; Cingano et al. 2016). In this case the drop in the availability of bank credit would impact firms' real activity and, thus, affect

[55]See online Appendix OA.2.2 for more discussion on this aggregation exercise. The quantitative exercise in Arellano et al. (2019) confirms that about 2/3 of the output losses incurred in Italy during the sovereign crisis period can be imputed to the security channel.

the economy as a whole.[56] To examine this question, we employ the specification in equation (2) and regress the sovereign exposure of a firm's lenders on changes in investments and employment.

We measure investment dynamics looking at the growth rate of fixed assets between 2009 and 2011 (gr(Inv)). Ideally, we would want to replicate the same measure for employment, but information on the number of employees is available only for a small and selected sample of firms in our dataset (approximately 15%). Instead, every firm reports full information on the wage bill paid during the fiscal year. Therefore, we study the effect of the sovereign shock on the labor market by looking at the growth rate of firms' payroll (gr(Empl)) between 2009 and 2011 (Barrot and Nanda, 2016; Cingano et al., 2016). Changes in this variable reflect a byproduct of adjustment in the number of employees, hours worked per employee, and wage per hour worked, and it has been generally considered a reliable measure of employment dynamics at the firm level.

We find that, on average, the credit shock had little or no effect on firms' real outcomes (Table 7). For investment, the coefficient associated with lenders' sovereign exposure is negative but nonsignificant at the canonical level, and economically small (Column 7). The same holds for employment (Column 4). These average effects, however, hide a substantial heterogeneity in the response across firms of different sizes. While we cannot reject the hypothesis that direct exposure to financial institutions with higher holding of distressed securities had no effect on the real activity of the largest firms, small firms were deeply jeopardized by the balance sheet shock suffered by their lenders (Columns 8 and 9). For a small firm, an increase in exposure to sovereigns by one standard deviation translated into a 4% decline in investment. Moreover, lender health also had an economically and statistically significant effect on employment at small firms (Columns 5 and 6). A difference in one standard deviation in lenders' health leads to an average reduction in payments to labor of 3%.

The micro estimates in Table 7 can also be used to back up the elasticities of investment and wage bills with respect to changes in credit supply.[57] In

[56] Using Belgian data and an identification strategy similar to ours, Lenzu et al. (2019) highlights the effects of credit supply shocks triggered by the security channel on firm-level productivity and output prices.

[57] For a small change in lenders' sovereign exposure, we can express the average investment elasticity as the ratio between the average semi-elasticity of investment with respect

line with the reduced-form analysis, the average elasticity for both asset and payroll is economically small (elasticity of 0.2). However, we find an economically significant sensitivity of both investment and payroll to changes in bank credit for small firms, but no sensitivity for larger firms.[58] In particular, we estimate a contraction by 38 cents of investments and 37 cents in payments to labor for every euro cut in funding.[59]

Robustness tests

We conclude this section with a set of robustness checks. First, we augment the model in (2) with the estimated firm fixed effects ($\hat{\rho}_j$) estimated by the model in (1) (Albertazzi and Bottero, 2013; Cingano et al. 2016). Other studies employing a similar within-firm identification strategy have treated the estimated fixed effects as nuisance parameters (Gan 2007b; Khwaja and Mian 2008; Jiménez and Ongena 2012; Jiménez et al. 2014; Cingano et al. 2016). However, to the extent that this parameter proxies for real demand-side shocks, the estimated fixed effects may convey useful information on the transmission of the sovereign shock to the real economy.[60] As presented in Table 8, including the estimated firm fixed effect from the within-firm regression as a control for credit demand does not affect our results, strengthening our confidence in the estimates' causal interpretation.

Second, we show that adding more granular controls of local credit demand does not change our inference. In particular, we augment Equation

to the supply shifter ($\frac{\partial gr(\text{Inv})}{\partial \text{Sovereigns}^{AVE}}$) and the corresponding semi-elasticity of total bank credit ($\frac{\partial g(\text{Loan})}{\partial \text{Sovereigns}^{AVE}}$). The same approach can be used to examine employment.

[58]For large firms, for which we found no effect of pre-shock lender exposure on credit, the point estimates are negative but statistically highly non-significant.

