Sovereign Risk and the Maturity of Bank Credit*

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Abstract

This paper studies how banks adjust the maturity of credit when sovereign stress rises. I use administrative data from the Banco de Portugal that track monthly bank–firm credit relationships and the maturity of outstanding credit during the 2010–2012 European sovereign debt crisis. I exploit differences in banks' pre-crisis exposure to distressed sovereign debt to compare lending to the same firm by banks with different exposure. I find that banks do not reduce lending proportionately across maturities. Relative to less exposed banks lending to the same firm, banks more exposed to sovereign risk cut medium- and long-term credit, while their short-term credit does not differ, so the maturity of credit shortens within continuing relationships. The contraction in medium- and long-term credit is larger for small, highly leveraged and financially constrained firms. At the firm level, firms borrowing from more exposed banks obtain less medium- and long-term credit and more short-term credit, and their total bank credit falls. They do not compensate by borrowing from other banks. Sovereign stress therefore reduces both the amount and the maturity of the bank credit available to firms.

Keywords: Sovereign risk; sovereign debt; bank lending channel; debt maturity; credit supply.

JEL Classifications: E44; G01; G21; G32; H63

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1 Introduction

Public debt has risen substantially in recent years. According to the IMF, global public debt reached nearly 94 percent of GDP in 2025 and is projected to reach 100 percent by 2029, while higher interest rates make it more costly to service (IMF, 2026).[1] These trends have brought the possibility of new sovereign crises back into the policy debate, more than a decade after the one that hit the euro area in 2010–2012. When the default risk of a government increases sharply, the banks that hold its bonds suffer losses on their balance sheets (Gennaioli et al., 2014; Bocola, 2016) and reduce their lending to firms, with consequences for investment, employment and productivity (Popov and Van Horen, 2015; Acharya et al., 2018; Balduzzi et al., 2018; De Marco, 2019; Bottero et al., 2020; Lenzu et al., 2024).

These studies measure the response of banks by the amount of credit they supply. A bank under pressure, however, can adjust its lending along other dimensions, and one of the most consequential for its borrowers is the length of time for which it commits its funds. Much less is known about whether banks hit by sovereign stress shorten this commitment. In this paper, I ask whether, during a sovereign debt crisis, banks reduce their lending to firms proportionally across maturities or instead change the maturity of the credit they supply, and what credit firms end up with as a result.

Maturity is a margin of adjustment for a bank under pressure. Credit granted for several years commits the bank to the borrower for that period, and the bank cannot reduce it or change its terms if its own condition deteriorates. Short-term credit comes due earlier and leaves the bank free to adjust (Milbradt and Oehmke, 2015). A bank whose balance sheet is under pressure may therefore reduce the credit that commits it for longer before it reduces the rest, as banks hit by sudden withdrawals of funding have been shown to do (Müller et al., 2025). For the borrower, the two are not equivalent. Credit that falls due within a year must be renewed on terms that depend on the future condition of the lender, which exposes the firm to rollover risk and raises its risk of default (Diamond, 1991; He and Xiong, 2012). The evidence from earlier crises shows that this risk affects real decisions. Firms with more long-term debt coming due at the onset of the 2007–2008 crisis cut investment more (Almeida et al., 2012), and so did small European firms that depend on bank debt (Vermoesen et al., 2013). In Portugal, firms with more short-term debt reduced investment more after the sovereign shock of 2010 (Buera and Karmakar, 2022). Firms that cannot obtain finance at longer maturities may also be less able to sustain long-term investment (Aghion et al., 2010; Garicano and Steinwender, 2016).

Existing work treats the maturity of firms' debt as given when a crisis begins. Firms with

[1] Tensions have also returned to euro-area sovereign bond markets. The spread between ten-year French and German government bonds reached 130 basis points in October 2026, its highest level since 2012.

more debt coming due invest less and grow more slowly, in the euro-area crisis as in earlier ones (Duval et al., 2020; Kalemli-Özcan et al., 2022), but their maturity is measured before the shock and taken as fixed. Where the maturity of loans has been studied as a response to the condition of banks, the shocks concerned their funding. Banks more exposed to rollover risk in their funding grant loans of shorter maturity (Paligorova and Santos, 2017), and in Portugal the banks that benefited more from the ECB's three-year refinancing operations of 2011–2012 lengthened the maturity of their loans (Jasova et al., 2021). This paper studies a loss on the assets of banks. I treat the maturity of credit as a decision that lenders take during the crisis, and ask which type of credit banks cut when sovereign stress hits their balance sheets and what firms are left with.

I study this question in Portugal during the sovereign debt crisis of 2010–2012. Three features make the Portuguese case well suited to it. First, the shock was large and reached firms through banks. The spread between Portuguese and German ten-year government bond yields rose from around 100 basis points in 2009 to around 1,200 basis points in January 2012, the country lost market access in April 2011, and Portuguese firms rely mostly on bank finance (Crosignani et al., 2015). Second, banks entered the crisis with different exposures to sovereign risk. The monthly balance sheets of all deposit-taking banks operating in Portugal report their holdings of government securities by issuing country, and in 2010Q1 holdings of debt issued by Greece, Ireland, Italy, Portugal and Spain (GIIPS) amounted to 6 percent of the assets of the banking system, with substantial dispersion across lenders. Third, the data record the maturity of credit for each bank–firm relationship. The Central Credit Register (CRC), an administrative register of the Banco de Portugal that covers the universe of bank lending to non-financial corporations, reports every month the outstanding credit of each relationship by maturity, both as originally contracted and as still remaining. Other data used to study the sovereign crisis do not offer this breakdown, since syndicated-loan data cover large borrowers and loans with maturities of several years (Acharya et al., 2018), while firm balance sheets report the maturity of total debt only once a year and without identifying the lender. Matched to the bank balance sheets and to the annual accounts that every Portuguese non-financial corporation is required to file, the register yields a sample of 131,515 firms and 28 banking groups from 2009Q1 to 2012Q2, which covers 64 percent of outstanding corporate credit in the register, and 71 percent of employment and 75 percent of turnover among Portuguese non-financial corporations.

Together, these features allow me to trace the bank channel of sovereign risk separately for each maturity of credit. To isolate the supply of credit, I compare banks with different pre-crisis exposure, measured as their holdings of GIIPS sovereign debt relative to their assets in 2010Q1, lending to the same firm in the same quarter (Khwaja and Mian, 2008). Firm × quarter fixed

effects absorb the firm's demand for credit, including changes in the maturity of the credit it seeks. I split the change in credit of each relationship into short-term credit with an original maturity of up to one year, and medium- and long-term credit with an original maturity above one year. Since the two components sum to the total, I can measure how much of any contraction in lending by exposed banks falls on each maturity.

I first show that sovereign exposure reduced the supply of bank credit in Portugal, as it did in other countries (Bottero et al., 2020; Lenzu et al., 2024). By 2011Q4, total credit from a bank with one standard deviation more exposure was 4.9 percentage points lower than credit from a less exposed bank to the same firm, following the path of Portuguese sovereign spreads. The decomposition by maturity, which these studies do not observe, shows that all of this contraction is in medium- and long-term credit, while short-term credit shows no difference between more and less exposed banks. Measured against its own pre-crisis stock, medium- and long-term credit from a more exposed bank is 8.9 percent lower by 2011Q4. By 2012Q2, about half of the decline is in credit granted for one to five years, and about a third in credit granted for five to ten years. The contraction does not reflect loans that were already close to maturity at more exposed banks, since it is essentially unchanged when I control for the residual maturity of each relationship's credit in 2010Q1. Nor does it reflect the end of relationships, since more exposed banks were not more likely to terminate them.

Second, banks also choose which borrowers bear this cut, and the answer is not obvious beforehand. Banks under pressure may protect weak borrowers to avoid recognising losses on their loans (Blattner et al., 2023; Schivardi et al., 2022), or withdraw from them because they are the riskiest. The reduction in medium- and long-term credit is 3.4 percentage points larger for small firms and 3.5 percentage points larger for highly leveraged firms. It is also larger for firms that the index of Hadlock and Pierce (2010) classifies as financially constrained, while exporters and firms with higher Altman Z-scores are comparatively insulated and profitability makes no detectable difference. For short-term credit, none of these characteristics matters. Since the comparison still runs across lenders to the same firm, these differences reflect how banks allocate the contraction across borrowers rather than differences in what firms demand.

Finally, I ask what firms end up with. A firm could offset the contraction by borrowing more from its less exposed lenders or by forming new relationships, so I aggregate credit at the level of the firm and compare firms whose pre-crisis lenders were more or less exposed. By 2012Q2, a one-standard-deviation increase in firm exposure lowers medium- and long-term credit by 4.2 percentage points of the total credit of the firm and raises short-term credit by 1.7 points, so that total credit falls by 2.5 points. The cut in medium- and long-term credit reaches firms almost in full. Firms do not obtain this credit from their other lenders, are less likely to form

new relationships, and do not draw more on the credit already committed to them. They make up for less than half of the loss with short-term credit.

Taken together, these results show how banks adjust their lending when sovereign stress hits their balance sheets. Relative to less exposed banks, exposed banks did not cut their credit uniformly. They withdrew from commitments that would have bound them to the borrower for several years, and withdrew most from riskier borrowers, while their short-term credit did not differ from that of less exposed banks. For the literature on the transmission of sovereign stress, this means that the contraction in lending measured in earlier studies reflects a choice about which credit to keep and for whom, which estimates based on the amount of credit alone cannot reveal. For the literature on debt maturity, it means that the maturity of firms' debt is itself shaped by the crisis. By cutting medium- and long-term credit, exposed banks raise the share of their borrowers' debt that must be renewed within a year, at a time when these same banks are under pressure, so measures of refinancing risk based on maturity before the crisis are incomplete. The shift also falls on the small, leveraged and financially constrained firms for which a loss of bank credit has been found to have the largest effects on investment and employment (Chodorow-Reich, 2014; Cingano et al., 2016).

Related Literature: This paper contributes to three strands of the literature. The first studies how sovereign stress reaches firms through bank lending. Banks increased their holdings of domestic sovereign debt as stress rose, which amplified its effect on their lending (Altavilla et al., 2017), and banks more exposed to sovereign risk reduced the supply of credit to firms (Popov and Van Horen, 2015; Bofondi et al., 2018; Acharya et al., 2018; Balduzzi et al., 2018; De Marco, 2019; Lenzu et al., 2024). The closest paper is Bottero et al. (2020), who apply the same within-firm comparison to the Italian credit register and measure the amount that each bank lends to a firm. I contribute to this strand by decomposing the contraction by maturity, which shows that the bank lending channel of sovereign risk operates through medium- and long-term credit.

The second strand studies debt maturity. Evidence on bank loans shows that their maturity depends on the risk of the borrower and on the information available to the lender (Diamond, 1991; Berger et al., 2005), and the debt maturity of small firms shortens more than that of large firms in downturns (Poeschl, 2023). Within this strand, one group of papers treats maturity as a source of vulnerability when a crisis begins (Almeida et al., 2012; Duval et al., 2020; Kalemli-Özcan et al., 2022; Buera and Karmakar, 2022). Another shows that shocks to the funding of banks change the maturity of their loans (Paligorova and Santos, 2017; Müller et al., 2025), including, in Portugal, the ECB's three-year refinancing operations (Jasova et al., 2021). I contribute by showing that a loss on the value of bank assets also changes the maturity of

the credit that banks supply, so that part of the vulnerability the first group takes as given is produced by the crisis itself.

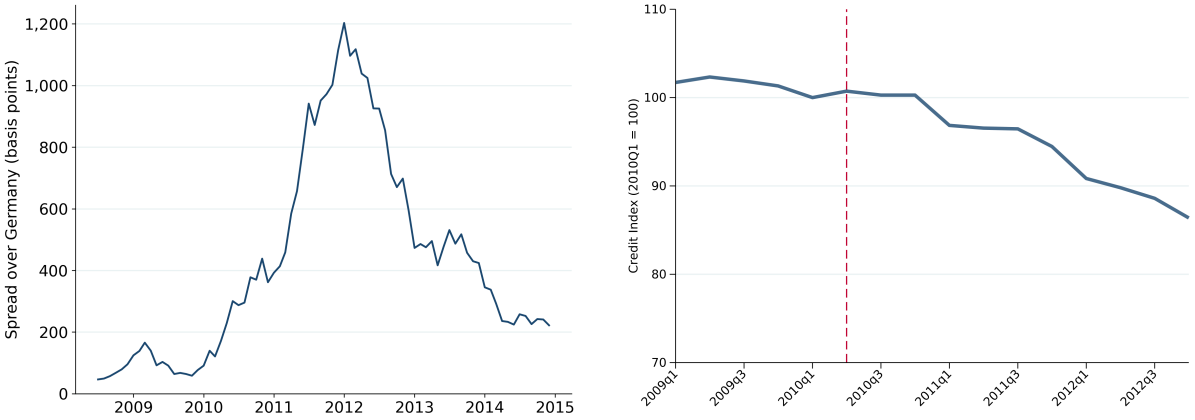
The third strand studies which firms bear a contraction in credit supply and whether they can offset it (Khwaja and Mian, 2008; Chodorow-Reich, 2014; Iyer et al., 2014; Cingano et al., 2016; Jonghe et al., 2020; Carletti et al., 2024). A related literature asks whether banks under pressure withdraw from weak borrowers or protect them to avoid recognising losses (Blattner et al., 2023; Schivardi et al., 2022). I contribute by showing how banks allocate the contraction across borrowers along the maturity of credit, and by following the change in maturity to the firm to ask whether firms can undo it through other lenders or through short-term credit.

The remainder of the paper is organized as follows. Section 2 describes the Portuguese setting and the data, and Section 3 sets out the empirical strategy. In Section 4 I present the effect of sovereign exposure on the maturity of bank credit, and in Section 5 I study which borrowers bear the contraction. In Section 6 I turn to the firm level, and Section 7 concludes.

2 Setting and Data

2.1 The sovereign debt crisis in Portugal

Until early 2010, sovereign distress within the euro area was widely regarded as unlikely. The introduction of the common currency had sharply compressed sovereign spreads across member states, and investors largely treated government debt issued by euro-area countries as close substitutes. This changed abruptly in the spring of 2010, when Greece requested financial assistance from the European Union and the International Monetary Fund (IMF). Concerns about sovereign creditworthiness spread rapidly to other peripheral euro-area economies, including Portugal, Ireland, Italy, and Spain. The spread between Portuguese and German ten-year government bond yields, which stood at around 100 basis points in 2009, rose sharply through 2010 and 2011 (Figure 1, Panel A). In April 2011, Portugal lost market access and entered a €78 billion EU–IMF adjustment program, and the spread peaked at roughly 1,200 basis points in January 2012. It remained elevated until the European Central Bank's July 2012 commitment to do "whatever it takes" marked a turning point in the repricing of peripheral sovereign debt.



(a) Portuguese sovereign spread

(b) Aggregate credit index (2010Q1 = 100)

Figure 1: Sovereign stress and bank credit to firms in Portugal, 2009–2012. Panel (a): spread between Portuguese and German ten-year government bond yields (basis points, monthly; source: ECB). Panel (b): total credit to firms in the credit register, indexed to 100 in 2010Q1 (source: CRC).

