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Not all shocks are created equal: assessing heterogeneity in the bank lending channel

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Abstract

We provide evidence that the strength of the bank lending channel varies considerably across three major events in the European sovereign debt crisis – the Greek debt restructuring (PSI), outright monetary transactions (OMT), and quantitative easing (QE). We study how lending responds to each shock using detailed bank, firm, and household data from Portugal, a country that was directly exposed to the three events. While the price of sovereign debt securities increased in all three events, banks reduced sovereign debt holdings and realized accumulated capital gains only after QE. As a result, lending to final borrowers reacted more strongly to QE than to the PSI or OMT events. Our results suggest that asset purchases were more effective than signalling events at stimulating the bank lending channel.

Keywords: asset purchases, bank lending channel, OMT, PSI, QE
JEL codes: E52, E58, G18, G21

Non-technical Summary

The bank lending channel theorizes that monetary policy events affect lending to firms and households through banks. Central banks may use this channel to incentivize lending in periods of credit market distress. However, evidence of the effectiveness of the bank lending channel is still scarce. Some papers have studied the effects of individual events in isolation, but it is difficult to compare different policy interventions because of the use of different samples and techniques. We add to this literature (e.g., Di Maggio et al. (2016), Chakraborty et al. (2017)) by studying events that affected bank balance sheets in the European sovereign debt crisis jointly and documenting significant heterogeneity in the strength of the bank lending channel.

We compare the effects of the announcement of three major events in the European sovereign debt crisis: the Greek Private Sector Involvement (PSI) in February 2012, Outright Monetary Transactions (OMT) in July 2012, and quantitative easing (QE) in January 2015. These interventions sought to revive the euro area economy, especially in countries exposed to the European sovereign debt crisis. As we and other researchers show using security price data (e.g., Koijen et al. (2017a), Krishnamurthy et al. (2018)), the three events had a positive effect on the price of European government bonds. However, QE differed from PSI and OMT because the central bank only conducted asset purchases with QE. We analyze the effects of these events using credit register, bank, and firm data covering 44 Portuguese banks and their credit relationships with firms and households.

We start our analysis by estimating the effect of exposure to euro area sovereign debt securities on bank balance sheets. We find that banks with a larger exposure to government bonds reduced their sovereign debt holdings in the first year after QE, but not after PSI and OMT. Next, we analyze the transmission of the three events to firms and households. In the first year after QE, banks that were more exposed to government bonds lent more to their customers, were less likely to terminate credit relationships, and were more likely to accept loan applications. We also find evidence of changes in creditor composition for QE, as the effect of exposure to sovereign debt on lending was stronger for riskier firms. We find a more moderate to null effect for PSI and OMT. Finally, we use detailed financial statement data to analyze the effect of exposure to sovereign debt on aggregate firm outcomes. Firm exposure to sovereign debt securities had a largely positive effect on aggregate firm-level lending after QE and a milder effect after PSI and OMT. Additionally, exposure to sovereign debt had a positive effect on sales growth for firms that applied for new loans at exposed banks after QE. Overall, we provide evidence that QE had a stronger effect than PSI and OMT on the transmission of unconventional monetary policy through the bank lending channel. Exposed

banks increased lending more after QE, and to some extent borrowers responded to additional credit availability with more economic activity. Overall, our evidence suggests that asset purchases were more effective than signaling events at stimulating the bank lending channel during the European sovereign debt crisis.

1 Introduction

In macro-finance models with financial intermediation, banks affect the transmission of monetary policy to final borrowers through the bank balance sheet channel. Banks hold securities in their balance sheet and increase lending when the value of these securities goes up. Interventions by the policymaker affect security prices and cause variation in bank lending. Shocks that potentially affect lending are not all equal. In some cases, the policymaker just signals its future behavior. In other cases, it intervenes directly by purchasing assets. Empirically, there is little evidence on how elasticities vary with the nature of shocks. Some papers study the effect of specific events on lending in isolation. However, it is difficult to compare different policies because the samples and techniques researchers use vary across papers.

In this paper, we fill this gap by comparing the effect of three major events of the European sovereign debt crisis on banks and borrowers: the Greek debt restructuring (PSI), Outright Monetary Transactions (OMT), and Quantitative Easing (QE). We use a sample of 44 Portuguese banks that were directly exposed to these shocks. Portugal provides a unique laboratory to test the effect of different shocks on the bank lending channel as the country was exposed directly to the three events. PSI avoided a disorderly Greek default (Zettelmeyer et al. (2013)). Positive news from Greece signaled lower risk of contagion and reduced government bond yields in other European periphery countries such as Portugal (Mink and De Haan (2013)). OMT directly affected Portuguese government bonds. Ireland and Portugal were the only countries that were eligible for OMT purchases because they received a financial assistance program but did not default on their debt. The yields of Portuguese bonds dropped significantly because of the OMT announcement (Krishnamurthy et al. (2018)). QE also had a positive effect on the price of sovereign debt securities from Portugal and other European countries (Koijen et al. (2017a)). However, in contrast to PSI and OMT, the central bank purchased government bonds under the QE program.

Using detailed bank, household, and firm data, we measure the effect of exposure to sovereign debt securities on bank balance sheets and lending for the three events. First, we use ISIN-level data with detailed information on the price, quantity, and book value of all securities held by individual banks to analyze the effect of each shock on bank balance sheets. This data allows us to compute the exposure of each bank to European sovereign debt. The value of securities held by exposed banks increased more after PSI and OMT than after QE. However, exposed banks reduced their exposure to government bonds and realized accumulated capital gains after QE but not after PSI and OMT.

Second, we analyze the transmission of these shocks to households and firms in the intensive and extensive margins. Using credit register data, we compute the change in lending for each borrower-bank credit relationship between the month before the event and up to one year after the event. Using the identification strategy from Khwaja and Mian (2008), we control for the effect of borrower demand on lending. We also compute the success rate of loan applications by employing a methodology that is similar to the one used by Jiménez et al. (2012). After QE, exposed banks lent more to their customers, were less likely to terminate credit relationships, and were more likely to accept loan applications. We also find evidence of changes in creditor composition for QE, as the effect of exposure to sovereign debt on lending was stronger for riskier firms. We find that exposure to sovereign debt had a more moderate to null effect on lending with PSI and OMT. We measure the elasticity of bank lending to changes in security prices and capital gains. We do not observe a strong relationship between price appreciation and lending. However, we find evidence of a strong and positive relationship between lending and realized capital gains, particularly after QE.

Finally, we analyze the effect of exposure to sovereign debt on aggregate firm outcomes. Consistent with the results from the bank-borrower analysis, exposure to sovereign debt securities had a largely positive effect on aggregate firm-level lending after QE and a milder effect after PSI and OMT. Additionally, exposure to sovereign debt had a positive effect on sales growth for firms that applied new loans at exposed banks after QE. We find no evidence that exposure to government debt had a positive effect on real outcomes for firms with existing relationships in any of the three events or for new loan applicants after PSI and OMT.

The contribution of this paper is twofold. First, we show that in a unified framework that covers the universe of borrowers in an economy, balance sheet shocks have a different effect on the transmission of lending to households. Policies such as PSI and OMT had a limited effect on lending in the intensive and extensive margins through the balance sheet channel, while asset purchases had a strong positive impact. Second, we compute lending elasticities to asset prices and capital gains. With these findings, we inform quantitative macro-finance modeling and show that bank shocks do not affect the bank lending channel in the same way.

Literature Our research contributes to the literature on the bank lending channel of monetary policy (Kashyap and Stein (1994), Holmstrom and Tirole (1997)), specifically to a growing body of literature exploiting variation in banks' sovereign debt holdings. We analyze empirically the effect of policies that potentially affect lending through changes in the value of assets held by banks (Brunnermeier and Sannikov (2016)), or through incentives to rebalance bank portfolios with assets that have similar characteristics (Goldstein et al. (2018)). Existing papers study single episodes in the sovereign debt markets in isolation[1]. For example, Bottero et al. (2019) study the corporate credit supply effects of the onset of the sovereign debt crisis in Italy. Acharya et al. (2017) exploit heterogeneity in the banks' sovereign bond holdings to study the effect of the announcement of the ECB's Outright Monetary Transactions (OMT) on credit misallocation to zombie firms. Our contribution is to study events that affect bank balance sheets jointly and document significant heterogeneity in the strength of the bank lending channel. We also relate our findings to the trading behavior of banks.

We also contribute to the extensive literature on the transmission and effects of unconventional monetary policy. In the US, Di Maggio et al. (2016), Chakraborty et al. (2017), Luck and Zimmermann (2017) and Rodnyansky and Darmouni (2017) exploit the differential bank holdings of mortgage-backed securities—similar to our cross-sectional identification strategy—find positive the effects of QE on lending in the mortgage market, especially for QE3, the most similar to the ECB's QE program.[2] Similar to our findings, Luck and Zimmermann (2017) find positive effects on both

[1] The literature also studies other ECB interventions, predominantly long-term refinancing operations (LTRO). Carpinelli and Crosignani (2017) study the ECB liquidity injections (LTRO) 2011-2012.

[2] The Federal Reserve's QE3 and the ECB EAPP were both open-ended commitments to purchase a certain monthly volume of securities until economic conditions improved. In earlier work, Stroebel and Taylor (2012) analyze the effect of the Federal Reserve's mortgage-backed securities purchase program on mortgage spreads.

commercial and industrial (C&I) and household lending.[3] Beyond the US, Morais et al. (2019) study the international transmission of quantitative easing through foreign banks. In Europe, the literature on the real effects of QE has focused on the real effects of corporate-sector purchase programs (e.g. B Grosse-Rueschkamp, S Steffen, D Streitz (2017), see also Dell'Ariccia et al. (2018) for a survey).