[59]We note that our estimates of the real effects of credit shocks are somehow larger than the ones two recent studies, Amiti and Weinstein (2016) and Cingano et al. (2016). This difference is not surprising, since the average firm in both studies is much bigger than the average firm in our sample, confirming that the sensitivity of corporate policies to bank credit is characterized by a substantial heterogeneity across firms of different size. Furthermore, in online Appendix OA.2.2, we repeat an aggregation exercise similar to the one discussed for credit, showing that these micro estimates could imply sizable aggregate effects.

[60]In online Appendix OA.2.6, we show that a more structural interpretation of parameter $\hat{\rho}_j$ seems reasonable. In fact, we find that $\hat{\rho}_j$ strongly correlates with a large set of variables that are generally considered to be correlated with credit demand in the literature in empirical corporate finance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	g(Tot Loans)			gr(Empl)			gr(Inv)		
Sovereigns^{AVE}	-0.154***	-0.315***	-0.116***	-0.040	-0.401**	0.030	-0.030	-0.466***	0.058
	(0.027)	(0.106)	(0.031)	(0.041)	(0.201)	(0.046)	(0.038)	(0.143)	(0.063)
Sovereigns^{AVE}		0.023			0.051*			0.061***	
× ln(Revenues)		(0.014)			(0.026)			(0.020)	
Sovereigns^{AVE}			-0.055*			-0.100**			-0.127**
× Small Firm			(0.031)			(0.042)			(0.061)
$\hat{\rho}$	0.833***	0.833***	0.833***	0.154***	0.154***	0.154***	0.207***	0.207***	0.207***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	141372	141372	141372	141372	141372	141372	141372	141372	141372
R-squared	0.688	0.688	0.688	0.041	0.041	0.042	0.028	0.028	0.028

Table 8: *The Real Effects of Sovereign Shock, Robustness Controlling for Estimated Firm Fixed Effects.* This table replicates Table 7 with additional controls for change in firm's credit demand. In Columns 1-3, the outcome variable is the normalized growth rate of total bank loans granted to firm j before-to-after the onset of the sovereign crisis (g(Tot Loans)); In Columns 4-6, the outcome variable is the growth rate in firms' wage bill between 2009 and 2011 (gr(Empl)); In Columns 7-9, the outcome variable is the change in firms' fixed assets (tangibles and intangibles) between 2009 and 2011 (gr(Inv)). The main independent variables are the weighted average of the exposure to Italian sovereign scaled by RWA of firm j's lenders (Sovereigns^{AVE}) and its interactions with two proxies of firm size: the logarithm of firm's revenues and a dummy identifying firms below the 2 million Euros in revenues in 2009 (Small Firm). All regressions include the (weighted averaged) bank and relationship controls at 2010:Q1, province fixed effects and industry fixed effects. This analysis is estimated on the sample of firms with multiple credit relationships. Standard Errors are clustered at lead-bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

(2) with an extra set of fixed effects at the province-by-industry level, which would effectively control for any unobservable variation in investment opportunities or credit demand that is specific to any industry-province pair. In other words, we compare two companies that are operating in the same industry and province but have different exposure to the sovereign shock. The only drawback of this approach is that our estimates would only reflect the set of observations for which we have variation in treatment within an industry-province pair. To make sure that this issue does not affect our results, we present the estimates interacting the province dummies with two different levels of industry aggregation. In particular, we look at both the two-digit and one-digit SIC codes.[61] The two panels of Table 9 show that results are generally unaffected by the inclusion of these more restrictive controls. If anything, we find that the effect increases in magnitude relative to the baseline results, but the significance remains generally unchanged.[62] Furthermore, results are also not particularly different across the two specifications, showing that restrictive fixed effects generally does not change our conclusions.

Altogether, our results suggest that the credit tightening caused by the sovereign crisis had a sizable impact on the real economy, with a disproportional effect on small companies that experienced a significant drop in bank credit, investment and employment. Importantly, we find these effects even if banks in our setting did not cut credit more extensively to smaller companies (Section 3). Instead, the disproportional effect on small-firm activity seems to be explained by their greater sensitivity to the availability of credit provided by their existing lenders. Compared to larger firms, small firms appear to be less able to compensate for a credit shortage of equal magnitude across different lenders (Khwaja and Mian 2008; Chodorow-Reich 2014). Furthermore, small businesses have less funding opportunities outside bank credit, and therefore they tend to be more sensitive to the state of the capital market as a whole. In line with this explanation, in online Appendix OA.2.7 we present additional analysis that takes advantage of variation across industries in their dependence to external finance.