Two features of the Portuguese economy made the banking system the channel through which this stress could reach firms. First, banks held sizeable portfolios of domestic and other GIIPS sovereign debt. At the beginning of 2010, these holdings accounted for around 6% of total banking-sector assets, and banks differed substantially in their size. As sovereign spreads widened, the fall in the value of these portfolios and the increase in their risk put pressure on bank balance sheets and funding conditions. Second, the Portuguese corporate sector was highly dependent on bank finance. Small and medium-sized firms account for a large share of economic activity and have limited access to bond and equity markets, so bank credit is the primary source of external finance for many firms (Crosignani et al., 2015). Firms could therefore not easily replace the credit that banks withdrew. Over the same period, total bank credit to firms in the credit register contracted by approximately 14% (Figure 1, Panel B).

2.2 Data

The empirical analysis combines four administrative datasets maintained by the Banco de Portugal.[2] The core dataset is the Central Credit Register (CRC), a monthly census of credit relationships between Portuguese financial institutions and non-financial corporations. For each bank–firm pair, the register reports the stock of outstanding credit at the end of each month, together with its breakdown by maturity. The CRC covers all credit institutions operating

[2]The datasets are accessed through the Banco de Portugal Microdata Research Laboratory (BPLIM): the Central Credit Responsibility Database—Firm Level Data (CRC; extraction June 2019, Version V2; Banco de Portugal Microdata Research Laboratory (BPLIM), 2019), the Bank Balance Sheet Monthly Data (BBS; extraction June 2022, Version V1; Banco de Portugal Microdata Research Laboratory (BPLIM), 2022), the Central Balance Sheet Harmonized Panel (CBHP; extraction June 2024, Version V1; Banco de Portugal Microdata Research Laboratory (BPLIM), 2024), and the Long Banking Series (SLB).

in Portugal, with a reporting threshold of just €50 per bank–firm relationship. Therefore, it provides a nearly comprehensive coverage of financial lending to Portuguese firms. I restrict attention to deposit-taking banks, which account for the overwhelming majority of corporate lending and are the only institutions for which detailed balance-sheet information is available. Individual institutions are aggregated at the banking-group level to avoid double-counting of lending by subsidiaries of the same financial group. Throughout the paper, I use these monthly credit stocks to construct quarterly measures of bank–firm and firm-level credit growth.

Information on banks' sovereign holdings and balance-sheet characteristics comes from the monthly Bank Balance Sheet (BBS) database. The BBS reports government securities holdings by issuer country, allowing me to distinguish Portuguese sovereign debt from other GIIPS sovereigns. It also provides detailed information on banks' balance sheets, including size, capitalization, liquidity, funding structure, and other characteristics used throughout the empirical analysis.

Firm characteristics are obtained from the Central Balance Sheet Harmonized Panel (CBHP), an annual panel covering the universe of Portuguese non-financial corporations filing financial statements. The dataset provides information on firms' balance sheets, employment, profitability, leverage, age, sector, location, and international trade activity. These variables are used to construct firm-level controls and the measures of firm heterogeneity.

Finally, I use the Long Banking Series (SLB) to construct aggregate banking-sector statistics used to validate the aggregation of individual institutions into banking groups.

2.3 Sample

I collapse the monthly credit register to a quarterly frequency, express all monetary variables in constant 2015 euros, and consolidate lending relationships at the banking-group level. The resulting panel contains quarterly observations of outstanding credit for each bank–firm relationship. The sample runs from 2009Q1, when the register begins to report credit by maturity, to 2012Q2. It ends before the European Central Bank pledged in July 2012 to support euro-area sovereign bond markets, an intervention that lowered spreads and eased bank funding independently of the sovereign shock.

The final sample is constructed in several steps. First, I keep credit relationships with at least €10,000 of outstanding credit in 2010Q1, a threshold that excludes economically negligible relationships accounting for only a small share of aggregate corporate credit (Buera and Karmakar, 2022).[3] Second, I restrict the sample to relationships that were already active before the onset

[3]Imposing this threshold excludes approximately 38,000 firms, but has a negligible effect on the aggregate amount of credit lost due to the restriction, which decreases by only about €400 million (Table A.1).

of the sovereign debt crisis and had not terminated before 2010Q2. This restriction ensures that the analysis follows lending relationships that existed before the crisis, rather than relationships formed in response to it, and that every relationship has credit outstanding in 2010Q1, the quarter in which I measure bank exposure. Finally, I retain banking groups that accounted for at least 0.1% of total corporate lending in the pre-crisis period, excluding very small institutions and specialized lenders whose business models differ from those of commercial banks.

Appendix Table A.1 summarizes the construction of the final sample. Starting from approximately 270,000 non-financial corporations and 80 financial institutions recorded in the CRC, the successive cleaning, merging, and sample restrictions yield a final sample of 28 banking groups and roughly 131,500 firms.[4] Although the final sample contains about 49% of the firms in the original register, it covers approximately two thirds of outstanding corporate credit included in the CRC. The excluded observations consist primarily of firms with small borrowing amounts and therefore account for only a limited share of aggregate corporate credit. Relative to the universe of firms in the CBHP, the final sample covers 71% of employment and 75% of turnover (Table A.1), so the restrictions drop many firms but little economic activity. The resulting panel follows 131,515 firms across 28 banks and 14 quarters, or 2.8 million pair-quarter observations (Appendix Table A.2).

2.4 Descriptive statistics

Tables 1 and 2 summarize the main variables used throughout the analysis, all measured in the pre-crisis quarter 2010Q1. I first describe the outcome variable, credit and its maturity, then the measure of banks' sovereign exposure, and finally the characteristics of the firms in the final sample.

Credit and its maturity. The outcome is the growth rate of outstanding bank credit, measured either at the bank–firm relationship level, where each observation is the credit extended by bank j to firm i, or at the firm level, where credit is aggregated across all banks lending to a given firm. Figure 2 shows the unconditional evolution of bank–firm credit growth relative to 2010Q1. Median credit growth is close to zero before the onset of the sovereign debt crisis and declines steadily thereafter.

[4]The largest reduction in coverage occurs when merging the CRC with the CBHP, for two main reasons. First, not all firms in the CRC have a banking relationship that can be matched to a firm in the CBHP. Second, the CRC includes financial corporations and government entities, whereas the CBHP covers only non-financial corporations. As a result, merging the two datasets leads to a substantial reduction in both the number of firms and the total amount of credit.

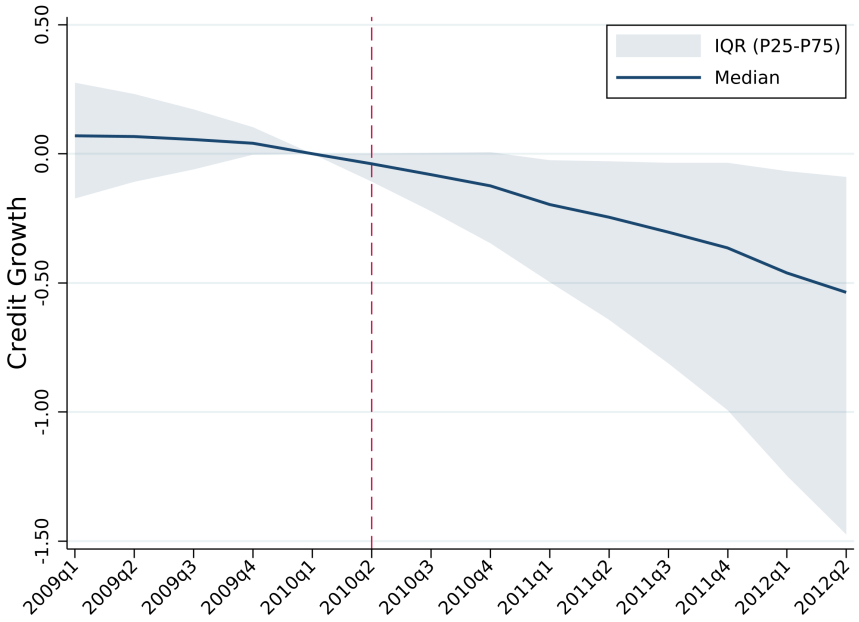


Figure 2: Bank–firm credit growth over the crisis, 2009Q1–2012Q2. The solid line is the median cumulative credit growth (DHS midpoint) across relationships; the shaded band is the interquartile range. The dashed line marks the Greek bailout (2010Q2).

The feature of the register that I exploit in this paper is that the credit of each relationship is reported by maturity. From 2009, the CRC reports credit exposures by both their original and their residual maturity. Original maturity records the contractual maturity established when the credit is granted, while residual maturity measures the time remaining until the contractual maturity date. I use original maturity throughout, because it records the horizon of the commitment the bank chose when the credit was granted rather than how much of that horizon has since elapsed. Under both concepts, the register distinguishes five maturity categories: up to one year, one to five years, five to ten years, ten to twenty years, and more than twenty years. Figure 3 reports the composition of the loan book in 2010Q1. Credit with an original maturity of up to one year is termed short-term credit, credit originated between one and five years is termed medium-term credit, and credit originated above five years is termed long-term credit, following the breakdown commonly used in euro-area bank lending statistics. Short-term credit is 39.5% of the stock, medium-term credit a further 24.9%, and long-term credit the remaining 35.6%, with only 3.7% of the stock contracted beyond twenty years. All three categories are large, so the maturity of credit is a margin on which banks have room to adjust.

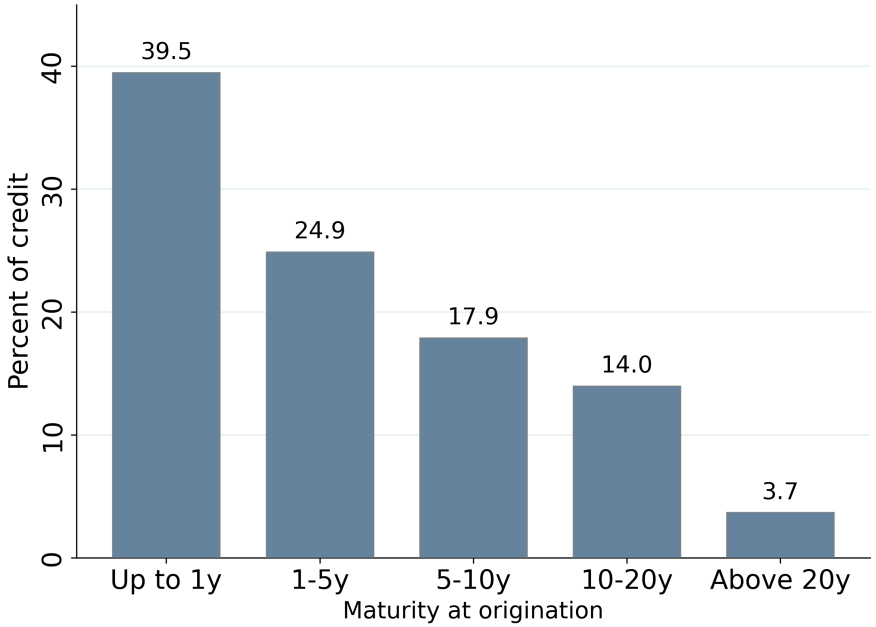


Figure 3: Composition of the loan book by maturity at origination, 2010Q1. Share of outstanding bank–firm credit in each band of original maturity. Multi-bank relationships, 131,412 of them.

The CRC uses the one-year threshold to distinguish short-term from long-term credit. I adopt the same threshold for the main results and split the credit of each relationship into credit with an original maturity of up to one year and credit above one year, which groups medium- and long-term credit. This split can be followed quarter by quarter for every relationship. I then use the five bands to show which maturities above one year account for the adjustment. Credit above one year accounts for 60% of the outstanding stock aggregated at the quarter level and for 58% of credit in the average relationship (Figure 3 and Appendix Table C.1). The two shares are almost identical, so large and small relationships have a similar maturity mix: the aggregate share is not driven by a few large exposures.

Bank variables and sovereign exposure. Table 1 reports summary statistics for the 28 banking groups in the estimation sample. The main treatment variable is a bank's sovereign exposure, defined as its holdings of government bonds issued by Greece, Ireland, Italy, Portugal and Spain (henceforth GIIPS) as a share of its total assets. I focus on these five countries because they were at the center of the euro-area sovereign debt crisis and experienced substantial increases in sovereign risk during this period. In the regressions, this exposure measure is standardized across banks. As robustness checks, I also consider exposure to Portuguese sovereign debt only and total sovereign exposure.

Portuguese banks displayed substantial heterogeneity in their pre-crisis sovereign portfolios.

Holdings of GIIPS sovereign debt averaged 2.6% of total assets, but the distribution was dispersed: the median bank held sovereign debt equivalent to 1.7% of assets, while the upper quartile exceeded 3.3% and a quarter of banks held none at all. Banks also differed substantially in their balance-sheet structure, including capitalization, funding composition, and liquidity. Between the first and the third quartile, total assets range from €790 million to €19.8 billion, equity from 2.0% to 10.5% of assets, and interbank funding from 20.9% to 84.9% of assets.

Table 1: Bank Summary Statistics (BBS, 2010Q1)

	Bank Characteristics (2010 Q1)					
	Mean	SD	P25	P50	P75	N
Sovereign Exposure, PRT (€m)	693.0	1320.0	0.0	13.9	676.0	28
Sovereign Exposure, GIIPS (€m)	941.0	1960.0	0.0	17.7	719.0	28
Sovereign Exposure / Assets, GIIPS (%)	2.64	3.56	0.00	1.69	3.29	28
Total Assets (€m)	19310.0	32950.0	790.0	2560.0	19810.0	28
Equity / Assets (%)	6.87	5.50	2.03	5.92	10.46	28
Interbank Funding / Assets (%)	51.48	32.42	20.85	48.74	84.91	28
Deposits / Assets (%)	79.85	15.07	66.80	82.30	92.71	28
Non-Financial Deposits / Assets (%)	20.62	20.74	0.29	20.64	32.70	28
Eurosystem Funding / Assets (%)	0.82	2.36	0.00	0.00	0.01	28
Debt Securities Issued / Assets (%)	5.83	9.64	0.00	0.24	8.80	28
Liquid Assets / Assets (%)	5.44	12.51	0.05	1.68	4.16	28

Notes: Cross-section of all 28 BBS banks at 2010Q1. Sovereign exposure is shown in levels (millions of constant 2015 euros, Portuguese-only and GIIPS) and scaled by total assets (GIIPS). All ratios are in percent of total assets, except the equity and sovereign-exposure ratios as labelled. Wholesale, customer-deposit, central-bank, and debt-securities funding are shares of the bank's total funding. The remaining rows are the bank balance-sheet controls.

Firm characteristics. Table 2 summarizes the characteristics of firms in the final sample. Portuguese firms are predominantly small and bank-dependent: the median firm employs five workers and has 300k euros in assets, while the average firm borrows from 1.6 banks. The average exposure to sovereign debt is 5%, weighted by credit shares. Firms also enter the crisis with substantial variation in their financial position. The median firm finances approximately 30% of its assets with debt, has a return on assets of 6%, and is 9 years old. Only 20% are exporters.

The distribution of bank relationships is particularly relevant for the analysis. Most firms borrow from a single bank: 64.2% of firms have one lender, while the remaining have multiple banking relationships (Figure A.1 and Table A.3). This concentration is much less pronounced when considering credit: single-bank firms account for only 22.6% of total credit in the sample, while firms with multiple banking relationships account for the remaining 77.4%. The empirical analysis focuses on multi-bank firms, which allow within-firm comparisons across lenders, and I also show that the results are consistent in the full sample.