Finally, our paper is related to literature that studies the incentives of European banks when choosing exposure to sovereign debt. Acharya and Steffen (2015) argue that a combination of regulatory arbitrage and risk-shifting led banks to increase exposure to sovereign debt with the onset of the sovereign debt crisis. Becker and Ivashina (2017) and Ongena et al. (2019) argue that government pressure played a role in the banks' increasing exposure to domestic sovereign debt. Abbassi et al. (2016) show that banks with trading desks scaled up their investment into sovereign debt as the yields became more attractive with the onset of the sovereign debt crisis. Our contribution is to show that these forces matter for the transmission of unconventional policy to lending. We show that banks only react to valuation gains by reducing their net positions in response to QE when many of the above incentives had been mitigated. We confirm the finding of Koijen et al. (2017b) that Euro-area banks started selling eligible securities to the ECB in response to QE.

The remainder of this paper is organized as follows. Section 2 describes the data and the sovereign debt events we exploit. Section 3 describes the empirical strategy. Section 4 provides results. Section 5 concludes.

2 Background and Data

In this section, we provide background on the three episodes we study and describe our data.

[3] In earlier work, Chakraborty et al. (2017) found that the increase in credit supply in the US mortgage market crowds out C&I lending.

2.1 Background on Events in European Sovereign Debt Markets

We study three key events that induced large changes in sovereign debt prices: the Greek government PSI program in February 2012, the OMT announcement in July 2012, and finally the announcement of the ECB's QE program in January 2015.

PSI On April 23 2010, the Greek government officially requested a bailout package from the EU and IMF, triggering a series of events that culminated in the European sovereign debt crisis (Lane, 2012). In 2012, there were two major interventions in the European securities market as a direct response to the sovereign debt crisis. In late February, the Greek government announced the *private sector involvement* (PSI), a program to restructure sovereign debt held by private investors. Under this agreement, bond holders accepted a haircut of 53.5% in exchange for new Greek government debt securities. On 9 March 2012, the International Swaps and Derivatives Association (ISDA) declared that Greece's restructuring represented a default, implying that credit default swaps would be triggered. The Greek government introduced a retroactive collective action clause to enforce private sector participation. PSI is widely seen as a positive system-wide shock as the restructuring prevented a potential disorderly default (e.g., Zettelmeyer et al. (2013)). Portuguese yields peaked in the month before PSI was announced and declined steadily in the subsequent months (Figure 1). In Appendix A we estimate that PSI reduced Portuguese government bond yields by 160-420 basis points.

[Figure 1]

OMT In July 2012, the then-president of the ECB, Mario Draghi, gave a speech in London that included the famous remark that "within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough." This speech was succeeded a week later by the *Outright Monetary Transactions* (OMT) program, in which the ECB pledged to buy government bonds from bailed out countries. This program was subject to conditionality: governments of bailed out countries could not default on their debt and had to actively request intervention from the ECB.

Even though the ECB never made use the OMT program, the OMT was perceived as having been successful in bringing down bond yields (Krishnamurthy et al. (2018)).

QE In January 2015, the ECB announced the *Public Sector Purchase Program* (PSPP), the first major government bond quantitative easing program in Europe. The ECB pledged to buy government bonds in the secondary market every month. The objective of these purchases was to decrease yields at the long end and transmit monetary policy to final borrowers through greater lending. PSPP distinguished itself from OMT for two reasons. First, it increased prices of government bonds not only from the periphery but also from countries in the core of the Euro Area (Koijen et al. (2017a)). Second, it resulted in actual purchases of assets from the central bank.

2.2 Portugal as a Laboratory

Portugal provides an excellent laboratory to study key events in sovereign debt markets that affected European banks in the aftermath of the sovereign debt crisis.

At the onset of the crisis, the balance sheets of Portuguese banks were directly exposed to securities from periphery countries (Greece, Ireland, Italy, Portugal, and Spain). Throughout the crisis period, banks increased their exposure to Portuguese securities significantly. Figure 2 depicts the evolution of sovereign debt held by Portuguse banks. In January 2010, sovereign debt from Portugal represented about 2% of the assets held by banks in the sample. At the end of 2016, Portuguese debt securities represented almost 6% of the assets held by these banks. The exposure to sovereign debt securities from other periphery countries was about 1% in the beginning of 2011 and increased to approximately 3% at the end of 2016.

[Figure 2]

Portugal was also directly exposed to each of the major programs that affected bond prices. Portugal and Ireland were the only countries that were eligible for OMT purchases, which required participants to be under an adjustment program and to have no default history. Among periphery countries, Portugal was also the most exposed to sovereign debt events in Greece (Mink and De Haan (2013)). Finally, the ECB actively bought Portuguese government bonds from Portuguese banks through the implementation of the QE program (Koijen et al. (2017a)).

2.3 Data

We use data for the universe of banks that operate continuously in Portugal between April 2010 and January 2016. Table 1 shows descriptive statistics for the variables used in the analysis for each of the 44 banks across the three events. In Columns (1) and (2) of Table 1a, we show descriptive statistics weighted by the number of borrowers in the sample (including borrowers with single relationships). In Columns (3) and (4), we show unweighted statistics. In Table 1b we provide descriptive statistics for firm and household borrowers. We show statistics for households with multiple credit relationships, as we use borrower fixed effects to control for demand factors throughout our analysis (see Khwaja and Mian (2008)). In Table A1 we provide descriptive statistics separately for each event.

[Table 1]

2.3.1 Credit Register

We obtain monthly lending data for all banks in Portugal from the Portuguese credit register maintained by the Bank of Portugal. The credit register has two distinctive advantages. First, there is nearly universal coverage because banks must report all exposures above EUR 50. Second, it covers both households and non-financial firms. Household loans include credit card borrowing, personal loans, and mortgage loans. An important feature of the data is that a substantial fraction of non-financial firms and households have multiple lending relationships. This allows us to implement a borrower fixed effect strategy following Khwaja and Mian (2008).

2.3.2 Credit Registry Inquiries

We also draw on the database of bank inquiries to the credit registry maintained by the Bank of Portugal. Banks can request information on a potential borrower from the credit register. Inquiries are usually requested only for a loan application of a potential new corporate or household borrower by lenders that have no pre-existing credit relationship. We match the inquiry data to the credit registry to compute successful and unsuccessful loan applications following Jiménez et al. (2012).

2.3.3 Bank Data

We use four separate sources of bank data from the Bank of Portugal. At the ISIN level, we use SIET (Estatísticas de Emissões de Títulos), a dataset that contains the list of all securities (with ISIN) held by each bank at the monthly frequency. We also use an *Asset Purchase Program* (APP) purchases dataset. This file contains the list of transactions of Portuguese assets performed by the ECB under the APP and includes the identification of counterparties. This dataset is provided by the Bank of Portugal.

We retrieve bank balance sheet variables from MFI (Estatísticas Monetárias e Financeiras), which has monthly financial statements for all banks. We augment this dataset with quarterly regulatory ratios from an additional FINREP/COREP dataset

Total gains with securities are derived by multiplying monthly price variation by outstanding security holdings. Realized gains are cumulative gains that banks monetize when they close their position in a certain security. We compute the effect of price variation and capital gains on bank net worth using the following formula:

$$\Delta\ log\ net\ worth_{bk} = log(1 + capital_{bt} + \Delta value_{bk}) - log(1 + capital_{bt}) \tag{1}$$

Where $capital_{bt}$ is the capital and reserves of bank b in the last period before the event and $\Delta value_{bk}$ is the change in value or capital gains for securities in SIET. We set $\Delta\ log\ net\ worth = -1$ when $-\Delta value_{bk} > capital_{bt}$. We winsorize monthly price changes from SIET at the 1% level.

We define bank exposure to sovereign securities using ISIN-level data from SIET. We obtain a list of marketable securities that are eligible for collateral from the ECB website at the monthly frequency. Securities from SIET are classified as exposed sovereign debt if they observe three conditions: 1) appear at least once in the list of marketable securities from the ECB; 2) are issued by central governments and; 3) are denominated in euro.

2.3.4 Firm Data

We use annual firm financial statements from Base de Dados das Contas Anuais (BDCA), a repository of financial statements maintained by the Portuguese government that covers the universe of non-financial corporations. We retrieve CAPEX/Sales and interest rates from this dataset and winsorize these variables at the 1% level.

3 Empirical Specification

We estimate the the following specification for the cross-section of banks at each event:

$$y_b = \beta_1 exposure_b + \gamma X_b + \epsilon_b \tag{2}$$

where y_i is the dependent variable of interest. We obtain $exposure_b$ by standardizing $\frac{Exposed\ assets_b}{Total\ bank\ assets_b}$, the book value of exposed assets divided by total assets in the last period before the event. We also include a number of bank controls X_i to absorb any confounding changes from changes in size (total assets), capitalization (capital ratio), or different levels of non-performing loans. The validity of our approach relies on the the assumption that the degree of a bank's exposure to sovereign debt should not be correlated with any other contemporaneous shock. One potential confounding factor are the ECB's long-term refinancing operations (LTRO) that provided cheap financing to the European banking system (e.g., Carpinelli and Crosignani (2017)). To address this concern, we include the bank-level LTRO take-up in X_b.

We also estimate a bank-level dynamic differences-in-differences model:

$$y_{bt} = \alpha_b + \alpha_t + \sum_{k=2011Q4}^{2016Q4} \beta_k (exposure_b \times \mathbb{1}_{t=k}) + \epsilon_{bt} \tag{3}$$

where y_{bt} is the outcome of interest in period t, α_b and α_t are bank and time fixed effects, and $\mathbb{1}_{t=k}$ is an indicator variable that is equal to 1 in period k.