[61] When we use one-digit SIC interacted with province, we still leave the two-digit SIC codes not interacted as a baseline control, as in the regression model in (2).

[62] The only exception is the Column 3, where we study the interaction of the dummy measure of size with credit, using the most restrictive fixed effects. In this case, despite the coefficient being larger than in the baseline, it becomes weakly nonsignificant.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel a: Province by macro-industry fixed effects									
	g(Tot Loans)			gr(Empl)			gr(Inv)		
Sovereigns^{AVE}	-0.186***	-0.491***	-0.112*	-0.037	-0.406**	0.026	-0.039	-0.541***	0.058
	(0.055)	(0.179)	(0.060)	(0.042)	(0.204)	(0.049)	(0.037)	(0.146)	(0.068)
Sovereigns^{AVE}		0.043**			0.052*			0.071***	
× ln(Revenues)		(0.022)			(0.026)			(0.021)	
Sovereigns^{AVE}			-0.107*			-0.092**			-0.141**
× Small Firm			(0.059)			(0.041)			(0.067)
Macro Industry									
× Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	138585	138585	138585	138585	138585	138585	138585	138585	138585
R-squared	0.118	0.118	0.118	0.035	0.035	0.035	0.017	0.017	0.017

Table 9: *Real Effects of Sovereign Shock: Robustness with Industry and Province Fixed Effects.* This table replicates Table 7 with the addition of more granular fixed effects. Instead of the simple province and industry fixed-effects, panel a includes province by macro industry (1-digit) fixed effects, while panel b includes province by industry (2-digit) fixed-effects. Apart from this, the table mirrors exactly Table 7. In particular, we first look at change in credit (Columns 1-3); wage bill (Columns 4-6); and fixed assets (Columns 7-9). The main independent variables are the weighted average of the exposure to Italian sovereign scaled by RWA of firm j's lenders (Sovereigns^{AVE}) and its interactions with two proxies of firm size: the logarithm of firm's revenues and a dummy identifying firms below the 2 million Euros in revenues in 2009 (Small Firm). All regressions include the (weighted averaged) bank and relationship controls at 2010:Q1. This analysis is estimated on the sample of firms with multiple credit relationships. Standard Errors are clustered at lead-bank level. *** denotes significance at the 1% level, ** at the 5%, and * at the 10%.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel b: Province by industry fixed effects									
	g(Tot Loans)			gr(Empl)			gr(Inv)		
$\text{Sovereigns}^{AVE}_{2010Q1}$	-0.166***	-0.447**	-0.107*	-0.037	-0.059	-0.346*	0.034	-0.549***	0.050
	(0.057)	(0.179)	(0.059)	(0.040)	(0.037)	(0.191)	(0.046)	(0.143)	(0.065)
$\text{Sovereigns}^{AVE}_{2010Q1}$		0.039*			0.052*	0.043*		0.069***	
× ln(Revenues)		(0.022)			(0.026)	(0.025)		(0.020)	
$\text{Sovereigns}^{AVE}_{2010Q1}$			-0.086			-0.092**	-0.103**		-0.158**
× Small Firm			(0.057)			(0.041)	(0.043)		(0.065)
Industry									
× Province FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	140510	140510	140510	140510	140510	140510	140510	140510	140510
R-squared	0.144	0.144	0.145	0.064	0.041	0.064	0.064	0.041	0.041

Table 9 (cotinued).

5. Conclusions

Using a detailed firm–bank matched panel dataset, we document the propagation of tensions in global financial markets to the Italian economy through a deterioration of banks' security holdings. Turmoil in the sovereign market spurred by the Greek bailout led to a tightening in credit supplied by financial institutions more exposed to sovereign securities of distressed countries. This leads to a consequent reduction in investment and employment by small firms that relies on the financing provided by these banks. At the firm level, when comparing lending to the same firm by two banks one standard deviation apart in sovereign holdings, the more exposed bank reduces loan supply by 10% more than the less exposed in the year after the Greek bailout. At the aggregate level, our calculations reveal that the sovereign shock passed along through bank exposure can explain about a 2% reduction in corporate lending over the same period.