Table 2: Firm Characteristics — All Firms Sample

	Mean	SD	P25	P50	P75	N
Credit Growth (midpoint)	-0.53	0.76	-0.97	-0.39	-0.06	131515
Firm Sov. Exp. / Assets (GIIPS)	5.04	3.97	1.87	3.69	6.86	131515
Total Assets (€m)	2.21	33.80	0.13	0.32	0.88	131419
Turnover (€m)	1.67	24.80	0.10	0.25	0.72	125404
Employees	14.79	130.16	2.00	5.00	10.00	123480
Financial Leverage	0.39	0.38	0.12	0.30	0.54	131439
Return on Assets	0.02	0.89	0.01	0.06	0.13	131413
Altman Z-Score	1.30	3.04	0.36	1.35	2.37	131254
Firm Age (years)	12.87	12.01	5.00	9.00	18.00	131514
Exporter	0.21	0.40	0.00	0.00	0.00	131515
N Bank Relationships	1.64	1.16	1.00	1.00	2.00	131515

Notes: Cross-section of all firms with positive credit at 2010Q1. *Credit Growth (midpoint)* is the DHS growth of firm total credit over the window; *Firm Sov. Exp.* is the credit-weighted average of the firm's lenders' GIIPS exposure, scaled by bank assets. Total assets and turnover are in millions of constant 2015 euros; all other ratios are in percent. All information refers to 2010Q1 baseline values

3 Empirical Strategy

The empirical analysis has two levels. At the level of the bank–firm relationship, I estimate how banks' sovereign exposure changed the maturity of the credit they lent. At the level of the firm, I then ask how much of this change remains once firms can turn to other banks and to other maturities. This section describes the bank–firm design, and Section 6 describes the firm-level design.

3.1 Identification

The main difficulty in estimating the effect of sovereign exposure on credit supply is that a change in the credit between a bank and a firm reflects both the supply of the bank and the demand of the firm. If more exposed banks lent to firms whose demand fell more during the crisis, a comparison across banks would attribute that fall in demand to the banks. To separate the two, I compare the lending of different banks to the same firm in the same quarter (following Khwaja and Mian, 2008; Amiti and Weinstein, 2018). The comparison assumes that a change in a firm's demand for credit affects all its lenders in the same way, so that a difference in how they change their credit to the firm reflects their supply. For maturity, the assumption is that a firm that seeks shorter credit during the crisis seeks it from all its banks. This is stronger than for total credit, because a firm may borrow from different banks for different purposes, and I return to it in Section 4.4.

This comparison is possible only for firms that borrow from at least two banks, and I estimate the main specification on these firms (Chodorow-Reich, 2014). They are about one third of the firms in the sample but hold more than three quarters of its credit.

The second assumption is that, without the sovereign crisis, more and less exposed banks would have changed their lending to the same firm in the same way. This would fail if more exposed banks were already lending differently before the crisis. It would also fail if exposure were correlated with other bank characteristics that made banks respond differently once the crisis began, such as reliance on wholesale funding, which became scarce during the crisis. To check the first case, the specification below also estimates coefficients for the quarters before 2010Q1, which should be zero if more and less exposed banks lent in the same way before the crisis.

To check the second case, I split the 28 banks at the median of their sovereign exposure in 2010Q1 and compare the two groups (Appendix Table A.4). They have similar size and similar deposit, liquidity, loan and capital ratios, while high-exposure banks rely less on interbank and wholesale funding. A regression of each bank's exposure on the same characteristics, which uses the full variation in exposure rather than the median split, finds none of them significant (Appendix Table A.5). In addition, the specification controls for bank size, liquidity, capital, deposits and interbank funding, each interacted with the quarter indicators, so that the estimates compare banks with the same values of these characteristics.

Finally, I check whether high- and low-exposure banks lend to different firms. Within a firm, the fixed effects absorb any such difference, but it would matter for the estimates on all firms and at the firm level. For each bank, I average the characteristics of the firms it lends to before the crisis and compare these averages between the two groups (Appendix Table A.6). The borrowers have similar size, employment, profitability, leverage, age and export status, and only the ratio of working capital differs. High- and low-exposure banks, therefore, lent to similar firms before the crisis.

3.2 Empirical specification

Let C_{ijt} denote the credit outstanding from bank j to firm i in quarter t, and C_{ijt}^m the part of it with original maturity $m \in \{\leq 1y, > 1y\}$, either up to one year or above one year, so that $C_{ijt} = \sum_m C_{ijt}^m$. For each maturity I measure the cumulative growth of credit since 2010Q1 as

$$g_{ijt}^m = \frac{C_{ijt}^m - C_{ij,0}^m}{\frac{1}{2}\left(C_{ijt} + C_{ij,0}\right)}, \tag{1}$$

where the subscript 0 denotes 2010Q1, the last quarter before the Greek bailout. The numerator is the change in credit of maturity m, and the denominator is the midpoint of the total credit of the relationship. Summing over the two components gives the midpoint growth rate of total credit of Davis et al. (1996),

$$g_{ijt} = g_{ijt}^{\leq 1y} + g_{ijt}^{>1y} = \frac{C_{ijt} - C_{ij,0}}{\frac{1}{2}\left(C_{ijt} + C_{ij,0}\right)}.$$

The midpoint growth rate is bounded between -2 and 2 and approximates the log change when credit is positive in both periods.[5] Unlike the log change, it remains defined when credit is zero in one of the two periods. This matters for the two components, because a relationship may have no credit of one maturity in 2010Q1 or may lose all of it later. Because the two components share the same denominator, the growth of credit up to one year and the growth of credit above one year sum to the growth of total credit, and each measures the contribution of that maturity to the change in the credit of the relationship.

The baseline specification is an event study at the bank–firm–quarter level, estimated separately for each maturity:

$$g_{ijt}^{m} = \sum_{\substack{\tau=2009Q1 \\ \tau\neq 2010Q1}}^{2012Q2} \beta_{\tau}^{m}\left(\text{Quarter}_{\tau} \times \text{Sovereign Exposure}_{j}\right) + \gamma^{m\prime}\mathbf{X}_{j} + \delta^{m\prime}\left(\text{Post}_{t} \times \mathbf{X}_{j}\right) + \alpha_{it}^{m} + \varepsilon_{ijt}^{m}, \quad (2)$$

where Quarter_{τ} is an indicator for quarter τ, with 2010Q1 omitted as the reference period, and Post_{t} is an indicator for the quarters after 2010Q1. $\text{Sovereign Exposure}_{j}$ is bank j's holdings of GIIPS sovereign debt as a share of its total assets in 2010Q1, standardized across banks. Because it is measured before the crisis, the crisis cannot have changed it. The firm $\times$ quarter fixed effects α_{it}^{m} absorb the firm's demand for credit in each quarter. The vector $\mathbf{X}_{j}$ contains bank size, liquidity, capital, deposit funding and interbank funding in 2010Q1, which are standard controls in this literature (Bottero et al., 2020; Buera and Karmakar, 2022; Lenzu et al., 2024; Bonfim et al., 2025). I also control for the pre-existing length of the bank–firm relationship. The bank controls enter both on their own and interacted with Post_{t}, so that their effect on lending can change with the crisis. All quarters are estimated in a single regression, so the coefficients of different quarters share the same fixed effects and controls.

The coefficient β_{τ}^{m} measures the difference in the growth of credit of maturity m since 2010Q1 between two banks lending to the same firm whose exposure differs by one standard deviation. Because the two outcomes sum to total credit growth and the regressors are the same, the two

[5] It takes a value of 2 when a lender enters a new lending relationship with a borrower and -2 when an existing lending relationship is terminated.

coefficients sum to the effect on total credit, $\beta_\tau^{\leq 1y} + \beta_\tau^{>1y} = \beta_\tau$. The total-credit coefficient is the one comparable with the existing literature, and the two components show how that effect is divided between maturities. If exposed banks reduced all their credit in proportion, credit above one year would account for about 58 percent of the total effect, its share in the credit of the average relationship (Section 2).

Standard errors are clustered at the bank level, the level at which exposure varies (Bertrand et al., 2004). Because there are only 28 banks, I also report standard errors with the bias correction of Bell and McCaffrey (2002) and the degrees-of-freedom adjustment recommended by Imbens and Kolesár (2016). The sample consists of relationships with positive credit in each quarter, so the estimates measure the intensive margin of lending.

To measure the change in each component relative to its own size, I also estimate Equation (2) with the midpoint of the component itself, $\frac{1}{2}(C_{ijt}^m + C_{ij,0}^m)$, as the denominator. The two coefficients then no longer sum to the total effect, and the sample is restricted to relationships with credit of maturity m in at least one of the two periods.

Two further specifications are reported in Appendix B. The first estimates Equation (2) on all firms, including those with a single bank, so that the estimates cover the whole sample. It is estimated for total credit and for each maturity, and replaces the firm $\times$ quarter fixed effects with industry $\times$ location $\times$ size $\times$ quarter fixed effects (ILST), which absorb demand shocks common to similar firms (Degryse et al., 2019; Meinen and Soares, 2022). Because these fixed effects control for demand less well, the multi-bank estimates remain the benchmark. The second is a linear probability model for the termination of the relationship, which measures the extensive margin of lending.

4 Bank–Firm Results

4.1 Credit by maturity

Figure 4 reports the central result of the paper. Panel A plots the coefficients of Equation (2) estimated separately for credit with an original maturity of up to one year and for credit with an original maturity above one year. Both are measured over the total credit of the relationship, so the two coefficients add up to the effect on total credit. Panel B plots the spread between Portuguese and German ten-year government bond yields over the same quarters.

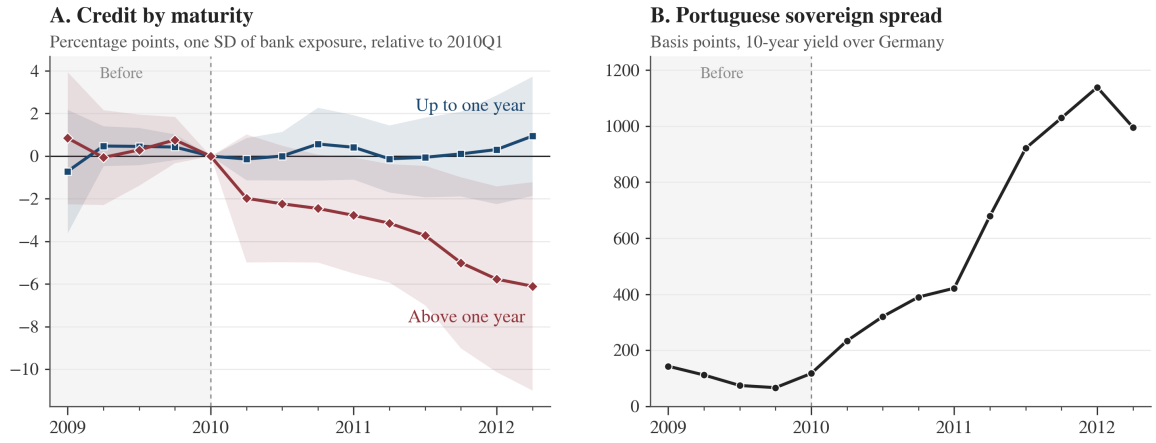


Figure 4: Credit by maturity at more exposed banks and the Portuguese sovereign spread. Panel A: coefficients on standardized GIIPS exposure over assets from Equation (2), as cumulative changes relative to 2010Q1, with 95 percent confidence intervals based on standard errors clustered by bank. Panel B: spread between the Portuguese and German ten-year government bond yields, quarterly average (ECB).

Before 2010Q1, the coefficients for both maturities are close to zero and none is statistically significant, so more and less exposed banks lending to the same firm were on similar paths before the crisis. After 2010Q1 the two paths separate. Short-term credit shows no difference between more and less exposed banks in any quarter, while medium- and long-term credit from more exposed banks falls relative to credit from less exposed lenders. Panel B shows that the timing of this decline follows the sovereign spread. Medium- and long-term credit falls by 2.0 percentage points in 2010Q2, the quarter of the first Greek bailout, and then declines slowly through 2010, while the spread stays below about 400 basis points. The decline accelerates in 2011, when Portugal requests financial assistance and the spread rises from about 420 basis points in 2011Q1 to more than 1,100 basis points in 2012Q1. The coefficient reaches 5.0 points by 2011Q4 and reaches 6 percentage points at the peak of the crisis in 2012Q2. The contraction is therefore strongest when sovereign stress is highest, consistent with losses on sovereign bonds weighing on the capital and funding of exposed banks.

Table 3 reports the estimates at three horizons, together with the effect on total credit. By 2011Q4, credit from a bank with one standard deviation more exposure has grown 4.9 percentage points less than credit to the same firm from a bank with one standard deviation less exposure. Medium- and long-term credit accounts for the whole of this difference, with a coefficient of 5.0 points, while the coefficient on short-term credit is 0.1 points. By 2012Q2, the effect on medium- and long-term credit reaches 6.1 points, while the coefficient on short-term credit is positive, at 0.9 points, and not statistically significant.

Table 3: Credit by maturity, bank–firm level

	Total credit (1)	Up to one year (2)	Above one year (3)
2010Q4	−1.89**	0.57	−2.46*
	(0.89)	(0.83)	(1.23)
2011Q4	−4.90***	0.10	−5.00**
	(1.71)	(0.97)	(1.96)
2012Q2	−5.17**	0.94	−6.10**
	(2.01)	(1.36)	(2.38)
Observations	1,667,981	1,667,981	1,667,981
Firm × quarter fixed effects	Yes	Yes	Yes
Bank controls and Post × bank controls	Yes	Yes	Yes

Notes: Coefficient on standardized GIIPS exposure over assets, in percentage points, from Equation (2): one regression per column, with exposure interacted with every quarter from 2009Q1 to 2012Q2 and 2010Q1 as the reference. The outcome is the change in credit of the bank–firm relationship since 2010Q1, measured over the relationship's total credit, so columns (2) and (3) add up to column (1). Multi-bank firms. Standard errors clustered by bank in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The effect on total credit is in line with the evidence on the transmission of sovereign stress through banks in other countries (Bottero et al., 2020; Lenzu et al., 2024). By 2012Q2 it corresponds to about 10 percent of the within-firm standard deviation of credit growth, compared with about 20 percent in the preferred within-firm specification of Bottero et al. (2020). The decomposition by maturity shows that this contraction consists entirely of a reduction in credit above one year.

These estimates show that the bank channel of sovereign risk operates entirely through medium- and long-term credit. The lower growth of total credit from more exposed banks is accounted for by medium- and long-term credit, while the growth of short-term credit does not differ between more and less exposed banks. Because the comparison is within the same firm and quarter, this pattern reflects a difference in what banks were willing to supply, under the assumption, discussed in Section 4.4, that a firm's demand for each maturity is common to its lenders. Sovereign exposure therefore affected how much credit banks committed for long horizons, and not their short-term lending. A bank that grants a medium- or long-term loan commits its funding and capital for several years at fixed terms, while it can reprice or reduce short-term credit at each renewal. Banks facing losses on their sovereign bonds therefore have the strongest reason to restrict medium- and long-term credit. Section 4.2 shows that this concentration is larger than a proportional contraction would imply.