At the borrower(i)-bank(b) level, we estimate the following specification cross-sectionally for each event:

$$y_{bi} = \beta_1 \text{exposure}_b + \theta_i + \varphi X_{bi} + \epsilon_{bi} \tag{4}$$

where y_{bi} is the outcome of interest. θ_i is a borrower fixed effect (Khwaja and Mian (2008)) that absorbs any borrower-level changes in credit growth, allowing us to identify the effect of changes in the share of lending supplied by more versus less exposed banks. We include borrower-bank level controls X_{bi}, including the number of years the relationship has existed to address worries that longer relationship might receive a differential treatment from recently established lending relationships. We cluster standard errors at the bank level, which is our level of the treatment (Bertrand et al. (2004)).

In addition to the lending volume in existing lending relationships (intensive margin), we also estimate effect of sovereign debt exposure on the likelihood that an existing relationships ends (linear probability model) and on new loan approval rates using credit registry inquiries (as in Jiménez et al. (2012)). Successful applications are credit inquiries followed by a lending relationship in the subsequent 6 months.

Additionally, we provide direct estimates of the lending elasticity to changes in bank net worth induced by price increases or realized capital gains:

$$y_{bi} = \tilde{\beta}_1 \Delta \text{net worth}_b^{capital} + \tilde{\beta}_2 \Delta \text{net worth}_b^{price} + \theta_i + \gamma X_{bi} + \nu_{bi} \tag{5}$$

where $\Delta \text{net worth}_b^{price}$ and $\Delta \text{net worth}_b^{capital}$ are changes to bank net worth induced by price appreciation and capital gains (see Equation 1).

In the Appendix (Table A11) we also estimate an instrumental variables model using 2SLS. We estimate the following first stage equation:

$$\Delta\text{net worth}_b^{capital} = \pi exposure_b + \theta_i + \delta\gamma X_{bi} + \nu_{bi} \tag{6}$$

In the second stage, we estimate:

$$y_{bi} = \bar{\beta}_1 \Delta\text{net worth}_b^{capital} + \theta_i + \gamma X_{bi} + \epsilon_{bi} \tag{7}$$

where we instrument for the bank-level change in net worth with the bank-level exposure using estimates from Equation 6. The 2SLS coefficient provides the elasticity estimates typically required to calibrate quantitative models.

Finally, we also estimate the effect of exposure to government debt securities on firm characteristics. In Equation 4 we can control for demand factors using borrower fixed effects θ_i. We cannot do the same after aggregating outcomes at the firm level. Instead, we control for time-varying factors that may affect firm demand by interacting firm fixed effects with a linear time trend. We estimate the following equation:

$$y_{it} = \alpha_i + \alpha_t + \sum_m \lambda_m[(t+6) \times \mathbb{1}_{i=m}] + \beta(exposure_b \times \mathbb{1}_{t\geq 0}) + \epsilon_{it} \tag{8}$$

Where y_{it} is a firm-level outcome t years after the event, α_i and α_t are firm and year fixed effects, $\mathbb{1}_{i=m}$ is an indicator variable equal to 1 for firm i and 0 otherwise, and $\mathbb{1}_{t\geq 0}$ is an indicator variable equal to 1 for observations in the year of the event or subsequent years.

4 Results

We describe the results of our paper in this section. First, we discuss the effect of exposure to sovereign debt securities on bank balance sheets for PSI, OMT, and QE. Second, we discuss the transmission of bank balance sheet shocks to firms and households.

4.1 Banks

In Table 2, we measure the effect of exposure to European sovereign debt on changes in exposed assets after the announcement of PSI, OMT and QE. The dependent variable $\frac{\Delta Exposed\ assets_k}{Total\ Assets_t}$ measures the change in exposed assets after each event as a percentage of bank assets in the month before the event. We compute changes in holdings by multiplying changes in quantity by the price in the month before the event. We do this to filter out price effects from changes in holdings. In Table 2, we report results for a one-year horizon after each event (includes the month of the event and the subsequent twelve months). In Table A2, we repeat the analysis at shorter horizons – *month* and *quarter*. The *month* horizon includes the month of the announcement and the subsequent month. The *quarter* horizon includes the month of the announcement and the subsequent three months. In Table 2 and throughout the rest of the paper, we use the number of customers as sample weights in bank-level regressions. We provide coefficient estimates using unit weights in Table A2.

[Table 2]

More exposed banks did not reduce their exposure to government bonds after OMT and PSI. After QE, banks that were more exposed to government bonds reduced their exposure relatively more. A one standard deviation increase in the exposure to government bonds is associated to a subsequent 1.9 p.p. decrease in government bond holdings. Before the event, the average exposure to government bonds was 5.1% (Table A1), meaning that the coefficient is relatively large.

In Figure 3, we depict estimates for β_k from Equation 3 between the first quarter of 2014 and the last quarter of 2015. W use the cumulative variation in debt holdings as the dependent variable. Consistent with QE having an effect on sovereign debt holdings, exposed banks started reducing their exposure more in the quarter when QE was announced.

[Figure 3]

Banks registered in Portugal were active in selling securities under the Quantitative Easing Program. Figure 4 depicts the percentage of Portuguese securities in the Quantitative Easing that were sold by banks in the sample. These institutions often represented over 20% of the sales.

[Figure 4]

In Table 3, we establish a relationship between exposure to sovereign debt and changes in bank net worth attributable to price appreciation and capital gains. One additional standard deviation in exposure increases price appreciation by 18% with PSI, 6% with OMT, and 3% with QE. However, there is a negligible relationship between capital gains and exposure with PSI and OMT, while one standard deviation in exposure increases capital gains by 2% with QE. These results are consistent with the results from Table 3, as exposed banks only reduce their security holdings after QE. In Tables A3 and A4 we repeat the analysis using shorter time horizons and unit regression weights. The results are similar.

[Table 3]

4.2 Borrowers

We present our main results on the lending effects for the three episodes in Table 4. Results for PSI, OMT, and QE differ significantly. Exposure to sovereign debt has a strong positive effect for QE, but no detectable effect for PSI and OMT. Comparing two banks who are a standard deviation apart in terms of exposure to affected securities, average lending to firms by 34% for QE, by 10% for PSI, and by 6% for OMT (Columns 1 to 3 of Table 4). However, we cannot reject the null that the effect of the PSI and OMT interventions is zero at conventional levels of significance. For households, we find similar patterns with lending increasing by 11%, 4%, and 1% respectively (Columns 3 to 6 of Table 4). In Table A5, we repeat the analysis for monthly and quarterly horizons. In Table A6, we repeat the analysis for a closed sample, i.e. excluding borrower-bank relationships that do not exist in at least one event. We get similar results.

[Table 4]

In Table 5, rates of relationship termination follow similar patterns. Exit rates for firms decrease by 4 p.p., 1 p.p. and 0.5 p.p. for QE, PSI, and OMT respectively (Columns 1 to 3 of Table 5).

For households, we get a decrease in the exit rates of 2 p.p. and 0.5 p.p. for QE and PSI and a increase in the exit rate of 0.04 p.p. for OMT (Columns 3 to 6 of Table 5), with the latter two estimates not statistically significantly different from zero. In Table A7, we repeat the analysis for shorter time horizons. We also repeat the analysis for relationship terminations without including borrower fixed effect from Equation 4. For firms, we add the following controls: log firm assets, log total workers, EBITDA/assets, equity ratio and an indicator variable that is equal to 1 if the firm has 90-day overdue loans. We report coefficients in Table A8.

[Table 5]

We now turn from the effects on firms and households that have no existing relationship with the bank to the formation of new relationships. We find a similar pattern of statistically and economically large effects for QE, with moderate to no effects for PSI and OMT (see Table 6). The acceptance rates for firms increases by 4% for QE and by 2% for PSI. We observe no significant effect for OMT. Households do not experience statistically significant changes in the aftermath of any event. In Table A9, we repeat the analysis for different time horizons.

We include borrower fixed effects in the main model. As most borrowers may apply only to one bank, the treated group might be highly selected, particularly in the case of households. Alternatively, we estimate Equation 4 excluding the borrower fixed effect θ_i. For firms, we add the following controls: log firm assets, log total workers, EBITDA/assets, equity ratio and an indicator variable that is equal to 1 if the firm has 90-day overdue loans. We report coefficients in Table A10. Results are directionally similar but statistically weaker.

[Table 6]

Lending and creditor composition We analyze the relationship between exposure to government debt securities and creditor composition in Table 7. The Bank of Portugal computes probabilities of default for firms (Antunes et al. (2016)). We restrict the sample to firms with available probability of default estimates. In Columns 1 to 3 the dependent variable is the 1-year change in log loans. In Columns 4 to 6 the dependent variable is an indicator equal to 1 for successful loan applications. We find some evidence that lenders exposed to government bonds increased their relative exposure to riskier borrowers after QE. In the intensive margin there is a negative relationship between the effect of exposure to government debt securities on lending and firm risk after PSI and OMT. In the extensive margin, exposed banks are more likely to establish new credit relationships with riskier borrowers after QE.

[Table 7]

The role of bank net worth on lending In Table 8 we report coefficients from estimating Equation 5. The elasticity of lending with respect to price appreciation is negative for firms and not statistically significant from 0 for households. However, we find a positive and significant elasticity of lending with respect to capital gains, particularly for QE.