Our results confirm that the security portfolio of banks can be a vehicle through which international macro-shocks can be propagated to the domestic economy. In this regard, this paper offers additional evidence that sheds light on the role played by banks in the international transmission of financial shocks (e.g. Cetorelli and Goldberg, 2011; Kalemli-Ozcan et al., 2013; Peek and Rosengren, 2000; Schnabl, 2012). At the same time, our results are also directly relevant to understanding the role of sovereigns in banks' balance sheet. Government bonds are typically viewed as a safer asset relative to other securities. However, a large and concentrated exposure to this asset class may still lead to a sizable contraction in credit during turmoil in sovereign debt markets (Krishnamurthy and Vissing-Jorgensen 2012). The risks associated with a financial system encumbered by an undiversified stock of public debt is still concerning today, since financial institutions increased their exposure to sovereign securities issued by their own governments as a result of the recent European crisis (Becker and Ivashina 2014b; Acharya and Steffen 2015).

Furthermore, the granularity of our data and the quality of our setting allows us to provide new evidence on the importance of bank credit for small firms. A series of papers have highlighted the need to break down the effects of the bank-lending channel by firm size (Gertler and Gilchrist 1994; Khwaja and Mian 2008; Chodorow-Reich 2014). Our study takes on this challenge and overcomes the data constraints that have limited past analyses to larger and more transparent firms. We show that even if small companies were not

a direct target of bank credit tightening, the real economic costs of financial instability could be particularly high for them. This implies a large elasticity of real activity to credit for small firms. Any policy intervention that aims to reduce the impact of credit shocks on the real economy must internalize this heterogeneity.

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Appendix A. Data Appendix

Appendix A.1. Data selection and other information on data construction

In this section, we discuss the data construction process. Starting from the universe of all business credit relationships appearing in the Italian Credit Register, we classify firms into two groups. The first sub-sample includes a random sample of seventy percent of all borrowers which established credit relationships with only one lender during our pre-shock period (2009:Q2-2010:Q1). The second group includes every firms that established multiple, simultaneous lending relationships with several banks.

For each of these two sub-samples, we exclude a number of observations. We drop defaulted loans as well as new credit granted to borrowers who already have some other relation in default, as these positions may no longer reflect genuine demand and supply dynamics, but rather capture debt restructuring operations or some other agreement due to the default procedures. We drop observations for which we have no information about the lender. We excludes credit provided by special purpose vehicles, non-bank financial intermediaries, and branches of foreign banks for which we have no detailed balance sheet information.[63] We drop observations referring to borrowers which operate in the financial and insurance sector, utilities or government-related industries. We exclude firms operating in the education sector and utilities because the government either runs them directly or indirectly subsidizes their activity for a majority of the cases. We eliminate firms with more than seven contemporaneous credit relationships, i.e. firms belonging to the top 5% of the distribution of lending relationships.[64]

Appendix A.2. Variables description

Relationship-specific variables. Our main dependent variable is the percentage change in average outstanding loans between the pre- and post-shock period for every firm-bank credit relation in our data set. More precisely, we collapse the quarterly amount of credit granted to firm j by bank b to a pre-shock average (2009:Q2-2010:Q1) and the post-shock average (2010:Q2-2011:Q1). Collapsing the dataset into a pre-shock and post-shock average

[63] As explained in Cingano et al. (2016), these lenders grant only a small share of total loans to Italian firms (about 6 percent).

[64] Our inspection of the data suggest that some of the credit relationships of firms with a high number of lending relationships do not reflect genuine credit relationships.

Region	Whole Sample (%)	Low Sovereigns (%)	High Sovereigns (%)
1	0.02	0.01	0.01
2	0.01	0.00	0.00
3	0.01	0.01	0.00
4	0.05	0.03	0.02
5	0.11	0.04	0.07
6	0.02	0.01	0.01
7	0.08	0.04	0.04
8	0.02	0.01	0.01
9	0.25	0.12	0.13
10	0.03	0.02	0.02
11	0.00	0.00	0.00
12	0.07	0.03	0.04
13	0.04	0.02	0.02
14	0.02	0.01	0.01
15	0.04	0.02	0.02
16	0.08	0.06	0.02
17	0.02	0.01	0.01
18	0.02	0.01	0.01
19	0.00	0.00	0.00
20	0.12	0.05	0.07

Table A.1: *Distribution of Firms Across Geographical Regions.* This table reports the distribution of firms across the Italian regions. The sample includes firms which established multiple lending relationships after the application of the filters described in Appendix A.1. The first column reports the geographical distribution of the whole sample. The second and third column report the geographical distribution within the sub-samples of firms borrowing from banks with sovereigns exposure ($\text{Sovereigns}^{AVE}_{j,2010Q1}$) above the median and below the median, respectively. Source: Italian Credit Register, Bank of Italy.