4.2 Is the contraction proportional?

Credit above one year is the larger part of the average relationship, so even a contraction proportional across maturities would fall mostly on it. In 2010Q1, credit above one year was 58 percent of the credit of the average relationship. Had exposed banks reduced both maturities in proportion, the effect of 4.9 percentage points on total credit at 2011Q4 would have consisted of a decline of about 2.8 points in credit above one year and 2.1 points in credit up to one year. Instead, credit above one year falls by 5.0 points and credit up to one year rises by 0.1 points. Two tests show that this departure from proportionality is statistically significant.

The first test uses the share of the relationship's credit with an original maturity above one year. A proportional contraction leaves this share unchanged, so its change since 2010Q1 should not depend on the exposure of the bank. Panel A of Figure 5 and column (1) of Table 4 report the estimates of Equation (2) with this change as the outcome. The coefficients are close to zero before 2010Q1 and turn negative afterwards. By 2011Q4, the share of credit above one year in a relationship with a bank one standard deviation more exposed has fallen by 1.3 percentage points more than in a relationship of the same firm with a less exposed bank, and by 2012Q2 by 2.5 points, from an average of 58 percent. Both estimates are significant at the 5 percent level or better.

The second test estimates the difference between the two maturities directly. The outcome is the growth of credit above one year minus the growth of credit up to one year, both measured over the total credit of the relationship, estimated with Equation (2). The difference compares the two maturities within the same relationship in the same quarter, so it nets out any shock that affects all the credit of the relationship. Measured in this way, credit above one year falls by 5.1 percentage points more than credit up to one year at more exposed banks by 2011Q4 and by 7.0 points more by 2012Q2, while the coefficients before 2010Q1 are jointly insignificant (Panel B of Figure 5 and column (2) of Table 4). On this scale, a difference of zero means that the two maturities decline by the same number of percentage points. A proportional contraction would imply a difference of less than one point, so most of the estimated difference reflects the departure from proportionality that the first test identifies.

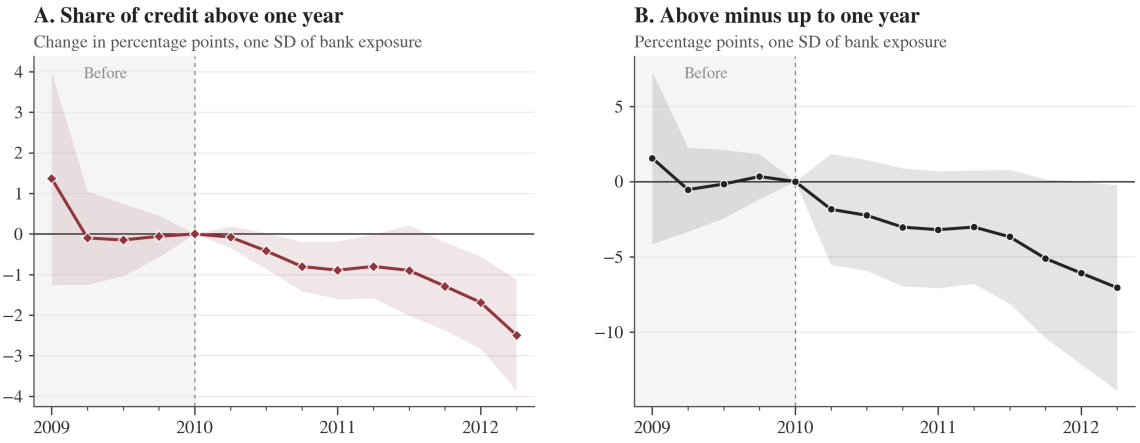


Figure 5: Tests of a proportional contraction. Panel A: coefficients on standardized GIIPS exposure over assets from Equation (2) with the change since 2010Q1 in the share of the relationship's credit with an original maturity above one year as the outcome. Panel B: coefficients from Equation (2) with the growth of credit above one year minus the growth of credit up to one year, both measured over the total credit of the relationship, as the outcome. Multi-bank firms, firm fixed effects and bank controls. Shaded bands are 95 percent confidence intervals with standard errors clustered by bank. The shaded area marks the quarters before 2010Q1.

Table 4: Is the contraction proportional across maturities?

	Share of credit above one year (1)	Above minus up to one year (2)
2010Q4	-0.80^{**}	-3.02
	(0.30)	(1.90)
2011Q4	-1.29^{**}	-5.11^{*}
	(0.53)	(2.57)
2012Q2	-2.49^{***}	-7.04^{**}
	(0.66)	(3.32)
Observations	1,667,981	1,667,981
Firm × quarter fixed effects	Yes	Yes
Bank controls and Post × bank controls	Yes	Yes

Notes: Coefficients on standardized GIIPS exposure over assets, in percentage points. Each column is estimated with Equation (2), one regression over all quarters. Column (1): change since 2010Q1 in the share of the relationship's credit with an original maturity above one year, which is zero under a proportional contraction. Column (2): growth of credit above one year minus growth of credit up to one year, both measured over the relationship's total credit. Multi-bank firms. Standard errors clustered by bank in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The two tests point in the same direction. More exposed banks did not reduce their lending proportionally across maturities. They reduced the credit that commits them for longer, so the sovereign shock changed the maturity of the credit they supply as well as its amount.

4.3 The size of the cut in medium- and long-term credit

The estimates in Sections 4.1 and 4.2 measure both maturities over the total credit of the relationship. They show where the contraction falls, but not how large it is for each maturity. To measure its size, Figure 6 expresses the growth of each maturity relative to its own credit. The denominator is the midpoint of that component, $\frac{1}{2}(C^m_{ijt} + C^m_{ij,0})$, and the estimates are in Appendix Table C.2. A relationship with no credit of a given maturity in either period drops out, because it has no growth of that maturity to measure.

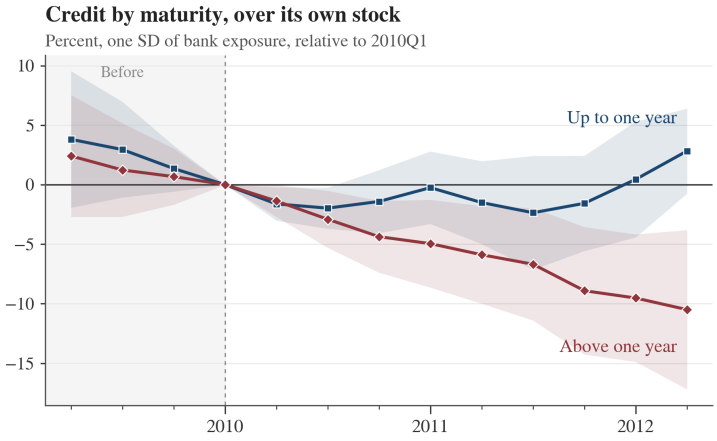


Figure 6: Credit by maturity, each measured over its own stock. Coefficients on standardized GIIPS exposure over assets, one regression per quarter, with the growth of each maturity measured over the midpoint of its own credit rather than over the total credit of the relationship, as cumulative changes relative to 2010Q1, from 2009Q2. The two paths do not add up to the effect on total credit. Multi-bank firms, firm fixed effects and bank controls. Shaded bands are 95 percent confidence intervals based on standard errors clustered by bank.

Measured in this way, medium- and long-term credit from a bank with one standard deviation more exposure grows 4.4 percent less than credit to the same firm from a less exposed bank by 2010Q4. The gap widens to 8.9 percent by 2011Q4 and 10.5 percent by 2012Q2, and each estimate is significant at the one percent level. Short-term credit shows no significant difference at any horizon.

These magnitudes show why maturity matters for measuring the bank channel of sovereign risk. On total credit, the effect of exposure is 4.9 percent by 2011Q4, a moderate contraction in line with estimates for other countries. This average hides two different responses. Short-term credit from more exposed banks does not differ from that of less exposed banks, while medium- and long-term credit falls by almost 9 percent more. An estimate on total credit alone would therefore capture the reduction in the amount of credit but miss the change in its maturity.

The credit register also divides medium- and long-term credit into four bands of original maturity. These bands show which maturities account for the cut. Figure 7 reports the estimates

at the peak of the crisis. Each band is measured over the total credit of the relationship, as in Section 4.1, so the four bands add up to the effect on medium- and long-term credit. Medium-term credit, between one and five years, accounts for 3.4 of these 6.9 points. Credit between five and ten years accounts for 2.2 points and credit between ten and twenty years for 1.3, while credit above twenty years barely changes. Dividing each coefficient by the share of the band in the loan book gives the decline relative to the credit in that band. It is about 14percent for medium-term credit, 12 percent between five and ten years, 9percent between ten and twenty years, and close to zero above twenty years. Weighted by the size of each band, these declines average about 11 percent, close to the 10.5 percent estimated directly. The cut is therefore the largest between one and ten years and fades at the longest maturities.

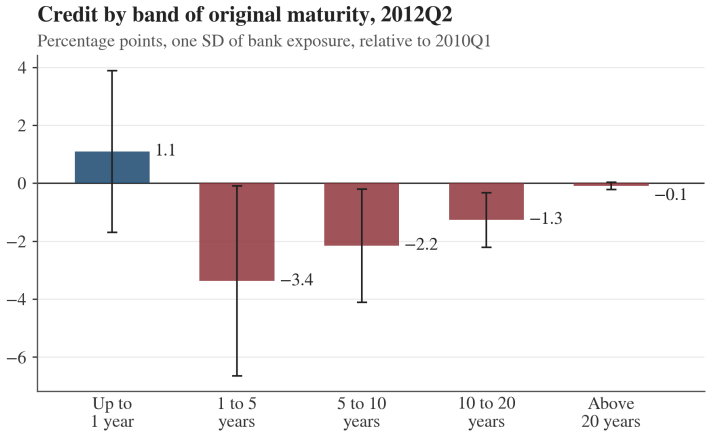


Figure 7: Credit by band of original maturity, 2012Q2. Coefficients on standardized GIIPS exposure over assets, relative to 2010Q1. Every band is measured over the midpoint of the total credit of the relationship, so the five coefficients add up to the effect on total credit. Multi-bank firms, firm fixed effects and bank controls. Bars are 95 percent confidence intervals based on standard errors clustered by bank. The coefficients are in Appendix Table C.3.

4.4 Alternative explanations

The estimates are interpreted as a decision of more exposed banks to supply less medium- and long-term credit. Two alternative explanations could produce the same pattern. The first is that medium- and long-term credit at more exposed banks declined because loans already on their books reached maturity, not because the banks lent less. The second is that firms reduced their demand for medium- and long-term credit at their more exposed lenders in particular.

The credit register records outstanding stocks, so a decline in medium- and long-term credit could reflect loans that mature and are not replaced. Short-term credit provides a benchmark. Because its original maturity is at most one year, almost all short-term credit outstanding in 2011Q4 was granted or renewed after 2010Q1. Short-term credit from more exposed banks does

not decline relative to that of less exposed banks (Section 4.1 and Appendix Table C.2). More exposed banks therefore granted and renewed short-term credit at the same pace as less exposed banks during the crisis.

Banks whose medium- and long-term loans were closer to maturity in 2010Q1 would also lose more of them in the following quarters, whatever their lending decisions. To account for this, the specification is re-estimated with the average residual maturity of the relationship's credit in 2010Q1 as a control. The coefficient on medium- and long-term credit at 2011Q4 is 5.4 percentage points with this control and 5.7 without it, and it remains statistically significant (Appendix Table C.4).

Two features of the data rule out mechanical changes in how credit is classified. Maturity is recorded at origination, so a loan does not move to a shorter category as it ages. A loan that becomes overdue or is written off also stays in the measure of credit and keeps its original classification.[6]

The second explanation concerns the identifying assumption of Section 3. The firm $\times$ quarter fixed effects absorb any change in a firm's demand that is common to all its lenders, including a change in the maturity it seeks. They do not absorb a change in demand that differs across the firm's banks. A firm may, for example, finance investment through one bank and working capital through another. If the bank that finances its investment is more exposed and the firm invests less during the crisis, its demand for medium- and long-term credit falls at that bank, and the estimates would attribute the decline to supply. Two results speak against this explanation. Before 2010Q1, the coefficients for both maturities are close to zero, so credit of each maturity from more and less exposed banks to the same firm evolved in the same way. This period includes the recession of 2009, when firm investment also fell, so a decline in demand for medium- and long-term credit at the banks that finance firms' investment would be expected to appear then as well. In addition, exposure does not predict the change in the average original maturity of a relationship's credit before the crisis (Appendix Table C.5).

A related concern is the ECB's three-year refinancing operations of December 2011 and February 2012, which lengthened the maturity of loans by the banks that benefited most from them (Jasova et al., 2021). To the extent that these were also the banks most exposed to sovereign risk, the operations work against the shortening documented here, and the estimates understate it.

[6]The credit measure is based on the Central Credit Register (CRC), which reports effective credit and classifies maturity according to original maturity. Exposures that are performing, overdue, in litigation, or written off remain in the corresponding original-maturity category. The treatment of written-off credit varies across reporting institutions, but this reporting practice would affect the estimates only if it were systematically related to banks' sovereign exposure (Banco de Portugal Microdata Research Laboratory (BPLIM), 2019).

One limitation is that the credit register does not distinguish new lending from the renewal of existing credit. Jiménez et al. (2012) address this by observing loan applications from firms that are not current borrowers of the bank, and comparable data are not available here. The short-term credit observed in 2011Q4 may therefore include loans renewed to existing borrowers. This is relevant in this setting, since Blattner et al. (2023) show that weaker Portuguese banks continued lending to impaired borrowers during this period. The concern is smaller for medium- and long-term credit, because renewing an existing loan would sustain its stock and work against the decline in the estimates.

4.5 Robustness

This subsection reports a set of checks on the bank–firm estimates above. Each check changes one element of Equation (2), and the estimates are reported at 2011Q4 and 2012Q2.

Small-cluster inference. Exposure varies across only 28 banks, so standard errors clustered by bank may understate the uncertainty of the estimates. With the bias correction of Bell and McCaffrey (2002) and the degrees of freedom of Imbens and Kolesár (2016), the effect on medium- and long-term credit remains significant at the 5 percent level at both horizons, with p-values of 0.034 and 0.031, and so does the effect on total credit, with p-values of 0.023 and 0.032. The difference between the two maturities is significant at the 10 percent level, with p-values of 0.076 and 0.059. Short-term credit remains far from significance (Appendix Figure B.2).

All firms. The within-firm comparison requires firms that borrow from at least two banks, so the main estimates leave out firms with a single bank, which are about two thirds of the firms in the sample. To check whether the results extend to these firms, Equation (2) is estimated on all firms, with industry × location × size × quarter fixed effects in place of firm × quarter fixed effects (Section 3). These fixed effects absorb demand shocks common to similar firms, although they control for demand less closely than the within-firm comparison. The results are consistent with the main estimates. Medium- and long-term credit from more exposed banks declines after 2010Q1 by a similar amount, while short-term credit shows no difference (Appendix Figure B.3).

Exposure to other sovereigns. If the estimates reflected a general characteristic of banks that hold government bonds, rather than their exposure to distressed sovereigns, exposure to the debt of other countries would predict the same decline. Total credit is therefore regressed on exposure interacted with an indicator for the quarters after 2010Q1, with exposure measured on different portfolios. Exposure to all sovereign debt and exposure to Portuguese debt alone

both predict lower credit growth. Exposure to the debt of sovereigns outside the GIIPS does not (Appendix Table B.2).