In Table A11 we estimate the relationship between loan growth and capital gains using the instrumental variables model from Equation 7. This exercise has illustrative purposes only, as banks do not choose their exposure to sovereign debt randomly (the independence assumption of the instrumental variables model does not necessarily hold). Again, we find a positive relationship between capital gains and loan growth, particularly after the QE event. These results suggest that incentivizing banks to sell securities and realize accumulate capital gains stimulates the bank lending channel than increasing the price of securities held by banks.

[Table 8]

Pre-trends In Equation 4, we control for the effect of demand by including borrower fixed effects on lending. However, the effect of each event on lending could be driven by other factors that were previously affecting borrower-bank relationships. In Table A12, we re-estimate Equation 4 using pre-trends variables. In Table A12a, the dependent variable is delta log lending between one year before the event and the last month before the event. In Table A12b, the dependent variable is an indicator variable that is equal to 1 for borrower-bank relationships that do not exist 1 year before the event. We observe a positive and strong relationship between lending and exposure for PSI but not for other events.

In Table A13 we estimate Equation 4 again but include the pre-trend variables from Table A12 as additional controls. In Table A13a we estimate the effect of exposure on lending and include the change in lending in the year before the event as an additional control variable. In Table A13b, we estimate the effect of exposure on the probability of relationship termination using an indicator variable that is equal to 1 for borrower-bank relationships that do not exist 1 year before the event as an additonal control. We find that coefficients from Table A13 are very similar to coefficients reported in Tables 4 and 5.

4.3 Firm Characteristics

We analyze the effect of exposure to government debt securities on real outcomes by aggregating outcomes at the firm level. We aggregate lending outcomes from the credit register at the firm level. Additionally, we retrieve data on average interest rates, sales and capital expenditure (CAPEX) from firm financial statements.

We measure the effect of exposure to government debt securities on two group of firms. First, we analyze firms that had pre-existing credit relationships. Our definition of firm-level exposure for existing credit relationships is similar to the one used by Jasova et al. (2021). Exposure is given by:

$$exposure_i = \frac{\sum_b (exposure_b \times credit_{bi})}{\sum_b (credit_{bi})} \tag{9}$$

where $exposure_i$ is the firm-level exposure, $exposure_b$ is the bank-level exposure variable used in the rest of the analysis, and $credit_{bi}$ is the outstanding amount of the firm-bank credit relationship.

In the extensive margin we define exposure as:

$$exposure_i = \frac{\sum_b (exposure_b)}{B_i} \tag{10}$$

where B_i is the number of loan applications between the month of the event and one year after the event.

In Table 9 we estimate Equation 8 using firm-level outcomes as the dependent variable. Table 9a depicts coefficients for firms with existing credit relationships (intensive margin). Table 9b depicts coefficients for firms that apply for new loans in the year after ech event (extensive margin). Consistent with the findings of Table 4, a one standard deviation increase in exposure for firms with existing credit relationships increases lending by 11% with QE, but only increases lending by approximately 3.5% with PSI and OMT. We do not find a strong relationship between exposure and interest rates for firms. We observe the same pattern in the extensive margin. A one standard deviation increase in exposure to government debt securities increases lending by 9.5% with QE, but only increases lending by 2.7% with PSI and has no statistically significant effect with OMT. The relationship between exposure to government debt securities and interest rates is economically small and statistically not very strong, as coefficients (measured in percentage points) are always smaller than 0.1 and mostly not significant at commonly reported significance levels (10%, 5% and 1%).

[Table 9]

We have fewer observations in the interest rate regressions than in the lending regressions. This difference is caused by two factors. First, some firms may have no loans. In these cases it is impossible to get an interest rate. Second, we use firm financial statements to obtain interest rates, and firms may not report financial statements in some years.

In Table 10 we measure the effect of exposure to government debt securities on sales and on the ratio of capital expenditure (CAPEX) to sales. We find evidence of a small but positive effect of exposure on the investment rate with PSI and OMT[4] and find no statistically significant effect with QE.

[Table 10]

In the extensive margin we find that a one standard deviation increase in exposure to government debt securities is associated with a growth in sales of 3% with QE. However, CAPEX grows more

[4]The average CAPEX/sales ratio is 11.1% for firms in the intensive margin sample and 9.4% for firms in the extensive margin sample.

slowly than sales with QE, as a one standard deviation increase in exposure is associated with a 0.7 p.p. decrease in the CAPEX/sales ratio. We also find a negative relationship between exposure and CAPEX/sales for PSI, but this relationship is weaker.

5 Conclusion

In this paper we make a comprehensive analysis of the relationship between the balance sheet channel and lending using data from Portugal. The Portuguese case is ideal to study balance sheet shocks. First, Portugal was affected by three large shocks – the Greek debt restructuring (PSI), Outright Monetary Transactions (OMT), and Quantitative Easing (QE). The the case of QE, the central bank actively intervened in banks' balance sheets. In the other cases, banks were only affected through a positive effect net worth shock. Second, Portugal has comprehensive credit and security registers covering both firms and households, and monthly bank balance sheet data. The richness of the data allows us to study these shocks in a unified framework.

We show that PSI and OMT had little impact on bank balance sheets. The price of government securities increased after these events but banks did not reduce their government debt holdings. QE had a smaller impact on the value of securities held by banks. However, banks that were more exposed to sovereign debt reduced their holdings and realized previously accumulated capital gains.

We analyze the transmission of each shock to firms and households through the bank balance sheet channel. Exposure to sovereign debt securities had a moderate to null effect on lending for PSI and OMT and a largely positive effect for QE, both in the intensive and extensive margins. We also find a positive relationship between exposure to sovereign debt and firm-level real outcomes for QE, particularly in the case of new loan applicants. Additionally, we observe a positive relationship between realized capital gains and lending after QE. However, we do not find a positive relationship between increases in security prices and lending.

Summing up, the main finding of this paper is that bank balance sheet shocks were not all created equal. The calibration of quantitative macro-finance models should consider that the balance sheet channel is considerably stronger when there is the provision of liquidity to banks' balance sheets.

Tables

Table 1: Descriptive Statistics

(a) Bank Descriptive Statistics

	Weighted		Unweighted	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
% exposed assets	4.25	3.92	2.29	6.04
Total assets (EUR M)	51,655.41	45,297.31	10,678.41	26,384.53
Capital ratio	14.12	12.90	18.83	16.91
% arrears (firms)	10.49	8.89	8.98	11.31
% arrears (households)	5.61	7.11	6.83	12.38
% accepted applications (firms)	12.86	11.45	11.99	19.57
% accepted applications (households)	21.89	15.94	11.82	17.50
% LTRO	0.45	0.75	0.15	1.60
Observations	132		132	

(b) Borrower Descriptive Statistics

	Firms		Households	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
Δ log loans (1 month)	-0.28	1.44	-0.32	1.25
Δ log loans (3 months)	-0.54	1.98	-0.57	1.69
Δ log loans (12 months)	-1.51	3.24	-1.33	2.58
Exit rate (1 month)	3.11	17.35	4.96	21.71
Exit rate (3 months)	5.77	23.32	8.63	28.07
Exit rate (12 months)	15.24	35.94	18.97	39.21
Relationship length (years)	4.56	2.83	3.1	1.62
Observations	684,426		679,299	

Notes. The table shows descriptive statistics for banks, firm-bank and household-bank pairs used in the analysis. In Columns (1) and (2) of Table 1a, statistics are weighted by the total number of customers (firms and households). In Columns (3) and (4) of Table 1a we use sample weights. Relationship length for households is censored to the left because the household credit register only starts in 2009. We use the month before each event as the reference date: January 2012 for PSI, June 2012 for OMT, and December 2014 for QE.

Table 2: Regression Results: Security Holdings

	$\frac{\Delta \text{ Exposed securities}}{\text{Total assets}}$		
	PSI (1)	OMT (2)	QE (3)
Exposure	0.001 (0.002)	-0.003 (0.003)	-0.019** (0.009)
Bank controls	Yes	Yes	Yes
Observations	44	44	44
R-squared	0.209	0.296	0.616

Notes. The table reports estimates of coefficient β_1 from Equation 2. The dependent variable $\frac{\Delta \text{ Exposed securities}}{\text{Total assets}}$ is the change in the ratio of exposed securities over total assets one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total bank assets in the last month before the event. We use bank-level characteristics from Table A1 as additional controls. Observations are weighted by the number of bank customers (firms and households) in the sample. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 3: Regression Results: Bank-level Net Worth Gains

	Δ log net worth					
	Price appreciation			Capital gains		
	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Exposure	0.182** (0.071)	0.062 (0.049)	0.027 (0.025)	0.001 (0.073)	-0.012 (0.053)	0.024*** (0.006)
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	44	44	44	44	44	44
R-squared	0.442	0.501	0.510	0.330	0.424	0.618

Notes. The table reports estimates of coefficient β_1 from Equation 2. The dependent variable Δ log net worth is the change in log bank net worth induced by price appreciation (Columns 1 to 3) and capital gains (Columns 4 to 6) one year after the event. We obtain gains from price appreciation by multiplying monthly price variation by outstanding security holdings. Realized gains are cumulative gains that banks monetize when they close their position in a certain security. We compute the effect of price variation and capital gains on bank net worth using Equation 1. The independent variable Exposure is the standardized ratio of exposed securities to total bank assets in the last month before the event. We use bank-level characteristics from Table A1 as additional controls. Observations are weighted by the number of bank customers (firms and households) in the sample. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Regression Results: Outstanding Loans

	Δ log outstanding loans					
	Firms			Households		
	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Exposure	0.109	0.064	0.336***	0.042	0.013	0.110***
	(0.083)	(0.090)	(0.084)	(0.036)	(0.035)	(0.018)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.433	0.434	0.426	0.461	0.468	0.469

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Δ log outstanding loans is the change in one plus log outstanding loans one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Regression Results: Termination of Credit Relationships