Industry	Whole Sample	Low Sovereigns	High Sovereigns
AGRICULTURE, FORESTRY AND FISHING	0.02	0.01	0.01
MINING AND QUARRYING	0.00	0.00	0.00
MANUFACTURING	0.34	0.17	0.17
CONSTRUCTION	0.14	0.07	0.07
WHOLESALE AND RETAIL TRADE; REPAIR OF VEHICLES	0.26	0.13	0.13
TRANSPORTATION AND STORAGE	0.04	0.02	0.02
ACCOMMODATION AND FOOD SERVICE ACTIVITIES	0.04	0.02	0.02
INFORMATION AND COMMUNICATION	0.04	0.02	0.02
REAL ESTATE ACTIVITIES	0.01	0.01	0.01
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	0.05	0.02	0.03
ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	0.03	0.01	0.02
ARTS, ENTERTAINMENT AND RECREATION	0.02	0.01	0.01

Table A.2: *Distribution of Firms Across Industries.* This table reports the distribution of firms across different macro industries. Macro industries are defined as broad aggregates of SIC codes. The sample includes firms that established multiple lending relationships, after the application of the filters described in Appendix A.1. The first column reports the industry composition of the whole sample. The second and third columns report the industry composition within the sub-samples of firms borrowing from banks with sovereigns exposure (Sovereigns^{AVE}) above the median and below the median, respectively. Source: Italian Credit Register, Bank of Italy.

	Obs	Mean	Sd	Pc10	Pc90
Panel a: Relationship-specific variables					
g(Loans)	533904	0.020	0.647	-0.549	0.667
g(Tot Credit)	533904	0.029	0.592	-0.462	0.667
g(Cred Lines)	533904	0.007	0.627	-0.545	0.667
1(Cut Credit)	533904	0.386	0.487	0.000	1.000
Δ ln(Loans)	533904	0.020	0.552	-0.494	0.659
Length Relationship	533904	27.897	22.214	1.000	60.625
Share Relationship	533904	9.783	5.693	2.000	17.000
Num Relationship	533904	3.437	1.670	1.000	6.000
Panel b: Firm-specific variables					
Total Assets	185133	5113.783	53657.700	285.000	7871.000
Revenues	185133	4684.015	41944.453	275.000	7421.000
Wage Bill	185133	719.486	5441.718	40.000	1183.000
Age	185133	15.161	12.042	3.000	31.000
Bank Leverage	185133	36.746	27.087	6.673	73.331
Credit Score	185133	5.073	3.828	2.000	7.000
gr(Empl)	185133	0.035	0.507	-0.432	0.486
gr(Inv)	185133	-0.014	0.650	-0.665	0.693

Table A.3: *Summary Statistics: multiple and single lending relationship firms.* This table reports the summary statistics of the relationship-specific (panel a) and firm-specific (panel b) variables for the full sample of firms that established at least one lending relationship in the one-year window centered around the Greek bailout.

reduces concerns related to serial correlation of the errors (Bertrand et al. 2004) and averages out any seasonality (Duchin et al. 2010). Then, we calculate the standardized growth rate between the two averages (Davis et al. 1996; Chodorow-Reich (2014)):

$$g(\text{Loans}_{bj}) = \frac{\text{Loans}_{bj,Post} - \text{Loans}_{bj,Pre}}{0.5 \cdot [\text{Loans}_{bj,Post} + \text{Loans}_{bj,Pre}]}$$

This growth rate is a second-order approximation of the log difference growth rate around 0. It is bounded in the range [-2,2], limiting the influence of outliers; and it accounts for changes in credit along both the intensive and extensive margin. We also construct a growth rate that considers only the change along the intensive margin ($\Delta ln(\text{Loans}_{bj})$, and a dummy variable that flags those relationship in place before the Greek bailout but terminated afterwards (Cut Credit_{bj}). In general, we show that our results are not affected by the choice of the outcome variable.