Exposure scaled by equity. The main measure scales a bank's holdings of GIIPS debt by its total assets, which captures how large these bonds are in the bank's portfolio. Losses on the bonds, however, are absorbed by the bank's capital, so a bank with little equity relative to its holdings is more vulnerable to the same decline in bond prices. To check whether the results depend on this choice, exposure is measured as holdings of GIIPS debt over equity. The results are consistent with the main estimates. Medium- and long-term credit from more exposed banks declines after 2010Q1, by somewhat more than with the asset-based measure, while short-term credit shows no difference (Appendix Table B.3).

Leave one bank out. The effect on total credit is re-estimated 28 times, each time excluding one bank. All 28 coefficients are negative and significant at the 10 percent level, and at 2012Q2 they range from 4.2 to 9.6 percentage points. No single bank drives the result (Appendix Table B.4).

Terminations. A linear probability model for the end of the relationship after 2010Q1 gives a coefficient on exposure of 0.5 percentage points but it is not significant. More exposed banks were not more likely to end their relationships, so the adjustment takes place within relationships that continue (Appendix Table B.5). This contrasts with evidence from previous sovereign and financial crises, where more exposed lenders were more likely to terminate lending relationships (Iyer et al., 2014; Acharya et al., 2018; Chodorow-Reich, 2014; Schivardi et al., 2022). Lenzu et al. (2024) also find an extensive-margin response after sovereign shock, although their effects are concentrated shortly after the onset of the crisis and flatten afterwards.

5 Firm Heterogeneity

In the baseline result, I show that more exposed banks during the euro area crisis adjust the maturity of supplied credit, cutting medium to long term credit most. This section asks which firms bear this adjustment. The incidence of a credit-supply shock depends on what a borrower can do once its lender retrenches. A firm that can document its prospects to an outside lender, or pledge assets against a new loan, can replace part of what it loses, whereas a firm that can do neither is tied to the relationships it already has. These frictions, such as the cost of conveying information about a borrower, the availability of pledgeable collateral and the expense of monitoring, are weaker for larger firms with stronger balance sheets (Gertler and Gilchrist,

1994; Petersen and Rajan, 1994). The contraction should therefore fall disproportionately on firms that are small, leveraged, or financially constrained.

To test this, the effect of sovereign exposure is allowed to vary with predetermined firm characteristics. For each maturity m, I estimate

$$g_{ij}^{m} = \beta^{m}\,\text{Sovereign Exposure}_{j} + \theta^{m}\big(\text{Sovereign Exposure}_{j} \times W_{i}\big) + \gamma^{m\prime}\mathbf{X}_{j} + \alpha_{i}^{m} + \varepsilon_{ij}^{m}, \qquad (3)$$

where g_{ij}^{m} is the growth of maturity credit m from bank j to firm i between the pre-crisis period and the peak of the crisis, defined as in Equation (1), and W_i is a characteristic of the firm measured before the crisis. The analysis considers six firm characteristics, each measured before the crisis and entered one at a time. They capture the frictions described above, together with two alternative reasons why banks might treat firms differently. Small firms, defined as those with assets below the median, are less transparent and have less collateral to pledge. Highly leveraged firms, with a ratio of financial debt to assets in the top quartile as in Buera and Karmakar (2022), have less room to take on new debt and a higher risk of default. The size–age index of Hadlock and Pierce (2010) combines size and age into a single measure of financial constraints, with higher values indicating a more constrained firm. It relies on these two characteristics because they change slowly and depend less on the firm's own financial choices than balance-sheet ratios. The Altman Z-score combines liquidity, retained earnings, operating profits, leverage and sales relative to assets into a measure of default risk, with higher values indicating a safer firm. Exporters sell part of their output abroad, so their revenues depend less on the domestic crisis and they may find it easier to obtain financing outside the Portuguese banking system. The return on assets measures profitability. It separates financial constraints from performance: if banks had simply cut credit to less profitable firms, the effect would vary with the return on assets rather than with size and leverage. Continuous characteristics are standardized. The bank controls $\mathbf{X}_j$ and the clustering of standard errors are the same as in Equation (2), and the sample is again restricted to multi-bank firms.

The coefficient of interest is θ^{m}, which measures how the effect of a lender's sovereign exposure on credit of maturity m changes with the characteristic of the borrower. Because the specification includes firm fixed effects α_i^m, the level of the characteristic is absorbed and the interaction is identified from the same firm borrowing from banks with different sovereign exposure. The interaction therefore measures how banks allocated a given contraction across borrowers.

Figure 8 reports the estimates of θ^{m} for short-term credit in Panel A and for medium- and long-term credit in Panel B, with the coefficients in Appendix Tables C.6 and C.7. The

differences across firms appear in medium- and long-term credit. For each standard deviation of lender exposure, firms with below-median assets lose an additional 3.4 percentage points of medium- and long-term credit[7], and highly leveraged firms an additional 3.5 points, in line with Buera and Karmakar (2022). Firms with a higher size–age index, which indicates tighter financial constraints, also lose more, while firms with higher Altman Z-scores and exporters lose less. The response does not vary with the return on assets, so the pattern does not simply reflect differences in firm performance. In short-term credit, none of the six interactions is statistically significant.

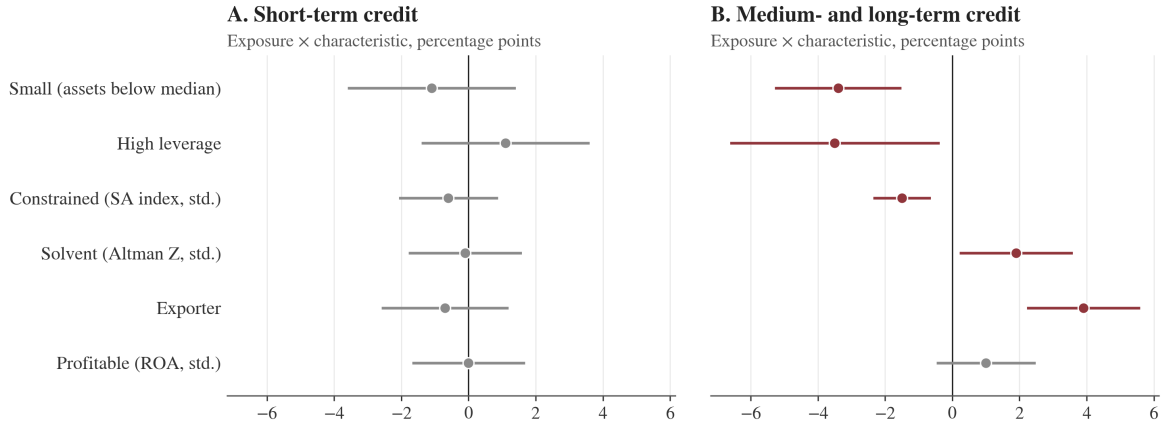


Figure 8: Heterogeneity across firms in short-term and in medium- and long-term credit. Coefficients on the interaction of standardized GIIPS exposure over assets with each firm characteristic from Equation (3), one regression per characteristic and maturity, for the growth of credit between the pre-crisis period and the peak of the crisis, measured over the total credit of the relationship. Multi-bank firms, firm fixed effects and bank controls. Lines are 95 percent confidence intervals based on standard errors clustered by bank, and coefficients significant at the 5 percent level are shown in colour.

Because the interaction is estimated within the same firm, it does not reflect how easily a firm could replace credit from other lenders. It measures how more exposed banks distributed their cut across borrowers. The estimates show that these banks did not cut evenly. They reduced medium- and long-term credit more to small, highly leveraged and constrained firms, and less to solvent firms and exporters. This is consistent with banks under pressure withdrawing long commitments first from the borrowers for which they are most costly, because information about them is poorer, their collateral is weaker and monitoring them is more expensive.

This result differs from the evidence for Italy. Bottero et al. (2020) find that small firms experienced a larger contraction in credit, but that within the same firm the interaction between bank exposure and firm size is small and not significant. They conclude that small firms were

[7]These differences are not explained by the composition of credit before the crisis. Small firms held 65 percent of their credit at medium and long term in 2010Q1 and large firms 58 percent (Appendix Table A.11), a gap that would account for about half a percentage point of the difference of 3.4 points.

hit harder because they could not smooth the shock across lenders, not because their banks cut them more. In Portugal, the same within-firm comparison shows that more exposed banks cut credit to small firms more, by 4.4 percentage points for total credit (Appendix Table C.8) and by 3.4 points for medium- and long-term credit. Small firms were therefore hit harder in part because their banks cut them more, and the split by maturity shows that this concerned the credit that commits a bank for longer.

A reduction in credit committed for more than one year during a period of financial stress can force firms to rely more heavily on funding that must be renewed in the near term, increasing their exposure to refinancing conditions (Diamond, 1991; He and Xiong, 2012; Almeida et al., 2012). The firms that lose more of this credit are those with the weakest capacity to obtain alternative financing. Section 6 follows the adjustment from the bank–firm relationship to the firm as a whole.

6 Firm-Level Results

The estimates so far compare the lenders of the same firm. The firm × quarter fixed effects that identify the supply shock also absorb any change common to all of a firm's lenders, so they do not show whether the cut reaches the firm (Khwaja and Mian, 2008; Degryse et al., 2019). A firm whose exposed lender cuts medium- and long-term credit could obtain it from another of its banks, or replace it with short-term credit. In the first case, the shortening of maturity documented in Section 4 would disappear once credit is aggregated across the firm's lenders. This section asks how much of the cut reaches firms, and in which maturities.

6.1 Empirical specification

Following the literature (Chodorow-Reich, 2014; Cingano et al., 2016; Bottero et al., 2020), I measure the sovereign exposure of a firm as the exposure of the banks it borrowed from before the crisis, weighted by each bank's share of the firm's credit in 2010Q1:

$$\text{Sovereign Exposure}_i = \sum_{j \in \mathcal{B}_i} \omega_{ij} \, \text{Sovereign Exposure}_j, \qquad \omega_{ij} = \frac{C_{ij,0}}{C_{i,0}}, \tag{4}$$

where $\mathcal{B}_i$ is the set of banks lending to firm i in 2010Q1, $C_{ij,0}$ is the credit of bank j to the firm in that quarter and $C_{i,0} = \sum_j C_{ij,0}$ is the firm's total credit. The measure is higher for firms whose borrowing was concentrated at more exposed banks. Both the weights and the exposure of banks are measured before the crisis, so the measure is predetermined with respect to the firm's later outcomes (Borusyak et al., 2025). Its distribution across firms is shown in Appendix

Figure A.4.

The outcome is the credit the firm receives from the banks it borrowed from in 2010Q1, $C_{it}^{m} = \sum_{j \in \mathcal{B}_i} C_{ijt}^{m}$ for each maturity m, as in Bonfim et al. (2025). Credit from banks the firm starts borrowing from after 2010Q1 is excluded, because opening a new relationship is itself a response to the crisis; it is studied separately in Table 5. The growth of each maturity component is defined as in Equation (1), over the midpoint of the firm's total credit. For each maturity and each quarter t, I estimate

$$g_{i,t}^{m} = \beta_{t}^{m} \text{ Sovereign Exposure}_{i} + \gamma_{t}^{m\prime} \overline{\mathbf{X}}_{i} + \delta_{t}^{m\prime} \mathbf{Z}_{i} + \mu_{s(i),t}^{m} + \mu_{r(i),t}^{m} + \varepsilon_{i,t}^{m}, \tag{5}$$

where $g_{i,t}^{m}$ is the cumulative growth of the firm's credit of maturity m between 2010Q1 and quarter t, and exposure is standardized across firms. The coefficient β_{t}^{m} is the difference in the growth of credit of maturity m between two firms whose lenders differ by one standard deviation in exposure. As at the bank–firm level, the two components sum to the growth of the firm's total credit, so $\beta_{t}^{\leq 1y} + \beta_{t}^{>1y}$ is the effect on total credit. $\overline{\mathbf{X}}_{i}$ contains the bank controls of Equation (2), averaged across the firm's pre-crisis lenders with the weights ω_{ij}. $\mathbf{Z}_{i}$ contains firm characteristics measured in 2009: the log of total assets, the log of hours worked, return on assets, financial leverage and age. $\mu_{s(i),t}^{m}$ and $\mu_{r(i),t}^{m}$ are sector and municipality fixed effects. Standard errors are clustered by the firm's main pre-crisis lender. The sample consists of multi-bank firms, the firms that can reallocate credit across existing lenders.

This design compares firms rather than the lenders of one firm, so firm fixed effects can no longer absorb credit demand. Identification requires that firms borrowing from more exposed banks would not have demanded different credit in the absence of the shock, conditional on the controls and fixed effects. Firm characteristics are largely balanced across exposure: of ten characteristics, only employment differs at the five percent level, and pre-crisis credit growth is unrelated to exposure (Appendix Table A.7). Exposure is also not driven by a single large lender (Appendix Table A.8 and Figure A.3).

6.2 Credit and its maturity

Figure 9 reports the estimates. Panel A splits the firm's credit by maturity. Before 2010Q1 neither component differs between more and less exposed firms. Afterwards, relative to firms whose lenders were less exposed, firms whose lenders were one standard deviation more exposed see their medium- and long-term credit fall by 3.3 percentage points by 2011Q4 and by 4.2 percentage points by 2012Q2, while their short-term credit rises by 1.1 and 1.7 percentage points (Appendix Table D.1). The shortening of maturity documented at the bank–firm level

survives aggregation across the firm's lenders.

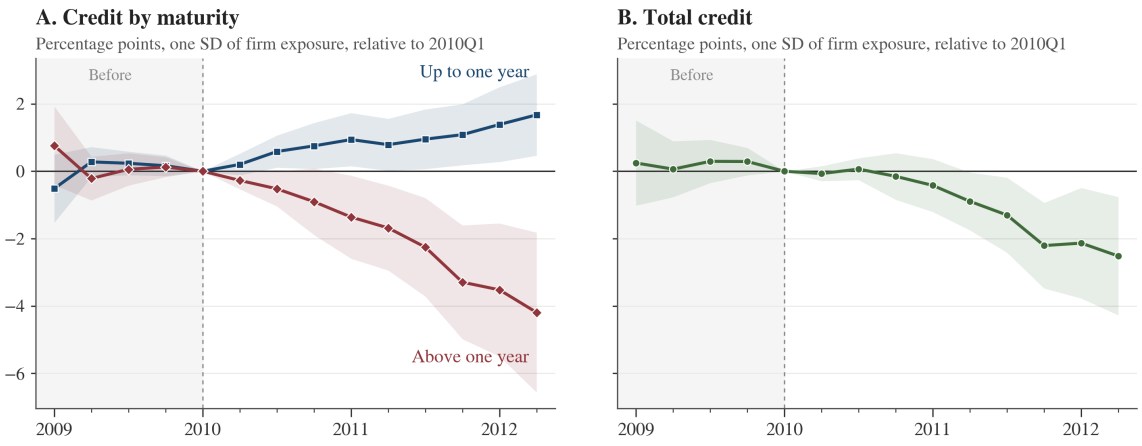


Figure 9: Firm-level credit by maturity and total credit, multi-bank firms. Coefficients on standardized firm exposure (GIIPS over assets) from Equation (5), as cumulative changes relative to 2010Q1, with 95 percent confidence intervals based on standard errors clustered by the firm's main pre-crisis lender. Panel A: credit from pre-crisis lenders with an original maturity of up to one year and above one year, each over the midpoint of the firm's total credit, so the two add to total credit. Panel B: total credit from pre-crisis lenders.