	Relationship ends = 1					
	Firms			Households		
	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Exposure	-0.010	-0.005	-0.039***	-0.003	0.0004	-0.019***
	(0.008)	(0.009)	(0.008)	(0.006)	(0.005)	(0.002)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.427	0.43	0.43	0.4667	0.4741	0.477

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Relationship ends = 1 is an indicator variable that is equal to 1 if the borrower does not have a credit relationship with the bank 1 year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Regression Results: Loan Applications

	Accepted application = 1					
	Firms			Households		
	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Exposure	0.023**	-0.001	0.036***	-0.002	-0.011	0.010
	(0.009)	(0.010)	(0.007)	(0.006)	(0.009)	(0.011)
Observations	14,676	16,279	19,861	13,051	13,477	16,542
R-squared	0.45	0.459	0.456	0.456	0.454	0.461

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Accepted application = 1 is an indicator variable that is equal to 1 if the loan application is accepted. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. The sample consists of loan applications between the 4th and the 12th month after the month of the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Regression Results: By Borrower Composition

	Δ log outstanding loans			Accepted application = 1		
	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Exposure	0.176**	0.113	0.249***	0.018**	-0.007	0.030**
	(0.084)	(0.099)	(0.059)	(0.008)	(0.011)	(0.011)
Exposure×P(default)	-0.005*	-0.005**	0.001	0.106	0.142	0.122**
	(0.002)	(0.003)	(0.006)	(0.102)	(0.098)	(0.055)
Observations	203,285	197,405	164,066	14,051	15,676	18,002
R-squared	0.436	0.438	0.437	0.45	0.46	0.451

Notes. The table shows coefficients from estimating Equation 4. In Columns 1 to 3 the dependent variable Δ log outstanding loans is the change in log one plus outstanding loans one year after the event. In Columns 4 to 6 the dependent variable Accepted application = 1 is an indicator equal to 1 for firms with accepted loan applications 4-12 months after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. The independent variable Exposure × P(default) is the interaction between Exposure and the probability of default provided by Antunes et al. (2016). We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Regression Results: Lending, Price Appreciation and Capital Gains

	Δlog outstanding loans					
	Firms			Households		
	PSI	OMT	QE	PSI	OMT	QE
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Price appreciation	-0.764**	-1.877***	-2.873	-0.014	1.794	0.367
	(0.339)	(0.677)	(2.087)	(0.294)	(1.106)	(0.657)
Capital gains	-0.288	1.524	4.589**	-0.061	-3.085*	0.498
	(0.291)	(1.191)	(2.200)	(0.217)	(1.577)	(1.509)
Observations	266,307	258,829	235,723	244,735	233,642	206,515
R-squared	0.417	0.418	0.400	0.460	0.467	0.468

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Δlog outstanding loans is the change in one plus log outstanding loans one year after the event. The independent variable Price appreciation is the change in log bank net worth induced by price appreciation. Capital gains is the change in log bank net worth induced by realized capital gains. The independent variables are defined with more detail in the text. We control for bank characteristics with variables from Table 1. Errors are clustered at the bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Regression Results: Firm-level Outcomes (Lending)

(a) Existing Credit Relationships

	Log outstanding loans			Interest Rate		
	PSI	OMT	QE	PSI	OMT	QE
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.035***	0.036***	0.113***	-0.010	0.035	-0.034
	(0.009)	(0.009)	(0.009)	(0.022)	(0.022)	(0.026)
Observations	1,396,656	1,372,482	1,301,640	923,186	901,385	665,307
R-squared	0.831	0.833	0.849	0.734	0.735	0.784

(b) Loan Applications

	Log outstanding loans			Interest rate		
	PSI	OMT	QE	PSI	OMT	QE
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.027**	-0.007	0.095***	0.055*	-0.060*	-0.013
	(0.012)	(0.012)	(0.011)	(0.029)	(0.032)	(0.030)
Observations	745,668	735,438	1,040,262	498,966	490,775	437,262
R-squared	0.913	0.914	0.907	0.728	0.728	0.786

Notes. The table shows coefficients from estimating Equation 8. Table 9a depicts coefficients for firms with existing credit relationships in the month before the event. Table 9b depicts coefficients for firms that applied for loans in the year after the event. The dependent variable Log outstanding loans is the change in log outstanding loans one year after the event. The dependent variable Interest Rate is the average interest rate paid by firms. Exposure is given by Equations 9 and 10. Errors are clustered at the firm level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 10: Regression Results: Firm-level Outcomes (Sales and Investment)

(a) Existing Credit Relationships

	Log Sales			CAPEX/Sales		
	PSI	OMT	QE	PSI	OMT	QE
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	-0.003	0.014*	-0.006	0.003**	0.003**	0.0003
	(0.008)	(0.008)	(0.008)	(0.002)	(0.002)	(0.002)
Observations	1,072,841	1,046,565	933,810	980,886	958,210	846,578
R-squared	0.866	0.867	0.897	0.628	0.634	0.638

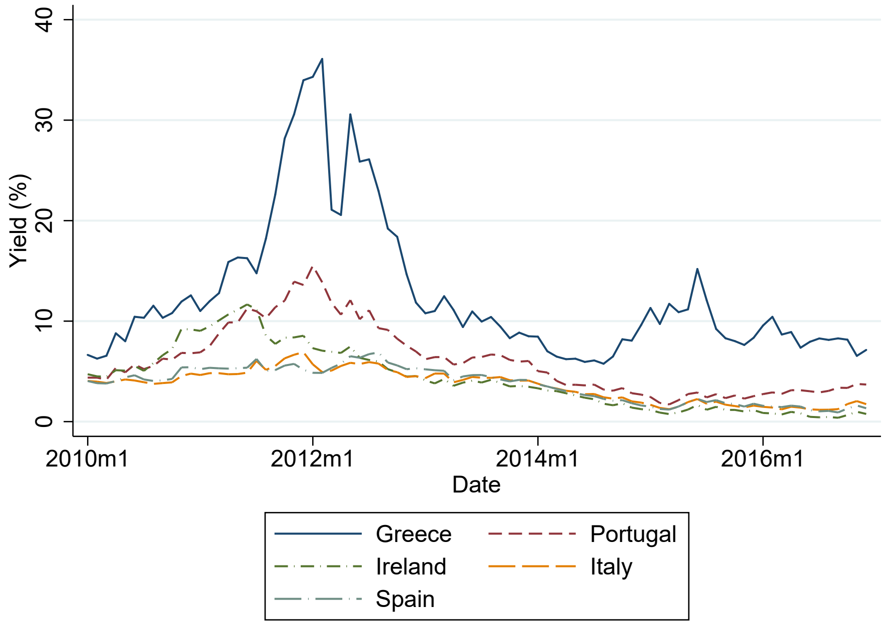
(b) Loan Applications

	Log Sales			CAPEX/Sales		
	PSI	OMT	QE	PSI	OMT	QE
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.003	-0.004	0.030***	-0.004**	-0.002	-0.007***
	(0.009)	(0.009)	(0.008)	(0.002)	(0.002)	(0.002)
Observations	617,178	607,964	771,656	566,540	558,472	694,137
R-squared	0.888	0.893	0.905	0.599	0.597	0.684

Notes. The table shows coefficients from estimating Equation 8. Table 10a depicts coefficients for firms with existing credit relationships in the month before the event. Table 10b depicts coefficients for firms that applied for loans in the year after the event. The dependent variable Log Sales is the change in log sales one year after the event. The dependent variable CAPEX/Sales is the ratio of capital expenditure to sales. Exposure is given by Equations 9 and 10. Errors are clustered at the firm level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