Bank-specific variables. All bank-specific variables come from the Bank of Italy Supervisory Records, and they are measured at the end of 2010:Q1 (the quarter before the sovereign shock). These variables include the stock of Italian sovereigns over risk-weighted assets (*Sovereigns*), the stock of Italian sovereigns over Tier1 (*Sovereigns /Tier1*), the stock of Italian sovereigns over total assets (*Sovereigns/Assets*), the fraction of total sovereign portfolio invested in Italian government bonds (*Sovereigns* over *Total Sovereigns*), profitability (*ROA*), bank size (*Size*, as log-transformation of RWA), Tier1 ratio (*Tier1*), deposit ratio (Deposits over RWA, *Deposits*), Liquidity ratio (Liquidity over RWA, *Liquidity*), interbank market ratio (Net interbank debt over RWA, *Interbank Debt*), quality of lending portfolio (Bad loans over RWA, *Bad Loans*), an indicator variable for cooperative banks (*BCC*), total stock of sovereign securities over RWA (*Total Sovereigns*), total stock sovereign securities issued by GIIPS (GR, IR, IT, PR and SP) over RWA (*Total Sovereigns GIIPS*), and total stock of sovereign securities issued by GIPS (GIIPS less IT) over RWA (*Total Sovereigns GIPS*); a dummy indicating Tier1 ratio $\leqslant 10\%$ (*Low Capital Ratio* over RWA). Furthermore, we also use two variables in capturing the strength of the relationship between firm j and bank b. These are *Length Relatioship*, which indicates the length of the lending relationship (in quarters) between borrower j and bank b, measured as the number of quarters the relationship has been in place between

2006:Q1 and 2010:Q1; *Share Relationship* is the faction of borrower j total bank credit provided by the lender b, at the quarter right before the crisis.

Firm-specific variables. All firm-specific variables come from the CERVED database. *Total assets* (thousand euros) and *Revenues* (thousand euros) refer to fiscal year 2009. We measure investment as the log change in fixed assets (both tangible and intangible) between 2009 and 2011 (*gr(Inv)*), and change in employment as the log change in wage bill (*gr(Empl)*). To limit the influence of outliers in the growth rate of investment and employment, we winsorize the top and bottom 1% of the distribution of these variables. We use two alternative definitions of small firms: log Revenues and a dummy variable that flags firms below 2 million euros in accordance to the definition of EuroStat. Our definition of industry follows the Nace Rev. 2 classification. Through the paper we use a two-digit classification. In Table 9 we also use one-digit industries by province.

Furthermore, we include province fixed effects in the second part of the analysis. At the time of our analysis, there were 110 provinces in Italy, which can be roughly compared to US counties. As pointed out by Guiso et al. (2013), provinces represent proper boundaries of the local market for bank credit. Indeed, provinces have been historically used by the Bank of Italy to decide the opening of new branches, and by the antitrust authority to assess and regulate deposit market concentration. *Credit Rating* is the credit score of the firm measured as the Altman Z-score (Altman 1968; Altman et al. 1994). Age is measured in years between year of incorporation and 2009. *Leverage* is measured as the ratio between a firm's bank credit (from the Credit Registry) and firm's total assets, both measured at the end of 2009. *RZ Index* is the Rajan and Zingales (1998) index of dependence on external finance. Following Rajan and Zingales (1998), we construct the RZ index for each industry (SIC 2-digits) as the median of (CapEx - Cash from Operations)/CapEx using data from the firms in Compustat North America between 1980 and 2008.

Appendix A.3. Other data

In this section of the Appendix, we briefly describe the other data that were collected for the paper.

First, we have included some analyses that examines whether the likelihood of political connection could explain our result in the paper. In the literature, the political connection of banks is identified by either looking

at the presence of politicians in the boards or by identifying directly the presence of government ownership. Unfortunately, these approaches are not suited to the Italian institutional context because the majority of banks are private and many of them are small, making it difficult to obtain reliable data on board members and executives and (even more) to link them to political data in a meaningful way. At the same time, the history of the Italian banking sectors offers a convenient way to bypass these limitations. After a period of widespread direct government ownership of banks, the government formally transferred its stakes to private entities called banking foundations during the 1990s (Jassaud, 2014). Broadly speaking, a banking foundation was created for each bank in which the Italian government had some ownership. Banking foundations are non-profit organization with a strong tie to the local territory in which the bank operates or headquarters. Overall, the main activity of the foundation is to manage the investment portfolio – which is made up in large part of the shares of affiliated banks – and to fund various cultural or welfare activities in the local area. While the exact organizational structure of a foundation changes case-by-case, in many cases they feature a political presence of some sort, lending themselves as an instrument to indirectly measure the possible influence of politics on banks' intermediation and investment activity.