The firm-level estimates can be compared with the bank–firm estimates once both refer to the same shock. Because a firm averages over several lenders, one standard deviation of firm exposure (3.0 percentage points) is about 0.7 of one standard deviation of bank exposure (4.4 percentage points). If firms did not adjust at all, the bank–firm estimates would imply a decline in medium- and long-term credit of 3.5 percentage points by 2011Q4 and 4.2 percentage points by 2012Q2. The firm-level estimates are 3.3 and 4.2. The cut in medium- and long-term credit therefore reaches firms almost in full, and firms do not obtain this credit from their other lenders.

Panel B reports total credit, which falls by 2.2 percentage points by 2011Q4 and by 2.5 percentage points by 2012Q2 (Appendix Table D.1). This is about two thirds of the decline implied by the bank–firm estimates, and the difference is the rise in short-term credit, which offsets about a third of the decline in medium- and long-term credit at 2011Q4 and two fifths at 2012Q2. At the bank–firm level, short-term credit does not grow faster at more exposed banks than at less exposed ones, so this rise comes from all of the firm's lenders, and the within-firm comparison does not detect it. Firms whose lenders were more exposed therefore end the crisis with less credit from their pre-crisis banks, and with a larger part of it due within a year. This leaves them more exposed to the terms on which their credit is renewed (Diamond, 1991; He and Xiong, 2012).

Including single-bank firms, which can replace a lender only by opening a new relationship, the decline in total credit roughly doubles, to 4.9 percentage points by 2012Q2, and it is again concentrated in medium- and long-term credit (Appendix Table D.1, Panel B). Single-bank firms

Table 5: Adjustment margins, firm level

	New lender outside 2010Q1 pool (1)	Any new lender (2)	Number of lenders (3)	Utilization of commitments (4)
Firm exposure	−2.5***	−2.0***	−1.0**	−0.2
	(0.9)	(0.6)	(0.4)	(0.2)
Observations	45,989	45,989	45,989	31,086
Sector and municipality fixed effects	Yes	Yes	Yes	Yes
Bank and firm controls	Yes	Yes	Yes	Yes

Notes: Coefficient on standardized firm exposure (GIIPS over assets), in percentage points, over 2011Q4–2012Q2. Columns (1) and (2) are indicators for borrowing from a bank the firm did not borrow from in 2010Q1 and from any bank outside its 2010Q1 relationships of at least EUR 10,000; column (3) is the midpoint growth of the number of lenders since 2010Q1; column (4) is the firm's drawn credit divided by its total commitments, drawn and undrawn, summed over its lenders and averaged over 2011Q4–2012Q2, for firms with some undrawn commitment. Multi-bank firms. Standard errors clustered by the firm's main pre-crisis lender in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

are also smaller than multi-bank firms, so the gap cannot be read as the value of having several lenders.

Firms could also replace lost credit by borrowing from new banks or by drawing more on committed credit lines. Table 5 reports these margins over 2011Q4–2012Q2, with the controls and fixed effects of Equation (5). Relative to firms whose lenders were less exposed, firms whose lenders were one standard deviation more exposed are 2.5 percentage points less likely to form a relationship with a bank they did not borrow from in 2010Q1, and 2.0 percentage points less likely to form any new relationship, and as a result they end the period with fewer lenders. Nor do they draw more on the credit already committed to them: the share of their total commitments that is drawn is no different from that of firms whose lenders were less exposed. The firms' balance sheets, which record borrowing from all lenders, give the same picture (Appendix Table D.2). Between 2010 and 2012, financial debt falls by 0.6 percent of assets per standard deviation of exposure, entirely in non-current debt, while trade payables and cash do not change. The one margin that moves is equity: paid-up capital rises by 1.0 percent of assets. None of these items differs with exposure between 2007 and 2009, apart from small differences in trade payables and cash. Firms therefore adjust through the maturity of credit from their existing lenders rather than by moving to other banks. This is consistent with exposed banks being no more likely to terminate relationships (Section 4.5), and with evidence from other episodes in which firms could not offset a shock to their lenders (Iyer et al., 2014; Ferrando et al., 2017).

Two caveats apply to these estimates. The design compares firms, so it relies on the controls and fixed effects to absorb differences in demand. The credit register also does not record which side initiated a change in maturity, so a firm that chose shorter credit would produce the same

pattern. The bank–firm estimates of Section 4, which hold demand fixed, identify the shortening as a supply response; the firm-level estimates show that firms do not undo it.

7 Conclusion

When a sovereign comes under stress, the banks that hold its debt pass part of that stress on to the firms that borrow from them. Most of what we know about this transmission concerns the amount of credit that firms lose, while the maturity of their debt enters the analysis as a characteristic that firms bring into the crisis. This paper treats maturity instead as a decision that lenders take during the crisis, and shows that it is the lever through which exposed banks cut. Using the Portuguese credit register and differences in banks' pre-crisis holdings of distressed sovereign debt, I compare the credit that more and less exposed banks supplied to the same firm during the crisis of 2010–2012.

The first result is that the cut was made entirely at longer maturities. Relative to less exposed banks, more exposed banks reduced their lending to the same firm, and the whole reduction was in medium- and long-term credit, mostly at maturities of one to five years. Short-term credit showed no difference between the two groups of banks. The bank channel of sovereign risk therefore operates through credit at longer maturities. The reduction is not explained by the maturity of the loans that banks held before the crisis, by the run-off of existing loans, or by differences in demand across banks.

The second result is that banks used this lever selectively. The cut in medium- and long-term credit was larger for small, highly leveraged and financially constrained firms, and smaller for exporters and for firms with a lower risk of default, while short-term credit showed no such differences. Exposed banks therefore did not shorten maturities uniformly. They withdrew long-term commitments from the borrowers for which these commitments were riskiest. This differs from the evidence for Italy, where Bottero et al. (2020) find that the reduction in lending by exposed banks did not vary with firm size.

These cuts reached firms. Relative to firms whose lenders were less exposed, firms borrowing from more exposed banks lost almost all of the medium- and long-term credit implied by the bank-level estimates. They replaced only part of it with short-term credit and were less likely to start borrowing from new banks. They ended the crisis with less credit, and with a larger part of it falling due within a year.

Sovereign stress therefore changes the terms on which firms borrow as well as the amount. Banks under pressure avoid credit that ties up their funding and capital for long periods, and they avoid it most with their riskiest borrowers, while they continue to renew credit at short

maturities. As a result, firms depend more on the condition of their banks at the time these banks are weakest. For policy, measures that restore the amount of bank lending need not restore its maturity, and measures of credit conditions based only on amounts understate the effect of a sovereign shock on firms. Jasova et al. (2021) show that banks more exposed to the ECB's three-year refinancing operations lengthened the maturity of their loans, which suggests that the conditions at which banks are funded matter for the maturity of the credit that firms receive.

More broadly, the results suggest that the maturity of credit deserves attention as an outcome in its own right. Studies of how shocks to banks reach firms usually measure the amount of credit that firms lose, and in this episode that measure misses the dimension along which banks adjusted most.

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A Additional Descriptive Statistics and Diagnostics

Table A.1: From the credit register to the estimation samples

Stage	Obs	Firms	Banks	Credit (€bn)	% Credit	% Firms
Raw CRC universe (2010Q1)	494,055	270,636	80	132.6	100.0	100.0
+ cleaning & construction	442,954	248,394	78	130.4	98.4	91.8
+ CBHP merge (firm accounts)	327,311	176,694	77	88.4	66.7	65.3
+ relationship threshold (≥ €10,000)	242,976	138,756	77	88.0	66.4	51.3
+ BBS merge (deposit-takers)	228,878	135,375	55	86.5	65.3	50.0
+ market-share threshold (≥0.1%)	223,384	133,558	29	85.9	64.8	49.4
Final sample	**215,795**	**131,515**	**28**	**84.6**	**63.8**	**48.6**

Counts at 2010Q1. "% Credit" and "% Firms" are shares of the raw 2010Q1 register. The final rows additionally restrict to relationships already active before the crisis and not terminated before 2010Q2, at which point one further banking group exits the sample. Multi-bank firms are 17% of the firms in the register but account for almost half of register credit, so the within-firm design leans on the credit-weighted core of the corporate sector.

Table A.2: Estimation Panel: Firms, Banks, Quarters and Pair-Quarters

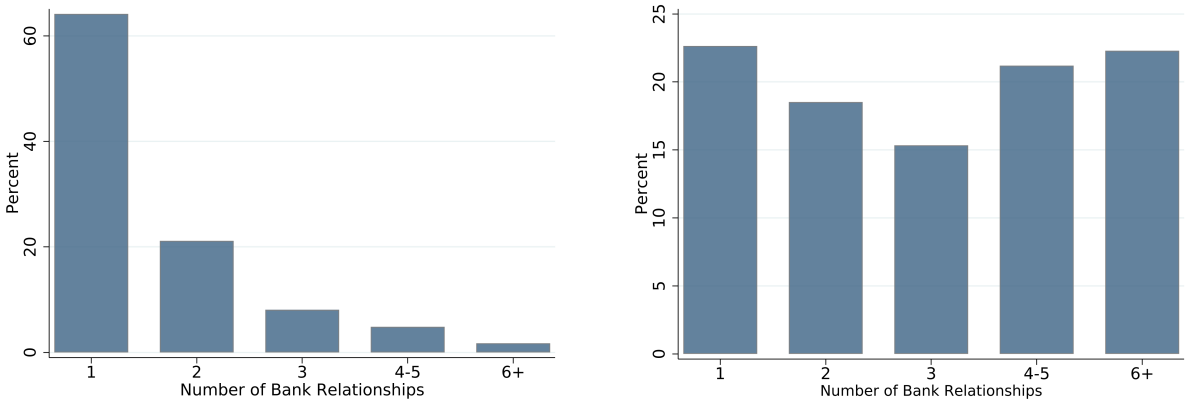
	All firms	Multi-bank
Firms	131,515	47,132
Banks	28	28
Quarters	14	14
Pair-quarter observations	2,803,272	1,716,801

Notes: Dimensions of the two estimation panels. The all-firms panel is used for the specifications with industry × location × size × quarter fixed effects; the multi-bank panel is used for the within-firm design with firm × quarter fixed effects. The sample window runs from 2009Q1 to 2012Q2.

Table A.3: Firms' Borrowing Relationships, 2010Q1

	N firms			
	nfirms	pfirms	credit	pcredit
1	84,383	64.16	19,150,115,618	22.64
2	27,808	21.14	15,667,419,584	18.52
3	10,651	8.10	12,974,994,433	15.34
4–5	6,385	4.85	17,929,079,882	21.20
6+	2,288	1.74	18,857,285,696	22.30

Notes: Distribution of firms by the number of distinct bank relationships at 2010Q1, by firm count and total credit volume.



(a) Share of firms

(b) Share of credit

Figure A.1: Distribution of bank relationships per firm, 2010Q1.

Table A.4: Bank Characteristics by Sovereign Exposure / Asset (2010Q1)

	Low Exposure			High Exposure			
	Mean	SD	N	Mean	SD	N	p-diff
Total Assets (€m)	11700.0	29700.0	14	26900.0	35400.0	14	0.231
Deposits Ratio	82.44	16.01	14	77.26	14.19	14	0.374
Liquidity Ratio	0.08	0.18	14	0.03	0.02	14	0.341
Loans Ratio	0.76	0.23	14	0.77	0.15	14	0.971
Equity Ratio	6.78	6.94	14	6.96	3.84	14	0.933
Wholesale Funding	75.30	21.70	14	54.68	24.72	14	0.027
Central Bank Funding	0.94	2.94	14	0.70	1.69	14	0.792
Debt Securities Funding	3.45	6.92	14	8.20	11.53	14	0.197
Interbank Ratio	64.98	32.18	14	37.97	27.46	14	0.024
NPL Ratio	0.00	0.00	14	0.01	0.01	14	0.477
Market Share	0.02	0.05	14	0.05	0.06	14	0.226
Observations	28						

Notes: The 28 banks are split at the median of sovereign exposure (GIIPS debt / asset at 2010Q1) into low- and high-exposure groups of 14. Columns report each group's mean, standard deviation, and number of banks; the last column (p-diff) is the p-value of a two-sample t-test of the difference in means (high vs. low). Total assets are in millions of constant 2015 euros.

Table A.5: GPSS Balance Test: Bank Covariates against the Standardized Shock

	(1) Std. Bank Sov. Exp.
Log Assets	0.203
	(0.121)
Liq. Ratio	-0.764
	(1.486)
Equity Ratio	-0.044
	(0.042)
Deposits Ratio	0.003
	(0.020)
Interbank Ratio	-0.006
	(0.009)
Observations	28
R^2	0.339

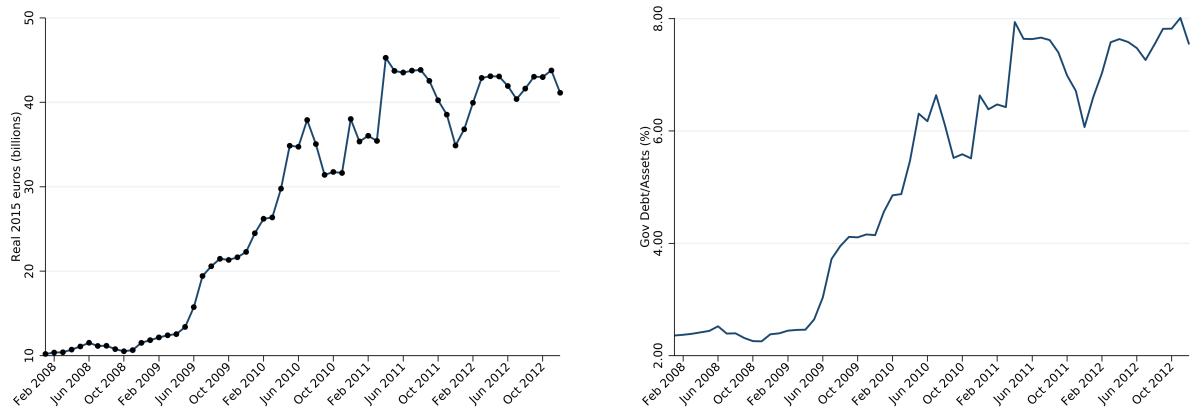
Notes: Goldsmith-Pinkham–Sorkin–Swift balance regression: the standardized bank sovereign exposure (asset-scaled σ_j) regressed on pre-period bank covariates over the 28 BBS banks. Robust SE in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.6: Balance Test: Borrowers of Low vs. High Exposure Banks (2010Q1)

	Low Exp	High Exp	Diff	p-value
Avg Borrower Log Assets	15.178	14.630	0.547	0.468
Avg Borrower Log Employment	2.689	2.633	0.056	0.823
Avg Borrower ROA	0.060	0.057	0.003	0.676
Avg Borrower Financial Leverage	0.439	0.404	0.035	0.488
Avg Borrower Wage	15229.872	13381.777	1848.095	0.291
Working Capital / Assets	0.024	0.062	-0.037	0.055
Altman Z-Score	1.106	1.258	-0.152	0.432
Firm Age (years)	16.009	17.133	-1.124	0.610
SA Index	-1.199	-1.004	-0.195	0.632
Exporter	0.317	0.376	-0.059	0.390

Each observation is a bank. Firm characteristics averaged across borrowers. N = 14 banks in each group.

Notes: t-test of the difference in mean borrower characteristics between firms borrowing from low- and high-exposure banks, split at the median. Each observation is a bank; firm characteristics are averaged across borrowers.