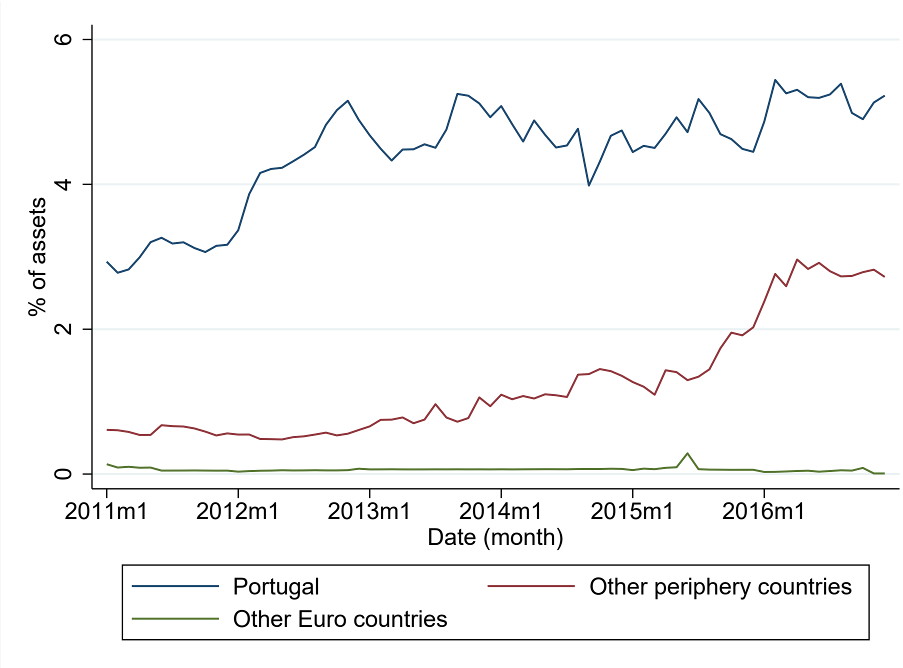
Figures

Figure 1: Government Bond Yields of Periphery Countries



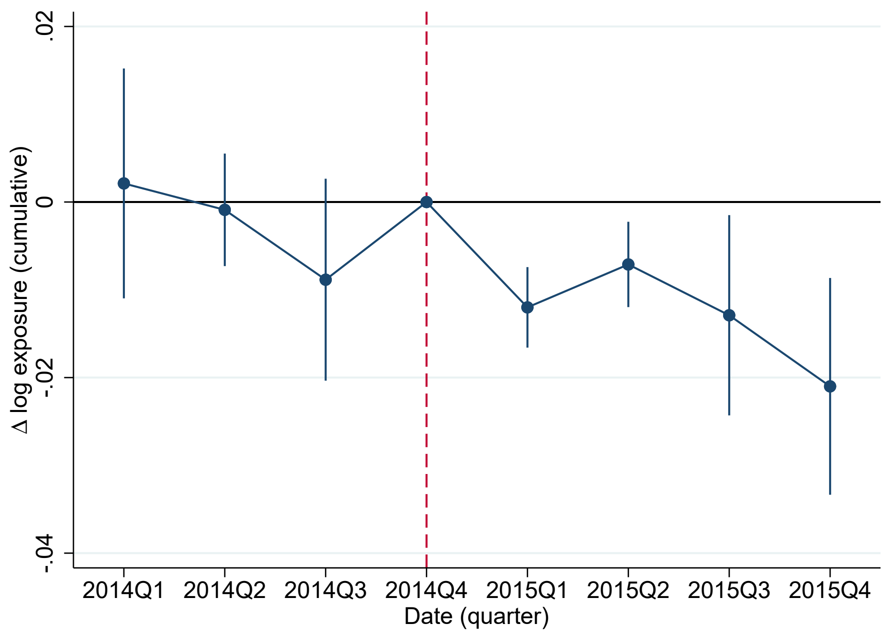
Notes. The table shows 10-year government bond yields for Greece, Portugal, Ireland, Italy and Spain.

Figure 2: Exposure to Sovereign Debt



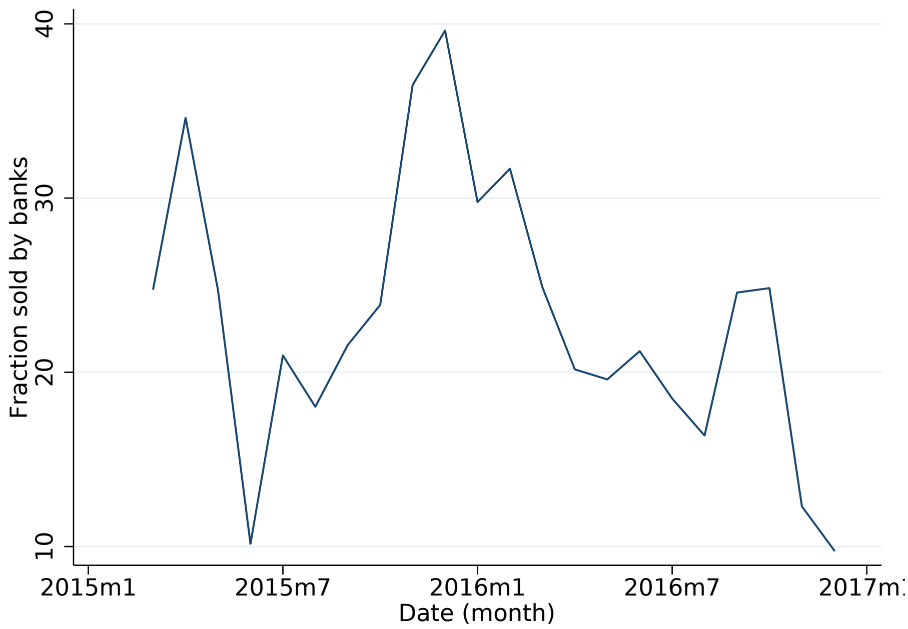
Notes. The figure shows the book value of sovereign debt securities held by banks in the sample as a percentage of total assets. We divide securities by issuer country. *Portugal* includes securities issued by the Portuguese government. *Other periphery countries* includes securities issued by Greece, Spain, Italy and Ireland. *Other Euro Area countries* includes securities issued by the remaining countries from the Euro Area.

Figure 3: Dynamic Variation of Exposed Security Holdings



Notes. The figure reports coefficients and 95% confidence intervals from Equation 3. The dependent variable is the cumulative variation in exposed security holdings as a percentage of total assets in the month before the Quantitative Easing event. The independent variable is the standardized ratio of exposed securities to total assets, measured in the last month before the event.

Figure 4: Fraction of Portuguese Assets Sold to the ECB by Banks in the Sample



Notes. The figure shows the percentage of ECB Portuguese government debt security purchases whose counterparty was a bank in the sample, weighted by security market value.

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Appendix Tables

Table A1: Descriptive Statistics by Event (PSI)

(a) Bank Descriptive Statistics

	Weighted		Unweighted	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
% exposed assets	3.50	3.34	1.78	4.03
Total assets (EUR M)	54,972.23	48,194.50	11,319.20	28,330.86
Capital ratio	12.22	12.47	18.04	17.49
% arrears (firms)	8.02	6.83	7.09	8.66
% arrears (households)	5.77	7.13	6.31	11.63
% accepted applications (firms)	13.11	11.78	14.68	21.40
% accepted applications (households)	20.60	13.69	10.75	14.47
% LTRO	0.31	0.51	0.23	1.09
Observations	44		44	

(b) Borrower Descriptive Statistics

	Firms		Households	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
Δ log loans (Month)	-0.29	1.44	-0.33	1.28
Δ log loans (Quarter)	-0.55	1.97	-0.58	1.71
Δ log loans (Year)	-1.55	3.21	-1.36	2.58
Exit rate (Month)	3.19	17.58	5.04	21.88
Exit rate (Quarter)	5.87	23.51	8.76	28.27
Exit rate (Year)	15.46	36.16	19.36	39.51
Relationship length (years)	4.08	2.37	2.45	0.92
Observations	241,311		241,311	

Table A1: Descriptive Statistics by Event (OMT)

(c) Bank Descriptive Statistics

	Weighted		Unweighted	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
% exposed assets	4.26	4.05	2.27	5.48
Total assets (EUR M)	55,261.49	48,491.42	11,339.60	28,488.66
Capital ratio	13.43	13.27	19.12	18.08
% arrears (firms)	9.96	8.49	8.30	9.97
% arrears (households)	5.43	7.07	6.70	13.06
% accepted applications (firms)	13.10	12.15	11.98	19.93
% accepted applications (households)	24.37	17.85	15.26	21.82
% LTRO	0.37	0.86	0.14	0.55
Observations	44		44	

(d) Borrower Descriptive Statistics

	Firms		Households	
	Mean (1)	Std. dev. (2)	Mean (3)	Std. dev. (4)
Δ log loans (Month)	-0.3	1.44	-0.32	1.23
Δ log loans (Quarter)	-0.57	1.98	-0.57	1.68
Δ log loans (Year)	-1.5	3.2	-1.33	2.56
Exit rate (Month)	3.22	17.64	5.02	21.83
Exit rate (Quarter)	5.99	23.73	8.78	28.31
Exit rate (Year)	15.12	35.82	19.11	39.31
Relationship length (years)	4.32	2.49	2.76	1.06
Observations	233,402		233,402	

Table A1: Descriptive Statistics by Event (QE)

(e) Bank Descriptive Statistics

	Weighted		Unweighted	
	Mean	Std. dev.	Mean	Std. dev.
	(1)	(2)	(3)	(4)
% exposed assets	5.06	4.20	2.29	6.04
Total assets (EUR M)	44,168.39	36,783.05	10,678.41	26,384.53
Capital ratio	16.93	12.48	18.83	16.91
% arrears (firms)	13.76	10.22	8.98	11.31
% arrears (households)	5.64	7.13	6.83	12.38
% accepted applications (firms)	12.35	10.23	11.99	19.57
% accepted applications (households)	20.66	15.77	11.82	17.50
% LTRO	0.69	0.79	0.15	1.60
Observations	44		44	

(f) Borrower Descriptive Statistics

	Firms		Households	
	Mean	Std. dev.	Mean	Std. dev.
	(1)	(2)	(3)	(4)
Δ log loans (Month)	-0.25	1.44	-0.32	1.23
Δ log loans (Quarter)	-0.48	2	-0.55	1.66
Δ log loans (Year)	-1.45	3.33	-1.28	2.61
Exit rate (Month)	2.89	16.74	4.79	21.36
Exit rate (Quarter)	5.41	22.62	8.29	27.57
Exit rate (Year)	15.12	35.83	18.35	38.71
Relationship length (years)	5.37	3.42	4.25	2.11
Observations	233,402		233,402	

Notes. The table shows descriptive statistics for banks, firm-bank and household-bank pairs used in the analysis. In Columns (1) and (2) of Tables A1a, A1c, and A1e, statistics are weighted by the total number of customers (firms and households) in the analysis. In Columns (3) and (4) of Tables A1a, A1c, and A1e, we use sample weights. Relationship length for households is censored to the left because the household credit register only starts in 2009. We use the month before each event as the reference date: January 2012 for PSI, June 2012 for OMT, and December 2014 for QE.