The idea that banking foundations are a vehicle to indirectly exert moral suasion on financial institutions in Italy is not new. For instance, De Marco and Macchiavelli (2016) extensively discuss how banking foundations can be used by Government to exert pressure on banks.[65] One data limitation in De Marco and Macchiavelli (2016) is that the paper focuses on the subset of banks participating in the European Banking Authority (EBA) regulatory stress test, which in Italy amounts to a small number of large banks. In light of this discussion, we have completed an extensive data collection that identifies if a bank has a banking foundation among its main shareholders. In particular, we have collected information on banking foundations' activities and holdings from the foundations' annual balance sheet for all financial institutions active during our sample period. This information is generally available through ACRI's website, which is the official association of the

[65]Consistent with this view, they use ownership by banking foundation to identify more politically connected banks in Italy and they show how political connection across large banks in Europe predicts the home-bias of the sovereign portfolio.

Italian banking foundations.[66] In some cases, we supplemented and validated the information with data from the bank's official website. To validate our approach, we have collected some information on governance of banks. For instance, Figure A.1 shows that more than 40% of the total board members of foundations are directly nominated by local politicians or self-nominated by board members. The remaining seats are nominated by entities that either depend on national government (e.g. universities or chambers of commerce) or that are potentially political (e.g. economic or professional associations).

For each of the 83 foundations, we identify the bank(s) in which foundations invest and the share of the banks' equity that they owned at the end of 2009. Then, we aggregate across foundations and compute the equity share owned by foundations for each banking group. Using this information, we label a bank as politically connected if foundations own more than 10% of the bank's equity in 2009 and include this dummy among the set of control variables in our regression model. We also examine an alternative definition, where we use a smaller threshold (5%).

Furthermore, in the paper we have also identified primary dealers for a robustness test. The information on primary dealers is collected from the website of the Italian Treasury.[67] Given the timing of our analysis, we collect the information on the identity of primary dealers active in 2010:Q1 (February file). Since our analysis is at the banking group level, we label a banking group as primary dealer if any of the banks is a primary dealer. Lastly, it is important to point out that some of the primary dealers are investment banks that are not directly involved in traditional commercial lending.

[66] https://www.acri.it/

[67] http://www.dt.tesoro.it/en/debito_pubblico/specialisti_titoli_stato/.

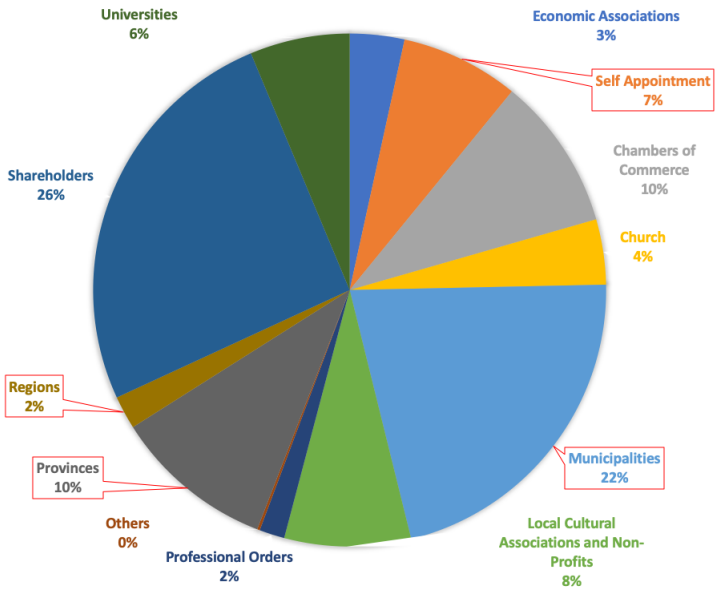

Figure A.1: *Who appoints board members of the Italian banking foundations.* This Figure shows the percentage of board members of banking foundations appointed by different shareholders. Source: Authors calculations from ACRI data.