(a) Level

(b) Scaled by total assets

Figure A.2: Sovereign debt holdings of the sample banks, 2010–2013, in levels and scaled by total assets. Asset-scaled exposure is the headline measure.

Table A.7: Firm-Side Covariate Balance on Standardized Firm Exposure (Asset-Scaled)

Dependent variable	Coefficient	Std. error	N
Log total assets	0.0254	(0.0334)	47,118
Log employment	0.0485*	(0.0223)	45,660
Financial debt / assets	−0.0136	(0.00674)	47,122
Average wage per employee	148.4	(77.09)	45,660
Firm age (years)	0.110	(0.156)	47,131
Hadlock–Pierce SA index	−0.0308	(0.0294)	47,118
Exporter	0.00686	(0.00469)	47,131
Number of bank relationships	−0.0583	(0.0615)	47,131
Log firm credit, 2010Q1	−0.000452	(0.0423)	47,131
Short-term credit share, pre window	−0.0391	(0.0195)	47,131
Log credit growth 2009Q1–2010Q1 (pre-trend)	0.00925	(0.00627)	46,433

Notes: Each row is a separate OLS regression of the listed firm characteristic on the firm's standardized asset-scaled sovereign exposure $\bar{\sigma}_i$ (the credit-weighted average of its lenders' exposures), with sector × region fixed effects, over the multi-bank sample. Standard errors clustered by the firm's main pre-crisis bank in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.8: Cross-Bank Exposure Dispersion

Statistic	Debt/Assets
N banks	28
Mean	2.640
SD	3.556
CV (unweighted)	1.347
CV (credit-weighted)	0.887
P25	0.000
P75	3.286
IQR	3.286

Notes: Cross-sectional dispersion of bank sovereign exposure at 2010Q1, unweighted and credit-weighted.

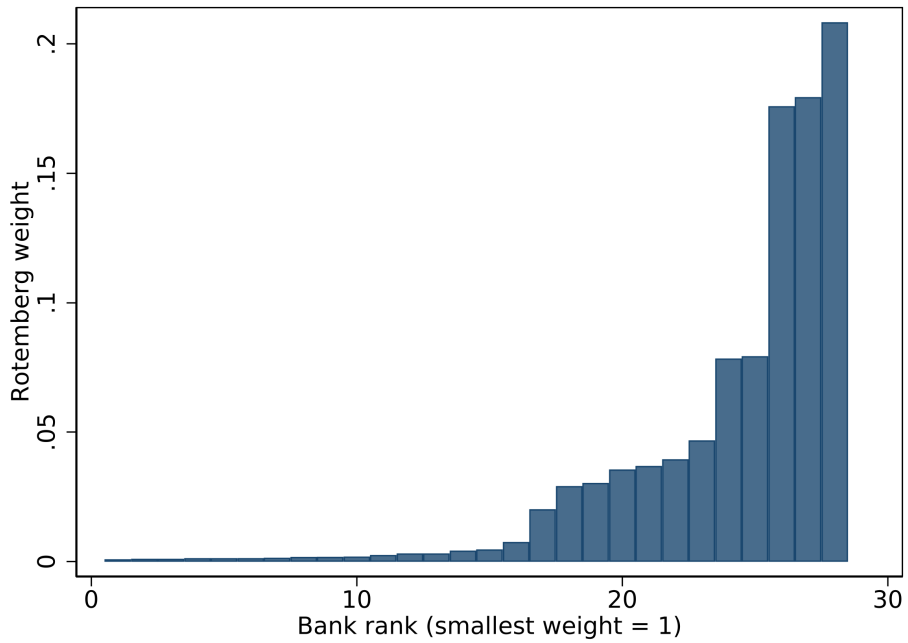


Figure A.3: Rotemberg-weight diagnostics for the shift-share exposure measure.

Table A.9: Firm Characteristics — Multi-Bank Sample

	Mean	SD	P25	P50	P75	N
Credit Growth (midpoint)	-0.38	0.61	-0.67	-0.30	-0.03	47132
Firm Sov. Exp. / Assets (GIIPS)	4.98	3.03	2.69	4.17	6.80	47132
Total Assets (€m)	4.45	50.20	0.30	0.72	2.02	47119
Turnover (€m)	3.24	38.60	0.22	0.57	1.62	45979
Employees	25.84	198.61	4.00	8.00	18.00	45661
Financial Leverage	0.38	0.30	0.17	0.32	0.51	47123
Return on Assets	0.05	0.55	0.02	0.07	0.12	47118
Altman Z-Score	1.35	2.16	0.62	1.39	2.16	47103
Firm Age (years)	15.24	13.02	7.00	12.00	20.00	47132
SA Index	-0.35	1.28	-1.21	-0.31	0.53	47119
Exporter	0.31	0.46	0.00	0.00	1.00	47132
N Bank Relationships	2.79	1.32	2.00	2.00	3.00	47132

All information refers to 2010Q1 baseline values

Notes: Cross-section of the 47,132 firms borrowing from more than one sample bank at 2010Q1 — the sample identifying the within-firm specifications. Total assets and turnover are in millions of constant 2015 euros; all other ratios are in percent.

Table A.10: Cumulative Bank–Firm Credit Growth by Period, Relative to 2010Q1

	Mean	SD	P25	P50	P75	N
Pre-crisis (2009Q1–2009Q4)	-0.000	0.469	-0.060	0.054	0.183	805,786
To peak (2010Q2–2011Q4)	-0.194	0.527	-0.386	-0.118	0.000	1,419,531
After peak (2012Q1–2012Q2)	-0.418	0.692	-0.827	-0.344	-0.049	362,160

Notes: Midpoint (DHS) growth of bank–firm credit relative to 2010Q1, pooled within each window.

Table A.11: Baseline Maturity Structure by Firm Type, 2010Q1

Firm group	Up to one year	Above one year	Median credit (€k)	Banks per firm	N firms
Large (above-median assets)	0.415	0.585	722	3.25	23,560
Small (below-median assets)	0.353	0.647	103	2.33	23,559
Low leverage (below median)	0.376	0.624	190	2.68	23,562
High leverage (above median)	0.392	0.608	311	2.90	23,561
Old (above-median age)	0.412	0.588	359	3.00	24,483
Young (below-median age)	0.354	0.646	161	2.56	22,649
Unconstrained (below-median SA)	0.419	0.581	704	3.23	23,560
Constrained (above-median SA)	0.349	0.651	106	2.35	23,559
High Z-score (above median)	0.408	0.592	217	2.80	23,552
Low Z-score (below median)	0.360	0.640	264	2.78	23,551
Non-exporter	0.369	0.631	186	2.58	32,527
Exporter	0.418	0.582	429	3.25	14,605

Notes: Maturity composition of the bank credit of multi-bank firms at 2010Q1, split at the median of each firm characteristic. For each firm, credit is summed across its banks in the estimation sample; the shares are the simple average across firms of each firm's share of credit up to and above one year at origination, and sum to one by construction. Median credit is in thousands of constant 2015 euros. 47,132 firms with 28 banks.

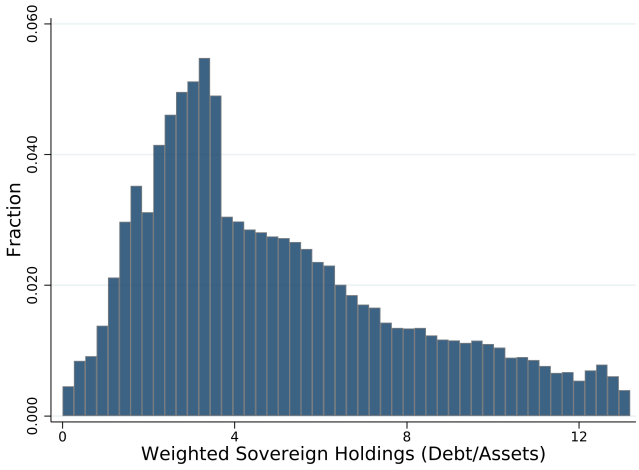


Figure A.4: Distribution of firm sovereign exposure / assets, multi-bank firms.

B Total Credit and Robustness

This appendix reports the results for total bank–firm credit and the exhibits behind the robustness checks of Section 4.5. Total credit is measured with the midpoint growth rate, which is the sum of the two maturity components in Equation (1).

The dynamic path. Figure B.1 reports the coefficients of Equation (2) for total credit, on the multi-bank sample with firm fixed effects and on all firms with ILST fixed effects. Table B.1 reports the estimates at 2010Q4, 2011Q4 and 2012Q2. By 2011Q4, credit from a bank with one standard deviation more exposure has grown 4.9 percentage points less on the multi-bank sample and 4.4 points less on all firms. For total credit, the coefficient in 2009Q4 is positive and significant in both samples, indicating that credit from more exposed banks had begun to decline in the quarter before 2010Q1, after the revision of the Greek deficit in October 2009. The coefficient is small relative to the effects after 2010Q1, and the coefficients for the two maturities, and for their difference, show no such movement (Section 4.1).

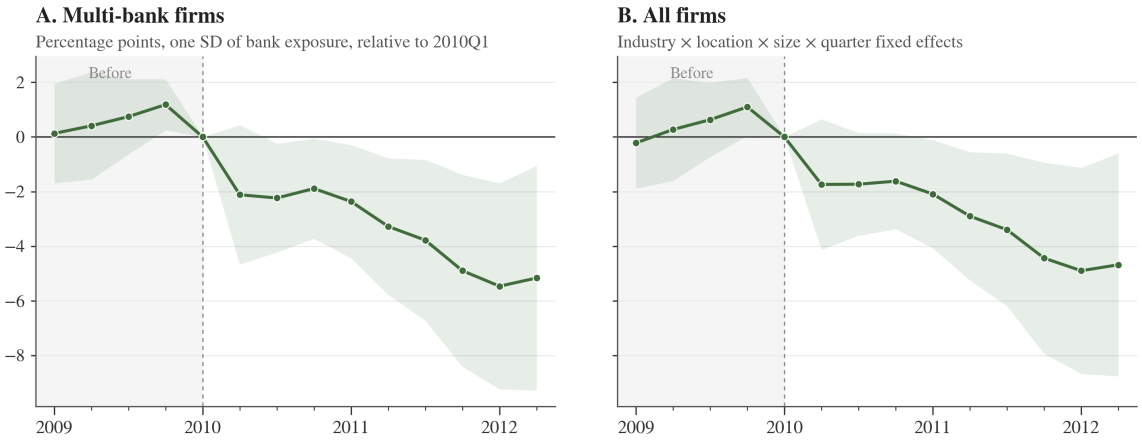


Figure B.1: Total credit at more exposed banks. Coefficients on standardized GIIPS exposure over assets from Equation (2), with total credit growth as the outcome, as cumulative changes relative to 2010Q1. Panel A: multi-bank firms, firm × quarter fixed effects. Panel B: all firms, industry × location × size × quarter fixed effects and firm controls. Bank controls in both. Shaded bands are 95 percent confidence intervals with standard errors clustered by bank. The shaded area marks the quarters before 2010Q1.

Table B.1: Pooled local projection: bank–firm credit growth, asset-scaled

	(1) Multi-bank (KM)	(2) All firms (ILST)
h = 2010Q4	-0.019**	-0.016*
	(0.009)	(0.009)
h = 2011Q4	-0.049***	-0.044**
	(0.017)	(0.017)
h = 2012Q2	-0.052**	-0.047**
	(0.020)	(0.020)
Observations	1,667,981	2,515,933
R^2	0.449	0.221
Firm × Quarter FE	Yes	No
ILST × Quarter FE	No	Yes
Firm Controls	No	Yes
Bank Controls	Yes	Yes
Bank Controls × Post	Yes	Yes
Sample	Multi-bank	All firms

Notes: Cumulative midpoint growth of pair-level credit relative to 2010Q1. All horizons are stacked in a single regression, so the rows share one estimation sample and one set of fixed effects. Column 1 has firm × quarter fixed effects on the multi-bank sample, column 2 ILST × quarter fixed effects and firm controls on all firms. Bank controls are interacted with post and not shown. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Robustness. The exhibits below accompany the checks of Section 4.5, in the same order.

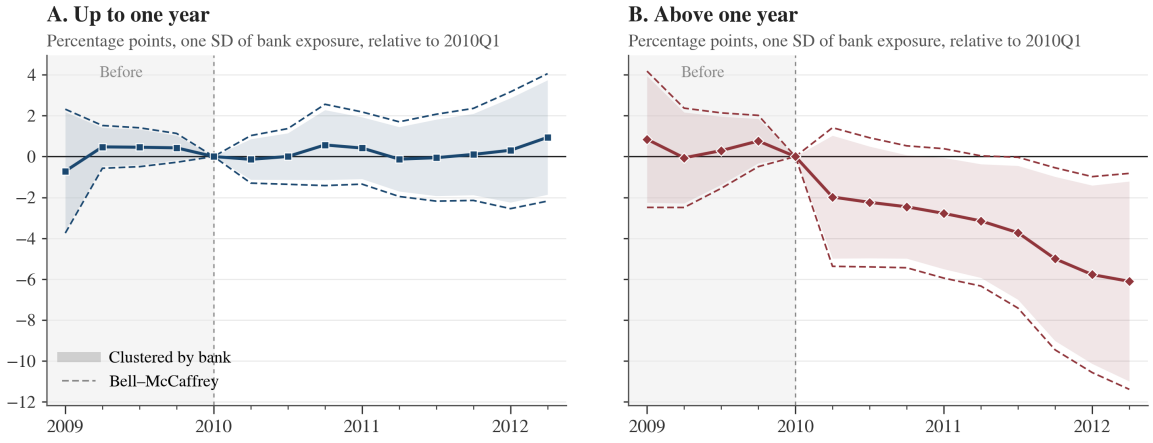


Figure B.2: Small-cluster inference. Coefficients on standardized GIIPS exposure over assets from Equation (2), as cumulative changes relative to 2010Q1, for credit up to one year (Panel A) and above one year (Panel B). Shaded bands are 95 percent confidence intervals with standard errors clustered by bank. Dashed lines are 95 percent confidence intervals with the bias-corrected standard errors of Bell and McCaffrey (2002) and the degrees of freedom of Imbens and Kolesár (2016). Multi-bank firms.

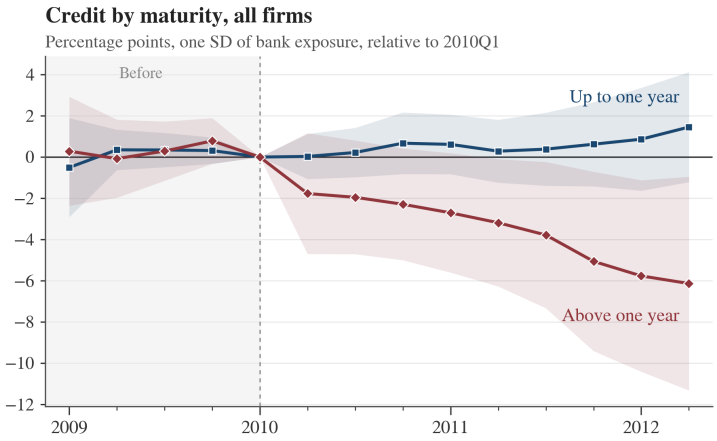


Figure B.3: Credit by maturity, all firms. Coefficients on standardized GIIPS exposure over assets from Equation (2) estimated on all firms, with industry × location × size × quarter fixed effects instead of firm × quarter fixed effects, as cumulative changes relative to 2010Q1. Bank controls. Shaded bands are 95 percent confidence intervals with standard errors clustered by bank.