Table A2: Robustness: Bank-level Exposed Security Holdings

(a) Weighted

	$\frac{\Delta \text{ Exposed securities}}{\text{Total assets}}$								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	0.001	0.002*	0.001	0.001	-0.0004	-0.003	-0.007*	-0.011***	-0.020**
	(0.001)	(0.001)	(0.002)	(0.0004)	(0.002)	(0.003)	(0.004)	(0.003)	(0.009)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.359	0.392	0.209	0.267	0.216	0.296	0.411	0.595	0.616

(b) Unweighted

	$\frac{\Delta \text{ Exposed securities}}{\text{Total assets}}$								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	0.003***	0.003***	-0.010*	0.001	-0.009***	-0.013***	-0.029***	-0.033***	-0.020***
	(0.001)	(0.001)	(0.006)	(0.0004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.001)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.515	0.589	0.457	0.433	0.700	0.615	0.891	0.917	0.877

Notes. The table reports estimates of coefficient β_1 from Equation 2. The dependent variable $\frac{\Delta \text{ Exposed securities}}{\text{Total assets}}$ is the change in the ratio of exposed securities over total assets one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total bank assets in the last month before the event. We use bank-level characteristics from Table A1 as additional controls. In Table A2a, observations are weighted by the number of bank customers (firms and households) in the sample. In Table A2b, we use unit sample weights. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A3: Robustness: Price Appreciation

(a) Weighted

	Δ log net worth								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	0.0866**	0.110**	0.182**	0.0779*	-0.00448	0.0615	0.00472***	0.0332**	0.0267
	(0.0400)	(0.0461)	(0.0705)	(0.0449)	(0.0329)	(0.0487)	(0.00134)	(0.0134)	(0.0247)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.378	0.410	0.442	0.472	0.485	0.501	0.140	0.486	0.510

(b) Unweighted

	Δ log net worth								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	0.060*	0.094**	0.19***	0.008	0.028	0.082***	0.032*	0.038**	-0.032*
	(0.031)	(0.040)	(0.063)	(0.018)	(0.019)	(0.020)	(0.018)	(0.018)	(0.019)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.197	0.257	0.397	0.157	0.196	0.329	0.128	0.130	0.140

Notes. The table reports estimates of coefficient β_1 from Equation 2. The dependent variable Δ log net worth is the change in log bank net worth induced by price appreciation one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total bank assets in the last month before the event. We use bank-level characteristics from Table A1 as additional controls. In Table A3a, observations are weighted by the number of bank customers (firms and households) in the sample. In Table A3b, we use unit sample weights. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A4: Robustness: Capital Gains

(a) Weighted

	Δ log net worth								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	-0.004 (0.062)	0.002 (0.061)	0.001 (0.072)	0.002** (0.001)	-0.077 (0.047)	-0.013 (0.053)	0.006* (0.003)	0.014** (0.005)	0.024*** (0.006)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.298	0.333	0.330	0.150	0.459	0.424	0.275	0.528	0.618

(b) Unweighted

	Δ log net worth								
	PSI			OMT			QE		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)	Month (7)	Quarter (8)	Year (9)
Exposure	-0.016 (0.024)	-0.014 (0.024)	0.029 (0.027)	0.0004* (0.0002)	-0.012 (0.015)	0.013 (0.019)	0.028 (0.018)	0.042** (0.018)	0.037** (0.018)
Observations	44	44	44	44	44	44	44	44	44
R-squared	0.124	0.134	0.150	0.083	0.051	0.135	0.053	0.138	0.136

Notes. The table reports estimates of coefficient β_1 from Equation 2. The dependent variable Δ log net worth is the change in log bank net worth induced by capital gains one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total bank assets in the last month before the event. We use bank-level characteristics from Table A1 as additional controls. In Table A4a, observations are weighted by the number of bank customers (firms and households) in the sample. In Table A4b, we use unit sample weights. Robust standard errors are reported in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A5: Robustness: Outstanding Loans (1/2)

(a) PSI

	Δ log outstanding loans					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.014 (0.013)	0.031 (0.024)	0.11 (0.083)	0.001 (0.013)	0.015 (0.022)	0.042 (0.036)
Observations	241,311	241,311	241,311	242,823	242,823	242,823
R-squared	0.401	0.411	0.433	0.435	0.441	0.461

(b) OMT

	Δ log outstanding loans					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.004 (0.017)	0.025 (0.034)	0.064 (0.090)	0.015 (0.013)	0.022 (0.020)	0.013 (0.036)
Observations	233,402	233,402	233,402	231,840	231,840	231,840
R-squared	0.404	0.411	0.434	0.453	0.459	0.468

Table A5: Robustness: Outstanding Loans (2/2)

(c) QE

	Δ log outstanding loans					
	Firms			Households		
	Month	Quarter	Year	Month	Quarter	Year
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.051***	0.092***	0.34***	0.017*	0.026*	0.110***
	(0.010)	(0.015)	(0.084)	(0.009)	(0.014)	(0.018)
Observations	209,713	209,713	209,713	204,636	204,636	204,636
R-squared	0.404	0.415	0.426	0.456	0.467	0.469

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Δ log outstanding loans is the change in one plus log outstanding loans one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A6: Robustness: Outstanding Loans (Closed Sample) (1/2)

(a) PSI

	Δ log outstanding loans					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.0089** (0.003)	0.015*** (0.004)	0.034** (0.013)	-0.005 (0.005)	-0.002 (0.004)	-0.021 (0.013)
Observations	130,351	130,351	130,351	108,939	108,939	108,939
R-squared	0.395	0.405	0.405	0.457	0.458	0.47

(b) OMT

	Δ log outstanding loans					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.005 (0.003)	0.017*** (0.005)	0.019 (0.015)	-0.007 (0.008)	-0.016 (0.011)	-0.030*** (0.010)
Observations	130,351	130,351	130,351	108,939	108,939	108,939
R-squared	0.411	0.408	0.41	0.476	0.479	0.469

Table A6: Robustness: Outstanding Loans (Closed Sample) (2/2)

(c) QE

	Δ log outstanding loans					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.076***	0.129***	0.518***	0.024***	0.039***	0.182***
	(0.018)	(0.023)	(0.129)	(0.007)	(0.013)	(0.030)
Observations	130,351	130,351	130,351	108,939	108,939	108,939
R-squared	0.433	0.443	0.455	0.471	0.478	0.484

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Δ log outstanding loans is the change in one plus log outstanding loans one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. We restrict the sample to borrowers who have credit relationships with banks in the three events. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A7: Robustness: Termination of Credit Relationships (1/2)

(a) PSI

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	-0.001 (0.001)	-0.003 (0.002)	-0.010 (0.008)	0.001 (0.002)	-0.0002 (0.003)	-0.003 (0.006)
Observations	241,311	241,311	241,311	242,823	242,823	242,823
R-squared	0.405	0.409	0.427	0.4413	0.4442	0.4667

(b) OMT

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.0003 (0.002)	-0.001 (0.004)	-0.005 (0.009)	-0.002 (0.002)	-0.002 (0.003)	0.0004 (0.005)
Observations	233,402	233,402	233,402	231,840	231,840	231,840
R-squared	0.407	0.413	0.43	0.4523	0.4615	0.4741

Table A7: Robustness: Termination of Credit Relationships (2/2)

(c) QE

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	-0.006***	-0.010***	-0.039***	-0.003	-0.005**	-0.019***
	(0.001)	(0.002)	(0.008)	(0.002)	(0.002)	(0.002)
Observations	209,713	209,713	209,713	204,636	204,636	204,636
R-squared	0.408	0.418	0.43	0.4569	0.4656	0.477

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Relationship ends = 1 is an indicator variable that is equal to 1 if the borrower does not have a credit relationship with the bank one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A8: Robustness: Relationship Terminations Without Borrower FE (1/2)

(a) PSI

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	-0.002 (0.001)	-0.003 (0.002)	-0.012 (0.007)	0.003 (0.002)	0.003 (0.004)	0.001 (0.008)
Observations	314,380	314,380	314,380	438,359	438,359	438,359
R-squared	0.011	0.012	0.017	0.02	0.035	0.072

(b) OMT

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.0001 (0.002)	-0.001 (0.004)	-0.006 (0.010)	-0.0002 (0.003)	0.0008 (0.004)	0.004 (0.005)
Observations	306,810	306,810	306,810	427,904	427,904	427,904
R-squared	0.011	0.012	0.016	0.026	0.045	0.079

Table A8: Robustness: Relationship Terminations Without Borrower FE (2/2)

(c) QE

	Relationship ends = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	-0.007*** (0.002)	-0.013*** (0.002)	-0.030*** (0.004)	-0.003 (0.003)	-0.005** (0.002)	-0.017*** (0.003)
Observations	266,761	266,761	266,761	401,652	401,652	401,652
R-squared	0.007	0.009	0.021	0.021	0.036	0.062

Notes. The table shows coefficients from estimating Equation 4, excluding the borrower fixed effect θ_j. The dependent variable Relationship ends = 1 is an indicator variable that is equal to 1 if the borrower does not have a credit relationship with the bank one month, one quarter, and one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. For firms (Columns 1 to 3), we use 1 plus the logarithm of firm assets and firm workers, EBITDA/Assets, equity ratio, and an indicator variable that is equal to 1 if the firm has 90-day overdue loans as additional control variables. We exclude firms without balance sheet data. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A9: Robustness: Loan Applications (1/2)

(a) PSI

	Accepted application = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.043*** (0.015)	0.022* (0.013)	0.023** (0.009)	-0.022 (0.014)	-0.007 (0.016)	-0.002 (0.006)
Observations	4,471	3,573	14,676	3,258	3,116	13,051
R-squared	0.432	0.449	0.45	0.445	0.457	0.456

(b) OMT

	Accepted application = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.011 (0.021)	-0.004 (0.012)	-0.001 (0.010)	-0.024** (0.011)	-0.005 (0.012)	-0.011 (0.009)
Observations	2,589	3,424	16,279	2,908	3,096	13,477
R-squared	0.449	0.452	0.459	0.432	0.471	0.454