Table B.2: Exposure to other sovereign portfolios, total credit

	Multi-bank (KM)			All firms (ILST)		
	(1) All	(2) PRT	(3) non-GIIPS	(4) All	(5) PRT	(6) non-GIIPS
Sov. Exp. (std.)	-0.002	-0.000	0.000	-0.002	-0.001	-0.002
	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Post × Sov. Exp. (std.)	-0.007***	-0.006***	-0.000	-0.006***	-0.005**	0.002
	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)
Observations	1,645,009	1,645,009	1,645,009	2,488,175	2,488,175	2,488,175
R^2	0.389	0.389	0.389	0.147	0.147	0.147
Firm × Quarter FE	Yes	Yes	Yes	No	No	No
ILST × Quarter FE	No	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls × Post	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank			All firms		

Notes: Each column estimates its own exposure variable: GIIPS, All (total sovereign holdings), PRT (Portuguese only) and non-GIIPS. Bank controls are additionally interacted with the post indicator. Columns 1–3 are the within-firm (Khwaja–Mian) specification: firm × quarter fixed effects on the multi-bank subsample. Columns 4–6 are the ILST specification: all firms, with industry×location×size×time fixed effects and firm controls. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table B.3: Exposure scaled by equity

	Total credit (1)	Up to one year (2)	Above one year (3)
2010Q4	-2.5^{**}	0.9	-3.4^{**}
	(1.0)	(1.1)	(1.5)
2011Q4	-6.5^{***}	0.3	-6.9^{***}
	(1.9)	(1.2)	(2.2)
2012Q2	-8.0^{***}	0.7	-8.6^{***}
	(2.1)	(1.6)	(2.5)
Observations	1,667,981	1,667,981	1,667,981
Firm × quarter fixed effects	Yes	Yes	Yes
Bank controls and Post × bank controls	Yes	Yes	Yes

Notes: Coefficients on standardized GIIPS exposure over equity from Equation (2), in percentage points, relative to 2010Q1. Multi-bank firms. Standard errors clustered by bank in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table B.4: Leave one bank out, total credit, 2012Q2

	Multi-bank firms	All firms
All 28 banks	-5.8^{***}	-5.3^{***}
	(1.7)	(1.7)
Estimate closest to zero	−4.2	−3.6
Estimate furthest from zero	−9.6	−8.6
Estimates negative, out of 28	28	28
Estimates with $p < 0.10$, out of 28	28	28

Notes: Coefficients on standardized GIIPS exposure over assets, in percentage points, for the growth of total credit between 2010Q1 and 2012Q2. The first row uses all banks; the following rows summarize 28 estimates, each excluding one bank. Multi-bank firms with firm fixed effects; all firms with industry × location × size fixed effects. Bank controls throughout. Standard errors clustered by bank in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table B.5: Relationship termination

	(1) Asset-scaled
Post × Sov. Exp.	0.00475
	(0.00322)
Observations	131,412
R^2	0.450
Randomisation-inference p	0.400
Firm FE	Yes
ILST FE	No
Firm Controls	No
Bank Controls	Yes
Sample	Multi-bank

Notes: Linear probability model; dependent variable is an indicator for the pair being terminated between 2009Q1–2010Q1 and the 2011Q3–2011Q4 peak. Firm fixed effects and bank controls. Standard errors clustered by bank in parentheses.

C Maturity: Additional Tables

This appendix collects the tables behind Sections 4 and 5, in the order in which the text first refers to them. Table C.1 gives the composition of the credit of the average relationship in 2010Q1 by original and by residual maturity. Table C.2 reports the estimates of Section 4.3, with each maturity measured over its own credit. Table C.3 reports the coefficients behind the five maturity bands of Figure 7. Table C.4 adds the residual maturity of the relationship's credit in 2010Q1 as a control, and Table C.5 is the pre-period placebo on the average original maturity. Tables C.6, C.7 and C.8 report the heterogeneity regressions of Equation (3) for short-term credit, for medium- and long-term credit and for total credit.

Table C.1: Maturity Composition of the Loan Book at 2010Q1

	Mean	SD	P25	P50	P75
Up to one year, original maturity	0.422	0.429	0.000	0.258	1.000
Above one year, original maturity	0.578	0.429	0.000	0.742	1.000
Up to one year, residual maturity	0.535	0.433	0.013	0.571	1.000
Above one year, residual maturity	0.465	0.433	0.000	0.429	0.987

Notes: Composition of outstanding bank–firm credit at 2010Q1 by maturity at origination (contracts of up to one year against contracts above one year) and, for comparison, by residual maturity. Shares are of the pair's total credit and sum to one by construction. Multi-bank relationships. The four rows share one estimation sample of 131,412 relationships.

Table C.2: Bank–firm credit growth by original maturity, relative to each component's own stock

	Up to one year			Above one year		
	(1) 2010Q4	(2) 2011Q4	(3) 2012Q2	(4) 2010Q4	(5) 2011Q4	(6) 2012Q2
Sov. Exp. / Asset (std.)	-0.014	-0.016	0.028	-0.044***	-0.089***	-0.105***
	(0.013)	(0.019)	(0.017)	(0.015)	(0.026)	(0.033)
Log Assets	0.055**	0.035	0.008	-0.007	-0.054	-0.058
	(0.025)	(0.033)	(0.041)	(0.026)	(0.040)	(0.040)
Liq. Ratio	0.009	0.019**	0.032**	0.025	0.033	0.013
	(0.009)	(0.008)	(0.015)	(0.016)	(0.025)	(0.021)
Equity Ratio	0.007	0.005	0.013*	0.004	0.009	0.014
	(0.005)	(0.007)	(0.007)	(0.005)	(0.009)	(0.012)
Deposits Ratio	0.012***	0.010**	0.004	0.009***	0.022***	0.032***
	(0.003)	(0.004)	(0.005)	(0.002)	(0.004)	(0.005)
Interbank Ratio	-0.006***	-0.010***	-0.009***	-0.004**	-0.011***	-0.017***
	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)
Observations	75,419	72,856	70,399	89,603	85,759	79,603
R^2	0.439	0.447	0.450	0.385	0.398	0.410
Denominator	Own	Own	Own	Own	Own	Own
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
ILST FE	No	No	No	No	No	No
Firm Controls	No	No	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank

Notes: Columns 1–3 report credit with an original maturity of up to one year and columns 4–6 credit with an original maturity above one year, at cumulative horizons 2010Q4, 2011Q4 and 2012Q2 relative to 2010Q1. Each component is scaled by the midpoint of its own stock rather than by total credit, so the two do not sum to total credit growth. The sample in each block is the set of relationships with credit in that component in at least one of the two periods. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.3: Credit by band of original maturity

	Up to 1 year	1 to 5 years	5 to 10 years	10 to 20 years	Above 20 years	Observations
2012Q2	1.10	−3.37**	−2.16**	−1.27**	−0.09	102,616
	(1.36)	(1.59)	(0.95)	(0.46)	(0.06)	
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	
Bank controls	Yes	Yes	Yes	Yes	Yes	

Notes: Coefficients on standardized GIIPS exposure over assets, in percentage points, for the growth of credit in each band of original maturity since 2010Q1. Every band is measured over the midpoint of the total credit of the relationship, so the five coefficients add up to the effect on total credit. Estimates at 2012Q2, as in Figure 7. Multi-bank firms. Standard errors clustered by bank in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.4: Residual-maturity controls

	Up to one year			Above one year		
	(1) 2010Q4	(2) 2011Q4	(3) 2012Q2	(4) 2010Q4	(5) 2011Q4	(6) 2012Q2
Sov. Exp. / Asset (std.)	0.003	-0.003	0.007	-0.019*	-0.054**	-0.064***
	(0.009)	(0.009)	(0.013)	(0.010)	(0.020)	(0.023)
Observations	123,561	111,951	102,616	123,561	111,951	102,616
R^2	0.394	0.420	0.435	0.390	0.428	0.446
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
ILST FE	No	No	No	No	No	No
Firm Controls	No	No	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Residual-maturity control	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank

Notes: Columns 1–3 report credit with an original maturity of up to one year and columns 4–6 credit with an original maturity above one year, at cumulative horizons 2010Q4, 2011Q4 and 2012Q2 relative to 2010Q1. Both components are scaled by the midpoint of total credit, so the two sum to total credit growth. The specification adds the average residual maturity of the relationship's credit in 2010Q1, to control for loans on the books in 2010Q1 that reach maturity. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.5: Placebo: pre-period change in average origination maturity, asset-scaled

	(1) Asset-scaled
Sov. Exp. / Asset (std.)	0.026
	(0.036)
Observations	124,739
R^2	0.361
Firm FE	Yes
Bank Controls	Yes
Sample	Multi-bank

Notes: Dependent variable: change in the average origination maturity of the pair's credit, in years, across two pre-crisis windows. Firm fixed effects, multi-bank sample. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.6: Heterogeneity across firms at the peak: credit up to one year

	(1) Small	(2) High Leverage	(3) SA Index	(4) Altman Z-Score	(5) Exporter	(6) Return on Assets
Sov. Exp. / Asset (std.)	0.008	0.002	0.002	0.004	0.007	0.004
	(0.020)	(0.017)	(0.018)	(0.019)	(0.019)	(0.019)
Sov. Exp. × Moderator	-0.011	0.011	-0.006	-0.001	-0.007	0.000
	(0.012)	(0.012)	(0.007)	(0.008)	(0.009)	(0.008)
Observations	131,377	131,388	131,377	131,344	131,412	131,375
R^2	0.438	0.438	0.438	0.438	0.438	0.438
Adj. R^2	0.124	0.124	0.124	0.124	0.124	0.124
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
ILST FE	No	No	No	No	No	No
Firm Controls	No	No	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank
Original maturity	≤1y	≤1y	≤1y	≤1y	≤1y	≤1y

Notes: Each column is a separate regression of the peak-window credit change on standardised sovereign exposure, the moderator, and their interaction. The row *Sov. Exp.* × *Moderator* is the interaction; the column header names the moderator. Dependent variable: growth of credit with an original maturity of up to one year, scaled by the midpoint of total credit. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.7: Heterogeneity across firms at the peak: credit above one year

	(1) Small	(2) High Leverage	(3) SA Index	(4) Altman Z-Score	(5) Exporter	(6) Return on Assets
Sov. Exp. / Asset (std.)	-0.043	-0.048	-0.061*	-0.057*	-0.071**	-0.056
	(0.034)	(0.033)	(0.033)	(0.033)	(0.032)	(0.033)
Sov. Exp. × Moderator	-0.034***	-0.035**	-0.015***	0.019**	0.039***	0.010
	(0.009)	(0.015)	(0.004)	(0.008)	(0.008)	(0.007)
Observations	131,377	131,388	131,377	131,344	131,412	131,375
R^2	0.438	0.437	0.438	0.438	0.438	0.437
Adj. R^2	0.123	0.123	0.123	0.123	0.123	0.122
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank
Original maturity	>1y	>1y	>1y	>1y	>1y	>1y

Notes: Each column is a separate regression of the peak-window credit change on standardised sovereign exposure, the moderator, and their interaction. The row *Sov. Exp.* × *Moderator* is the interaction; the column header names the moderator. Dependent variable: growth of credit with an original maturity above one year, scaled by the midpoint of total credit. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table C.8: Incidence at the peak, total credit

	(1) Small	(2) High Leverage	(3) SA Index	(4) Altman Z-Score	(5) Exporter	(6) Return on Assets
Sov. Exp. / Asset (std.)	-0.035	-0.046*	-0.058**	-0.052**	-0.064***	-0.052**
	(0.024)	(0.025)	(0.024)	(0.024)	(0.022)	(0.024)
Sov. Exp. × Moderator	-0.044**	-0.024**	-0.021**	0.018*	0.031**	0.010
	(0.016)	(0.010)	(0.009)	(0.009)	(0.014)	(0.008)
Observations	131,412	131,388	131,377	131,344	131,412	131,375
R^2	0.463	0.463	0.463	0.463	0.463	0.462
Adj. R^2	0.163	0.162	0.163	0.162	0.162	0.162
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
ILST FE	No	No	No	No	No	No
Firm Controls	No	No	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank	Multi-bank

Notes: Each column is a separate regression of the peak-window credit change on standardised sovereign exposure, the moderator, and their interaction. The row *Sov. Exp.* × *Moderator* is the interaction; the column header names the moderator. *Small* is an indicator for below-median firm assets. Dependent variable: growth of total pair-level credit. The moderators are the same as in Table C.7, which reports credit with an original maturity above one year. Robust SE clustered at bank in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

D Firm-Level: Additional Results

This appendix reports the estimates behind Section 6. Table D.1 gives the firm-level effects on total credit and on its two maturity components at three horizons, for multi-bank firms and for all firms. Table D.2 reports the changes in their balance-sheet funding.

Table D.1: Credit by maturity, firm level

	Total credit (1)	Up to one year (2)	Above one year (3)	Observations
A. Multi-bank firms				
2010Q4	−0.15	0.75**	−0.90*	45,825
	(0.34)	(0.33)	(0.48)	
2011Q4	−2.21***	1.09**	−3.29***	45,153
	(0.62)	(0.44)	(0.82)	
2012Q2	−2.52***	1.67***	−4.19***	44,451
	(0.85)	(0.59)	(1.15)	
B. All firms				
2010Q4	−1.15*	0.42	−1.57*	121,952
	(0.63)	(0.49)	(0.80)	
2011Q4	−4.49***	0.37	−4.86***	115,049
	(1.37)	(0.81)	(1.75)	
2012Q2	−4.89***	1.08	−5.97***	108,794
	(1.52)	(1.00)	(2.11)	
Sector and municipality fixed effects	Yes	Yes	Yes	
Bank and firm controls	Yes	Yes	Yes	

Notes: Coefficient on standardized firm exposure (GIIPS over assets), in percentage points, from Equation (5), one regression per quarter and column. The outcome is the change in the firm's credit from its pre-crisis lenders since 2010Q1, measured over the firm's total credit, so columns (2) and (3) add up to column (1). Panel B adds single-bank firms. Standard errors clustered by the firm's main pre-crisis lender in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table D.2: Balance-sheet funding, firm level

	Financial debt (1)	Non-current (2)	Current (3)	Trade payables (4)	Cash (5)	Paid-up capital (6)
2010 to 2012	−0.6***	−0.5*	−0.1	−0.1	−0.1	1.0***
	(0.1)	(0.3)	(0.3)	(0.1)	(0.1)	(0.1)
2007 to 2009	0.3	0.2	0.1	−0.4**	0.3**	0.3
	(0.4)	(0.1)	(0.3)	(0.1)	(0.1)	(0.2)
Observations, 2010 to 2012	39,746	39,746	39,746	39,746	39,746	39,746
Observations, 2007 to 2009	44,554	44,554	44,554	44,554	44,554	44,554
Sector and municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank and firm controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Coefficient on standardized firm exposure (GIIPS over assets), in percentage points. The outcome is the change in each balance-sheet item over the window, divided by total assets at the start of the window. Financial debt is the sum of non-current and current financial debt from all sources. The 2007 to 2009 window is a placebo before the crisis. Multi-bank firms. Standard errors clustered by the firm's main pre-crisis lender in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.