Table A9: Robustness: Loan Applications (2/2)

(c) QE

	Accepted application = 1					
	Firms			Households		
	Month	Quarter	Year	Month	Quarter	Year
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.037***	0.024***	0.036***	0.013	-0.006	0.010
	(0.008)	(0.008)	(0.008)	(0.018)	(0.015)	(0.011)
Observations	6,549	5,654	19,861	3,354	3,742	16,542
R-squared	0.492	0.494	0.456	0.454	0.451	0.461

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Accepted application = 1 is an indicator variable that is equal to 1 if the loan application is accepted. *Month*, *Quarter*, and *Year* report coefficients for applications 0-1, 2-3, and 4-12 months after the event, respectively. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A10: Robustness: Loan Applications Without Borrower FE (1/2)

(a) PSI

	Accepted application = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.028***	0.018*	0.017*	-0.012	0.002	-0.009
	(0.009)	(0.010)	(0.009)	(0.025)	(0.018)	(0.025)
Observations	30,339	27,600	110,108	26,064	25,042	103,477
R-squared	0.047	0.053	0.042	0.08	0.091	0.124

(b) OMT

	Accepted application = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.003	0.001	-0.000006	-0.046	-0.040	-0.025
	(0.016)	(0.009)	(0.011)	(0.033)	(0.035)	(0.022)
Observations	21,426	25,227	118,261	22,364	23,868	106,496
R-squared	0.049	0.041	0.033	0.119	0.147	0.131

Table A10: Robustness: Loan Applications Without Borrower FE (2/2)

(c) QE

	Accepted application = 1					
	Firms			Households		
	Month (1)	Quarter (2)	Year (3)	Month (4)	Quarter (5)	Year (6)
Exposure	0.016 (0.013)	0.009 (0.012)	0.016 (0.012)	-0.022 (0.026)	-0.021 (0.022)	-0.009 (0.024)
Observations	44,772	37,952	139,384	23,487	24,885	109,966
R-squared	0.036	0.03	0.041	0.104	0.075	0.086

Notes. The table shows coefficients from estimating Equation 4, excluding the borrower fixed effect θ_j. The dependent variable Accepted application = 1 is an indicator variable that is equal to 1 if the loan application is accepted. *Month*, *Quarter*, and *Year* report coefficients for applications 0-1, 2-3, and 4-12 months after the event, respectively. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. For firms (Columns 1 to 3), we use 1 plus the logarithm of firm assets and firm workers, EBITDA/Assets, equity ratio, and an indicator variable that is equal to 1 if the firm has 90-day overdue loans as additional control variables. We exclude firms without balance sheet data. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A11: Robustness: Lending and Capital Gains (IV model)

	Δ log loans					
	Firms			Households		
Variable	PSI (1)	OMT (2)	QE (3)	PSI (4)	OMT (5)	QE (6)
Capital gains	-154.304 (8,579.068)	1.427 (2.410)	24.929** (9.521)	-1.055 (1.512)	0.243 (0.700)	8.660*** (1.903)
Observations	241,311	233,402	209,713	242,823	231,840	204,636

Notes. The table shows coefficients from estimating Equation 7. The dependent variable Δ log loans is the change in log one plus outstanding loans one year after the event. The independent variable Capital gains is the change in log bank net worth induced by realized capital gains. The independent variables is defined with more detail in the text. We control for bank characteristics with variables from Table 1. Errors are clustered at the bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A12: Robustness: Credit Exposure Before Events

(a) Outstanding Loans

	Δ log exposure pre-trend					
	Firms			Households		
	PSI	OMT	QE	PSI	OMT	QE
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.164**	0.011	0.127*	0.217**	0.019	-0.006
	(0.067)	(0.059)	(0.068)	(0.105)	(0.042)	(0.055)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.553	0.540	0.551	0.655	0.659	0.624

(b) Termination of Credit Relationships

	Relationship ends = 1 pre-trend					
	Firms			Households		
	PSI	OMT	QE	PSI	OMT	QE
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.012**	-0.002	0.001	0.029**	0.006	-0.005
	(0.006)	(0.004)	(0.005)	(0.012)	(0.005)	(0.007)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.569	0.559	0.568	0.676	0.675	0.641

Notes. The table shows coefficients from estimating Equation 4. In Table A12a, the dependent variable is the change in lending between one year before the event and the month before the event. In Table A12a the dependent variable is an indicator variable with value equal to 1 if the borrower-bank relationship does not exist one year before the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table A13: Robustness: Loan Exposure Correcting for Pretrends

(a) Outstanding exposure

	Δ log exposure					
	Firms			Households		
	PSI	OMT	QE	PSI	OMT	QE
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	0.097	0.063	0.330***	0.035	0.012	0.110***
	(0.081)	(0.087)	(0.085)	(0.035)	(0.035)	(0.017)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.435	0.436	0.430	0.461	0.468	0.472

(b) Termination of Credit Relationships

	Relationship ends = 1					
	Firms			Households		
	PSI	OMT	QE	PSI	OMT	QE
	(1)	(2)	(3)	(4)	(5)	(6)
Exposure	-0.010	-0.005	-0.039***	-0.007	-0.0005	-0.018***
	(0.008)	(0.009)	(0.008)	(0.007)	(0.005)	(0.002)
Observations	241,311	233,402	209,713	242,823	231,840	204,636
R-squared	0.427	0.430	0.430	0.471	0.480	0.478

Notes. The table shows coefficients from estimating Equation 4. The dependent variable Δ log loan exposure is the change in log outstanding loans one year after the event. The dependent variable Relationship ends = 1 is an indicator variable that is equal to 1 if the borrower does not have a credit relationship with the bank one year after the event. The independent variable Exposure is the standardized ratio of exposed securities to total assets, measured in the last month before the event. We control for bank characteristics with variables from Table 1. In Table A13a we include the change in log outstanding loans between one year before the event and one month before the event as an additional control variable. In Table A13b, we include a dummy that is equal to 1 for credit relationships that do not exist one year before the event as an additional control variable. Errors are clustered at bank level. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

A Effect of PSI on Portuguese bond yields

In this section we measure the effect of the Greek debt restructuring (PSI) on Portuguese government bond yields. We follow a methodology that is similar to the one used by Krishnamurthy et al. (2018) to measure the impact of OMT on yields of government bonds in periphery Euro Area countries.

There was a series of events that signalled an increase in the probability of a successful debt restructuring between February and April 2012. We obtain a list of these events using Factiva. We search for all news between February 2012 and April 2012 that include the terms "Greece" and "PSI". We filter the results to include only news from Reuters. Using this procedure, in Table A14 we obtain a list of news articles that indicate an increase in the probability of a successful Greek debt restructuring.

In Table A15 we estimate the following equation:

$$\Delta yield_t = \beta \mathbb{1}_t^{PSI} + \epsilon_t \tag{11}$$

where $\Delta yield_t$ is the change in yield between day $t-1$'s close and day t's close, and $\mathbb{1}_t^{PSI}$ is an indicator equal to 1 on the day of the news reported in Table A14 and on the subsequent working day. We retrieve yields for the 2-year, 5-year, and 10-year reference Portuguese government bonds from MarketWatch.

On average, Portuguese bond yields fall on days with positive news about the Greek debt restructuring. We compute the cumulative change in yields on days with positive news about PSI. Yields fall by about 420 bps at the 2-year maturity, 230 bps at the 5-year maturity, and 160 bps at the 10-year maturity. These yield drops are larger than the ones reported by Krishnamurthy et al. (2018) for the OMT event (74 bps for the 2-year bond, 152 for the 5-year bond, 118 bps for the 10-year bond).

Table A14: List of PSI News

Date	Title	Summary
4/25/2012	Greece says final participation rate in bond swap is 96.9 pct	Greek bond swap completed with 96.9% participation rate
3/9/2012	Gilts dip as Greek deal confirmed, eye UK data	A sufficient number of private creditors agreed on PSI conditions for a successful deal (86% participation rate)
3/8/2012	EURO GOVT-Italian, Spanish yields fall on Greek hopes	Yields of periphery countries went down with increased optimism of a successful Greek debt swap
2/21/2012	ANNOUNCEMENT-Greece launches debt swap plan (PSI)	Greece announced the final terms of the debt swap program
2/20/2012	Deal near to lower Greek debt-Greek finmin source	European countries appeared to agree on credit conditions to finance the Greek debt swap
2/13/2012	Greek bond swap seen wrapped up in March- govt	The Greek government announced that the Greek debt swap would be completed in March 2012
2/7/2012	EURO GOVT-Bunds slide as markets anticipate Greek deal	Yields of periphery countries went down with positive signs of a Greek debt swap deal
2/5/2012	France says Greek PSI talks going "relatively well"	French finance minister said talks on the Greek debt swap were moving relatively well

Notes. The table lists news between February and April 2012 that were associated with an increase in the probability of a successful Greek debt restructuring. We obtain this list using the procedure described in Appendix A

Table A15: Regression: Effect of PSI News on Yield Changes

	Δ yield (bps)		
Variable	(1)	(2)	(3)
PSI event = 1	-34.625***	-19.267**	-13.108**
	(11.163)	(8.001)	(5.384)
Cumulative effect (bps)	-415.500	-231.204	-157.296
N	269	269	269
R-squared	0.026	0.009	0.014

Notes. The table shows coefficients from estimating Equation 11 using yields of the reference 2-year, 5-year, and 10-year Portuguese government bonds. We retrieve yields measured at each day's close from MarketWatch for all days with available data in 2012. *Cumulative effect (bps)* measures the sum of daily yield changes for all days in which the indicator variable associated with the PSI event is equal to 1. We display heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

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